Model Test Paper–6

Answer all the questions. Each question carries equal marks.
Total time for attempting all the questions is three hours.

1. Erichsen test is concerned with
   (*a*) hardness determination
   (*b*) bending test
   (*c*) cupping test
   (*d*) secant modulus determination
   (*e*) impact test.

2. When all the bonds in an organic compound are single, it is said to be
   (*a*) covalent bonding (*b*) polymerised
   (*c*) cross linked (*d*) saturated
   (*e*) unsaturated.

3. In organic compounds, we are principally concerned with covalent bonding between carbon and other elements. Carbon has a valency of four and can form strong covalent bonds. The compounds with following bonds are most reactive
   (*a*) no bond (*b*) single bond
   (*c*) double bond (*d*) triple bond
   (*e*) all of the above are equally reactive chemically.

4. Pick up the wrong statement about organic compounds
   (*a*) Plasticizers are used to improve ductility of a polymer
   (*b*) Branched and cross-linked molecules are more rigid than their linear counterparts
   (*c*) Materials which contain long coiled molecules are called elastomers
   (*d*) The chemical reaction by which monomers are combined together to produce polymers is called condensation
   (*e*) A polymer is a molecule produced by linking together a large number of monomers.

5. Which of the following is not a thermoset material
   (*a*) phenolic resin (*b*) formaldehyde
   (*c*) bakelite (*b*) nylon
   (*e*) epoxy resin.

6. Which of the following is not thermoplastic material
   (*a*) polyethylene (*b*) polyvinyl chloride
   (*c*) polystyrene (*d*) polypropylene
   (*e*) phenolic resin.

7. Which of the following moulding process is not concerned with moulding of thermoplastics
   (*a*) compression moulding
   (*b*) extrusion (*c*) injection moulding
   (*d*) calendering (*e*) blow moulding.

8. Graphite is used as a filler metal in thermosets for
   (*a*) reducing amount of resin and improving mechanical properties
   (*b*) improving impact strength
   (*c*) increasing electrical resistance
   (*d*) lowering surface friction
   (*e*) giving better resistance to heat and acid attack.

9. The eutectic composition refers to a particular composition of alloy for which
   (*a*) solidification occurs at a single temperature
   (*b*) structure is close packed hexagonal
   (*c*) grain structure comprises of perfect single crystals
   (*d*) grain structure is dendritic
   (*e*) phenomenon of partial solubility is exhibited.

10. Pure iron without carbon has elongation of 42% in tensile test. When carbon contact is increased to 1.2%, the elongation reduces to
(*a*) 37% (*b*) 31%
(*c*) 27% (*d*) 17%
(*e*) 3%.

11. Iron has following number of allotropic forms
(*a*) 0 (*b*) 1
(*c*) 2 (*d*) 3
(*e*) 4 .

12. Pick up the wrong explanation for terms used in structure of steel
(*a*) alpha iron is pure iron having a body-centered cubic lattice structure
(*b*) gamma iron has a face-centered-cubic lattice structure
(*c*) austenite is gamma iron with carbon in solution (non-ferromagnetic)
(*d*) pearlite is alpha iron with a small amount of carbon in solution (ferromagnetic)
(*e*) cementite is a compound of iron and Fe_3C

13. Silicon in steel is added to
(*a*) increase strength and hardness
(*b*) make it easier to harden the steel
(*c*) improve the impact properties
(*d*) improve creep properties
(*e*) the molten steel ingot to reduce the oxygen content.

14. Fig. 1 shows a

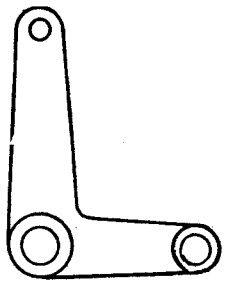


Fig. 1

(*a*) lever (*b*) bell crank
(*c*) bell and spigot joint
(*d*) crank
(*e*) amplifying rod.

15. Fig. 2 shows a

Fig. 2

(*a*) nut (*b*) castle nut
(*c*) flange nut (*d*) shank nut
(*e*) locking nut.

16. Fig. 3 shows a key used for heavy work. It is

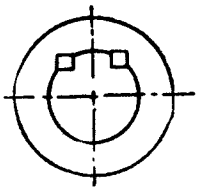


Fig. 3

(*a*) kennedy key (*b*) twin key
(*c*) tangent key (*d*) woodruff key
(*e*) square key.

17. Fig. 4 shows a

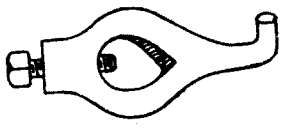


Fig. 4

(*a*) lathe tool (*b*) carrier
(*c*) lathe dog (*d*) lathe centre
(*e*) lathe chuck.

18. The term fuse-lage refers to
(*a*) a porcelain or slate base to which are fastened fuse clips or other contacts for holding fuses
(*b*) the fusible part of a cartridge fuse
(*c*) the spring part of a cutout or switch which holds the ferrules of a cartridge fuse
(*d*) the body of an airplane, to which are attached the wings and tail unit
(*e*) used in furnace crown of a steam boiler to extinguish fire when water level falls down.

19. A connecting link or device, used for fastening parts together, usually in such a manner as to permit some motion, is called
(*a*) shank (*b*) shackle
(*c*) swage block (*d*) tackle block
(*e*) twin buckle.

20. A boiler stay is
(*a*) any shaped piece of metal which is stressed in tension and it prevents flat surfaces under pressure from tearing apart (rupturing)

(*b*) a part of foundation on which boiler is supported
(*c*) support for furnace walls
(*d*) strap for rivetted joints
(*e*) used to hang boiler drum.

21. A lap-seam crack is a crack that runs parallel to the seam and is in the shell plate. When it occurs, then
(*a*) it is repaired by welding
(*b*) it is repaired by providing additional straps and rivetting
(*c*) the shell is repaired by opening all the joints
(*d*) the shell in condemned
(*e*) the shell is allowed to work till greater leakage develops.

22. Which of the following drum head is stronger
(*a*) dished head
(*b*) bumped plus (dished head with pressure on concave side)
(*c*) bumped minus (dished head with pressure on convex side)
(*d*) flat head
(*e*) all of the above are equally strong.

23. The major axis of elliptical manholes on a boiler shell should be provided
(*a*) circumferentially
(*b*) longitudinally
(*c*) at 45° to longitudinal direction
(*d*) at the principal plane
(*e*) any one of the above.

24. A radiant superheater in a boiler has
(*a*) constant straight line characteristic
(*b*) continuously rising characteristic
(*c*) drooping characteristic
(*d*) first rising and then falling characteristic
(*e*) first falling and then rising characteristic.

25. A convection-type superheater in a boiler has
(*a*) constant straight line characteristic
(*b*) continuously rising characterstic
(*c*) drooping characterstic
(*d*) first rising and then falling characteristic
(*e*) first falling and then rising characteristic.

26. If the feed water temperature to the economiser in a boiler is too low, it would result into
(*a*) lower steam generation rate
(*b*) lower steam temperature
(*c*) higher drum level
(*d*) corrosion of economiser tubes
(*e*) corrosion of superheater tubes.

27. Pick up the false statement about enthalpy in air conditioning
(*a*) enthalpy lines on the psychrometric chart are the same as the wet-bulb lines
(*b*) enthalpy depends almost entirely on the wet bulb temperature
(*c*) enthalpy is used as a measure of both sensible heat and latent heat changes on the psychrometric chart
(*d*) enthalpy directly defines the moisture in the air
(*e*) enthalpy can be used to determine the sensible heat factor.

28. In cooling and humidifying process, the spray water
(*a*) lowers both the dry-bulb temperature and the dewpoint temperature
(*b*) raises both the dry-bulb temperature and the dewpoint temperature
(*c*) lowers the dry-bulb temperature and raises the dewpoint temperature
(*d*) raises the dry-bulb temperature and lowers the dewpoint temperature
(*e*) lowers the dry-bulb, wet-bulb and dewpoint temperatures.

29. In the cooling and dehymidifying process, the chilled spray water
(*a*) lowers the dry-bulb temperature
(*b*) lowers the wet-bulb temperature
(*c*) lowers the dewpoint temperature
(*d*) all of the above
(*e*) lowers the dry-bulb temperature and raises the dewpoint temperature.

30. The heating and humidifying process uses the spray water to add moisture to the air. In this process
(*a*) web-bulb temperature rises
(*b*) dry-bulb temperature rises
(*c*) dew point temperature rises
(*d*) all of the above
(*e*) web-bulb and dry-bulb temperatures rise but dew point temperature lowers.

31. According to Toricelli's theorem, the liquid velocity at an outlet discharging into the free atmosphere is proportional to the
(*a*) head (*b*) $(\text{head})^2$
(*c*) $\sqrt{\text{head}}$ (*d*) $(\text{head})^{3/2}$

(*e*) $\frac{1}{\text{head}}$

32. According to the Darcy's formula, the pressure drop due to flow friction through a tube or pipe is proportional to

(*a*) $\sqrt{\frac{\text{Length } (L)}{\text{diameter } (D)}}$ (*b*) $\frac{L}{D}$

(*c*) $\frac{D}{L}$ (*d*) $\left(\frac{L}{D}\right)^2$

(*e*) $\left(\frac{L}{D}\right)^{3/2}$

33. Change in viscosity of oil indicates

(*a*) contamination or oxidation instability
(*b*) more leakage (*c*) cavitation
(*d*) high wear and tear
(*e*) chances of fire.

34. Pick up the wrong statement about centrifugal pump. In the case of centrifugal pumps, the head (H) versus capacity (Q) curve may be stable or unstable. In the case of stable characteristics, the false statement is

(*a*) The value of H decreases as Q increases
(*b*) input power required rises to a peak at or near the design operating point and then falls again
(*c*) any fall in head below the design operating point can't overload the pump driver
(*d*) the maximum head is achieved at zero discharge
(*e*) the value of H at first increases from the value at zero discharge, as the discharge increases, and then falls with further increase in discharge.

35. Pick up the correct statement about centrifugal pumps

(*a*) pumps with low rotational speeds tend to cavitate less readily and pumps with high specific speeds more readily
(*b*) pumps with low rotational speeds tend to cavitate more readily and pumps with high specific speeds less readily
(*c*) pump speed does not affect cavitation
(*d*) cavitation of pump is directly directly proportional to speed
(*e*) cavitation is high both at low and high speeds and is absent in the middle range.

36. Fig. 5 shows the characteristic curves for various types of pumps. Curves *A*, *B*, *C*, and *D* respectively are for

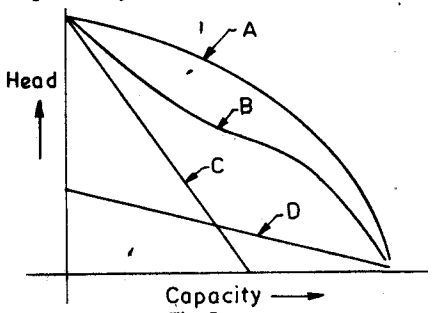


Fig. 5

(*a*) centrifugal, mixed flow, axial flow, and regenerative type
(*b*) centrifugal, mixed flow, regenerative, and axial flow type
(*c*) mixed flow, centrifugal, axial flow, and regenerative type
(*d*) centrifugal flow, regenerative, mixed flow, and axial flow type
(*e*) centrifugal flow, axial flow, regenerative, and mixed flow type.

37. Pick up the wrong statement about mixed flow type pumps

(*a*) head capacity curve tends to be steep
(*b*) the point of maximum efficiency is displaced towards maximum capacity
(*c*) power input curve is much flatter
(*d*) input power demand does not vary much with the working point
(*e*) the head is maximum in the middle i.e. not at zero discharge.

38. Which of the following pump does not fall under the category of turbo machines

(*a*) centrifugal (*b*) mixed flow
(*c*) axial flow (*d*) rotary
(*e*) regenerative.

39. A clutch is placed in the power train between the

(*a*) crankshaft and the transmission (change gears)
(*b*) change gears and front axles
(*c*) front axles and differential
(*d*) high and low gears
(*e*) before and after the gear box.

40. The power train in an automobile includes the clutch, propeller shaft, differential, and

(*a*) chassis (*b*) transmission

(*c*) front axles (*d*) steering gear
(*e*) all of the above.

41. To take care of the difference in driving angle as the rear axle moves up and down, the propeller shaft has one or more
(*a*) slip joints (*b*) elbow joints
(*c*) release joints (*d*) universal joints
(*e*) knee joints.

42. To take care of the lengthening and shortening of the propeller shaft with rear axle movement, shaft has one or more
(*a*) slip joint (*b*) universal joint
(*c*) knee joint (*d*) elbow joint
(*e*) release joint.

43. In an automobile the power train transmits power from the engine to the
(*a*) crankshaft (*b*) steering gear
(*c*) front wheels (*d*) rear wheels
(*e*) clutch plate.

44. The gear in the transmission that is always in mesh with the clutch gear is called the
(*a*) idler gear
(*b*) countershaft drive gear
(*c*) countershaft second gear
(*d*) second-and-high-speed gear
(*e*) low speed gear.

45. In the differential, the ring gear is attached to the
(*a*) bevel gear (*b*) drive gear
(*c*) differential case (*d*) propeller shaft
(*e*) differential pinion gear.

46. In a clutch, the friction disk is positioned between the
(*a*) engine and crankshaft
(*b*) flywheel and engine
(*c*) flywheel and pressure plate
(*d*) pressure plate and reaction plate
(*e*) pressure plate and propeller shaft.

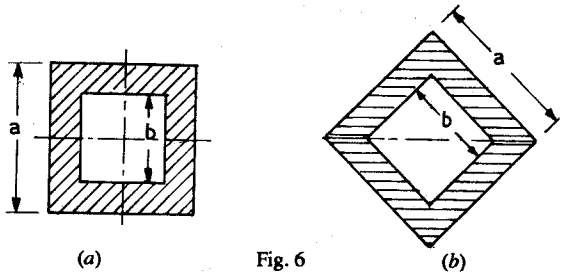
47. The clutch cover is bolted to the
(*a*) friction disk (*b*) flywheel
(*c*) car-frame (*d*) engine block
(*e*) pressure plate.

48. In the typical friction disk, torsional vibration is absorbed by the use of a series of heavy
(*a*) cushion bolts (*b*) waved pads
(*c*) coil springs (*d*) cushion pads
(*e*) clutch pedal.

49. Clutch slippage while clutch is engaged is particularly noticeable
(*a*) during idle (*b*) at low speed
(*c*) during acceleration when starting the engine
(*d*) when changing gear
(*e*) when braking.

50. Clutch noise is usually most noticeable when the engine is
(*a*) idling (*b*) being started
(*c*) accelerating (*d*) decelerating
(*e*) overheated.

51. The moment of Inertia of a hollow square section shown in Fig. 6 (*a*) is $\frac{a^4-b^4}{12}$. If this section is rotated by 45°, then M.I. about diagonal axis shown in Fig. 6 (*b*) will



(*a*) Fig. 6 (*b*)

(*a*) increase
(*b*) decrease (*c*) remain same
(*d*) increase/decrease depending on ratio a/b
(*e*) uncomparable.

52. M.I. of a triangular section, if taken about axis passing through base X_2X_2 compared to the axis passing through its centre of gravity X_1X_1 (Fig. 7) will be more by

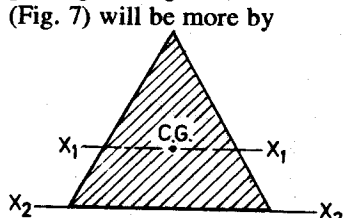
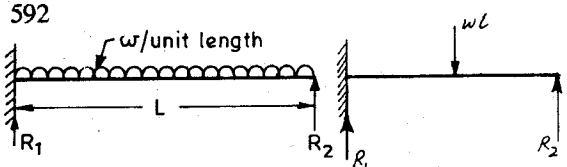


Fig. 7

(*a*) 2 times (*b*) 3 times
(*c*) 4 times (*d*) $1\frac{1}{2}$ times
(*e*) $2\frac{1}{2}$ times.

53. Fig. 8 (*a*) shows a beam fixed at one end, supported at other end, and having uniformly distributed load. The ratio of $R_1 : R_2 = 5 : 3$



(a) Fig. 8 (b)

and stress is zero at $\frac{L}{4}$ from R_1. In Fig. 8 (*b*), load is concentrated at the centre. Now ratio of reactions $R_1 : R_2$, and distance of zero stress from R_1 compared to case (*a*) will

(*a*) increase, increase
(*b*) decrease, decrease
(*c*) increase, decrease
(*d*) decrease, increase
(*e*) none of the above.

54. Fig. 9 shows a beam fixed at one end, free but guided at the other, with concentrated load W at free end. The stress will be zero at

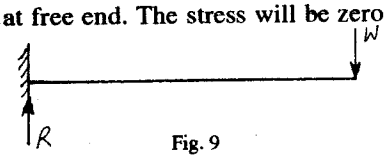


Fig. 9

(*a*) R
(*b*) W
(*c*) middle of beam
(*d*) between R and mid point
(*e*) between W and mid point.

55. Fig. 10 shows a beam fixed at both ends, carrying uniform load. In this case maximum stress is at ends. Stress will be zero at

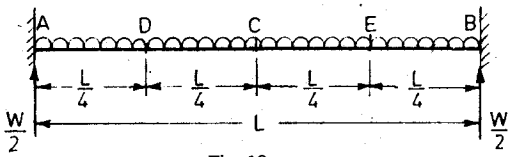


Fig. 10

(*a*) mid point
(*b*) between A and D and between E and B
(*c*) between D and C
(*d*) between C and E
(*e*) at two places between D and E.

56. If a beam is supported at both ends and carries a uniformly distributed load, then in order that beam may have uniform strength throughout its length and have uniform width, the profile of depth of beam will be

(*a*) triangle
(*b*) one-half of ellipse
(*c*) two parabolas with vertexes at middle
(*d*) two triangles with apexes at middle
(*e*) none of the above.

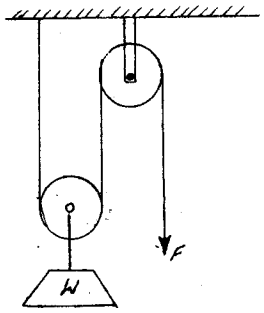


Fig. 11

57. For the arrangement shown in Fig. 11 force F required to lift weight W is equal to

(*a*) W (*b*) $2W$
(*c*) $\frac{W}{2}$ (*d*) $\frac{W}{4}$
(*e*) none of the above.

58. In the case of inclined plane of angle α, force P to hold body of weight W stationary (if μ = coefficient of friction) is equal to (Refer Fig. 12)

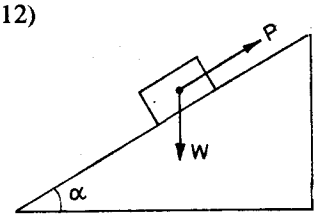


Fig. 12

(*a*) $W(\mu \cos \alpha + \sin \alpha)$
(*b*) $W(\mu \cos \alpha - \sin \alpha)$
(*c*) $W(\cos \alpha - \mu \sin \alpha)$
(*d*) $W(\cos \alpha - \mu \sin \alpha)$
(*e*) $W(\sin \alpha + \mu \cos \alpha)$.

59. In the toggle joint shown in Fig. 13 members AB and BC are equal. Relationship between F and P is

(*a*) $P = \frac{Fa}{2h}$ (*b*) $P = \frac{Fa}{h}$

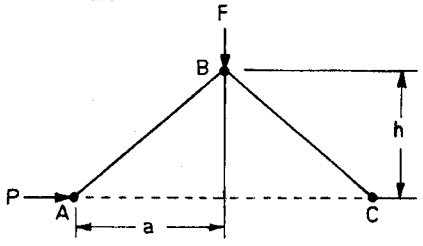


Fig. 13

(c) $P = \frac{2Fa}{h}$ (d) $P = F$

(e) $P = \frac{F}{2}$.

60. In the differential pulley shown in Fig. 14

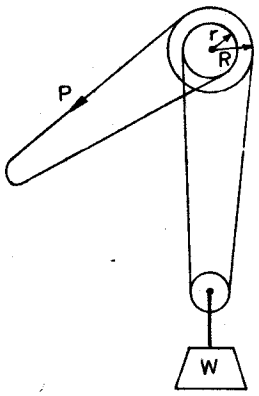


Fig. 14

(a) $P = \frac{W(R-r)}{R}$ (b) $P = \frac{2W(R-r)}{R}$

(c) $P = \frac{W(R-r)}{2R}$ (d) $P = \frac{W(R-r)}{2r}$

(e) $P = \frac{W(R-r)}{r}$

61. If the weights of two bodies are W_1 and W_2 and the distance between their centre of gravity is a, then centre of gravity of these two bodies is at b from W_1, and b = (Refer Fig. 15)

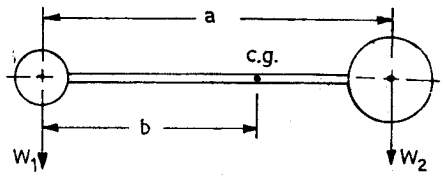


Fig. 15

(a) $\frac{W_2 a}{W_1 + W_2}$ (b) $\frac{W_1 a}{W_1 + W_2}$

(c) $\frac{W_2 a}{2(W_1 + W_2)}$ (d) $\frac{W_1 a}{2(W_1 + W_2)}$

(e) $\frac{(W_1 - W_2)a}{W_1 + W_2}$.

62. Radiation depends upon one of the following for heat transfer
(a) temperature (b) humidity
(c) heat flow from a cold to a hot surface
(d) heat rays (e) pressure.

63. The evaporation process produces cooling effect because
(a) of air movement
(b) it creates reverse air flow
(c) moisture, in becoming a vapour, gives up heat
(d) moisture, in becoming a vapour, absorbs heat
(e) humidity changes.

64. A grain of water vapour is the unit of measurement used to determine the
(a) % relative humidity
(b) humidity
(c) evaporation process
(d) body comfort
(e) vapour pressure.

65. Body comfort is affected by
(a) temperature (b) relative humidity
(c) air movement (d) all of the above
(e) none of the above.

66. The comfort range of the human body is
(a) 22.2°C to 26.7°C at 45% to 50% relative humidity
(b) 20°C at 50% relative humidity (RH)
(c) 20–25°C at 40 to 60% RH
(d) 20-30°C at 35 to 65% RH
(e) 25°C at 0% RH.

67. 1 kg of water contains following grains of water vapour
(a) 15500 (b) 165000
(c) 7000 (d) 70,000
(e) 700.

68. Moisture is continuously evaporating from the surface of the body. The evaporation process increases by
(a) decrease in temperature
(b) increase in air movement
(c) less relative humidity
(d) all of the above
(e) reverse of (a), (b), and (c).

69. Evaporation takes place in refrigeration where there is a change of state from
(a) gas to liquid (b) liquid to gas
(c) gas to solid (d) solid to gas
(e) solid to liquid.

70. The unit in the refrigeration cycle in which heat is rejected is the
(a) condenser (b) coil

(c) compressor (d) evaporator
(e) expansion valve.

71. The dividing point between the high-pressure and low-pressure sides of the refrigeration cycle occurs at the
(a) cooling coil (b) expansion valve
(c) compressor (d) evaporator
(e) condenser.

72. Increasing the pressure of a refrigerant
(a) increases its temperature
(b) decreases its temperature
(c) increases its density
(d) lowers its boiling-point
(e) does not affect its temperature.

73. A basic absorption cycle functions properly because
(a) it has no moving parts
(b) of the action and reaction between adsorbent and refrigerant
(c) it is cylindrical (d) it uses no heat
(e) it requires no compressor.

74. Which of the following is not basic component of an adsorption system
(a) evaporator (b) absorber
(c) generator (d) compressor
(e) condenser.

75. In a lithium-bromide-water absorption system, which of the following is used as refrigerant
(a) lithium (b) bromide
(c) water (d) ammonia
(e) air.

76. In an ammonia-water absorption system
(a) ammonia is used both as refrigerant and adsorbent
(b) water is used both as refrigerant and adsorbent
(c) water is used as adsorbent and ammonia as refrigerant
(d) water is used as refrigerant and ammonia as adsorbent
(e) air is used as absorbent and bromide as refrigerant.

77. Absorbents absorb the moisture rapidly and then give it up again when
(a) enough heat is applied
(b) enough pressure is applied
(c) water is mixed
(d) refrigerant reacts with adsorbent
(e) required.

78. Heat in the absorption-refrigeration cycle is applied at
(a) cooler (b) generator
(c) absorber (d) evaporator
(e) condenser.

79. The action of the generator and the absorber in absorption refrigeration cycle can be considered to be similar to
(a) metering device (b) throttling device
(c) producing cooling effect
(d) work done by the compressor
(e) vapour compressor cycle.

80. Adsorbents in absorption system separate from the refrigerant
(a) only when sufficiently heated
(b) only when cooled
(c) by means of a filter
(d) by means of a separator
(e) by reacting with water.

81. A water-lithium-bromide absorption system uses
(a) water as the refrigerant and ammonia as adsorbent
(b) water as the refrigerant and lithium bromide as the adsorbent
(c) lithium as the refrigerant and ammonia bromide as the adsorbent
(d) water as cooling medium and lithium bromide as refrigerant
(e) water as cooling medium and lithium bromide as adsorbent.

82. Pick up the wrong statement when sensible heat is added to the air
(a) the dry bulb temperature increases
(b) the wet bulb temperature increases
(c) the dew point does not change
(d) the relative humidity decreases
(e) grains of moisture decrease.

83. Pick up the wrong statement about latent heat as referred to in air conditioning
(a) latent heat of vaporisation is the heat required to change a liquid to a vapour
(b) latent heat is concerned with the processes of evaporation and condensation
(c) as latent heat increases/decreases, temperature also increases/decreases
(d) latent heat principle refers to changes in the moisture content

(*e*) Increase/decrease in latent heat is shown as a straight vertical line on the psychrometric chart.

84. Pick up the wrong statement about sensible heating
(*a*) sensible heat increases the temperature but does not change the moisture content of the air
(*b*) sensible heating is shown as a straight horizontal line on the psychrometric chart
(*c*) sensible heat can be detected by human senses
(*d*) sensible heating is like humidifying process
(*e*) when sensible heat is added, dry-bulb and wet bulb temperature increase, relative humidity decreases but dew point remains unchanged.

85. A cooling and dehumidifying process
(*a*) occurs by heating coil and a water spray coil
(*b*) removes sensible heat and latent heat
(*c*) is represented by horizontal line on psychrometric chart
(*d*) is represented by vertical line on psychrometric chart
(*e*) is represented as a diagonal line beginning at the lower left and moving to the upper right of the psychrometric chart.

86. Pick up the wrong statement about evaporative cooling process
(*a*) it removes sensible heat and adds latent heat
(*b*) it requires a spray water coil
(*c*) it is used primarily in comfort air conditioning rather than in industrial processes
(*d*) it mostly proceeds along the wet-bulb temperature line
(*e*) it is shown as a diagonal line extending from the lower right to the upper left of the psychrometric chart.

87. Pick up wrong statement about bypass air in air conditioning
(*a*) Bypass air flows through a cooling coil but does not contact the coil surface
(*b*) the amount of air that bypasses the coil surface depends upon the coil construction and the air velocity
(*c*) the bypass process is measured in terms of a bypass factor
(*d*) A low bypass factor can mean that more air is required and that larger ducts, fans and motors are necessary
(*e*) Average bypass factor for comfort air conditioning usually varies in the range of 0.10 to 0.30.

88. Pick up the wrong statement about psychrometric charts (PC)
(*a*) PC simplifies the measurement of air properties
(*b*) PC is a graphic representation of air properties and conditions
(*c*) PC is shaped like a boot
(*d*) If the value of one psychrometric term is known, the value of any other term can be found on the PC
(*e*) The dry-bulb temperature lines are vertical, wet-bulb temperature lines are diagonal, and dewpoint lines are horizontal on PC.

89. At a given temperature, the wet bulb temperature in wet air as compared to in dry air is
(*a*) lower (*b*) higher
(*c*) same
(*d*) may be higher or lower depending on other conditions
(*e*) unpredictable.

90. An equilibrium diagram in metallurgy records the changes which take place in an alloy when the cooling rate is sufficiently slow to allow metallurgical reactions to go to completion.

The equilibrium diagrams help
(*a*) to recognise the factors influencing structure and hence properties
(*b*) in depicting the formation of various types of grain structures
(*c*) in determining the changes in lattice orientation
(*d*) in establishing various types of bondings possible
(*e*) in determining best possible heat treatment.

91. In the process of oxidation, the oxide layer continues to get thicker with prolonged exposure for most of the materials. However for some materials, oxide layers reach an optimum thickness and at this point the oxide

layer becomes impervious to oxygen. Such materials are
(*a*) cast iron and mild steel
(*b*) copper and zinc
(*c*) aluminium and steels with 20% to 25% chromium
(*d*) iron and copper
(*e*) silver and gold.

92. The three common ferromagnetic materials (strongly attracted by magnet) are
(*a*) iron, copper and tin
(*b*) iron, chromium and manganese
(*c*) iron, graphite and silver
(*d*) iron, cobalt and nickel
(*e*) steel, copper and aluminium.

93. Galvanic corrosion occurs in practice when two dissimilar metals are in contact and form a cell. Choose wrong sentence from following in this regard
(*a*) steel nuts corrode if they are used with washers made from copper or brass
(*b*) small regions of different composition on the surface of a metal can form anode and cathode, setting up small galvanic cells causing corrosion
(*c*) localised corrosion occurs at cracks in the oxide layer because the oxide scale on the surface of metal acts as a cathode
(*d*) the incidence of galvanic corrosion is affected by temperature, composition, concentration and oxygen content of the liquid; the surface condition; the presence of stress etc.
(*e*) current from outside source must flow for galvanic corrosion to proceed.

94. Which is the smallest particle of an element which can take part in a chemical reaction
(*a*) compound (*b*) molecule
(*c*) atom (*d*) electron
(*e*) neutron.

95. Which is the smallest particle of an element which retains the physical characteristics of that element
(*a*) atom (*b*) electron
(*c*) neutron (*d*) molecule
(*e*) all of the above.

96. Matter can be visualised as a collection or agglomeration of atoms. The properties and characteristics of matter depend on
(*a*) type of atom
(*b*) arrangement of electrons in atom
(*c*) the position and behaviour of atoms in the agglomeration
(*d*) structure of the atom
(*e*) treatment of atoms.

97. The diameter of an iron atom is of the order of $1.24\times$
(*a*) 10^{-10} m (*b*) 10^{-9} m
(*c*) 10^{-11} m (*d*) 10^{-8} m
(*e*) 10^{-12} m

98. Materials which show long-range order (*i.e.* in their structure the atoms are arranged in regular lines, in layers throughout the thickness) are termed
(*a*) metallic (*b*) crystalline
(*c*) amorphous (*d*) metalloids
(*e*) polymers.

99. Pick up the wrong statement in regard to structure of an atom
(*a*) the mass of an atom is concentrated in the nucleus
(*b*) electrons make only a small contribution to the total mass
(*c*) nucleus contains protons and neutrons
(*d*) neutrons contribute little to the total mass of atom
(*e*) number of protons in the nucleus is a characteristic of the element and is known as the atomic number.

100. Pick out the wrong statement
(*a*) valence electrons are the electrons in outermost shell
(*b*) the essential feature of covalent bonding is the sharing of electrons
(*c*) covalent bonding is very common among most of the metals
(*d*) electropositive and electronegative ions attract each other and an ionic bond is established between them
(*e*) a metallic bond cannot exist simply between a few atoms - it is found only where there are a large number of atoms in close proximity.

101. Young's modulus is a measure of the following property of a material
(*a*) tensile strength (*b*) ductility
(*c*) malleability (*d*) stiffness
(*e*) creep resistance.

102. The hardness of a material can be defined as

(*a*) how easily if can be scratched
(*b*) how resistant it is to wear
(*c*) how difficult it is to mark the surface with a centre punch
(*d*) hardness is an indication of the way in which the surface of a material deforms under specific types of localised loading
(*e*) how much the rubber ball rebounds back after striking the surface.

103. The main attraction in measuring hardness is that
(*a*) it is a useful non-destructive indicator of strength
(*b*) it can be measured quickly
(*c*) all other properties can be predicted by measure of hardness
(*d*) measurement of hardness can be done in-situ
(*e*) it is the index of quality of metal.

104. In the Rockwell hardness test, the depth of indentation is measured
(*a*) by a scale
(*b*) under a microscope
(*c*) by micrometer screw gauge
(*d*) directly by a dial gauge
(*e*) by a feeler gauge.

105. The loads applied with a diamond indentor on specimen in case of Rockwell B and Rockwell C hardness measurement respectively are
(*a*) 100 kgf and 150 kgf
(*b*) 50 kgf and 100 kgf
(*c*) 100 kgf and 200 kgf
(*d*) 150 kgf and 250 kgf
(*e*) 150 kgf and 100 kgf.

106. Whether a given material is brittle or ductile can be tested by
(*a*) hardness test (*b*) impact test
(*c*) bend test (*d*) cupping test
(*e*) tensile test.

107. The results of an impact test are reported
(*a*) in terms of height of hammer
(*b*) as deformation around the notch in specimen
(*c*) as weight of hammer
(*d*) in terms of impact numbers
(*e*) in joules.

108. Pick up the wrong statement about thermoplastic materials
(*a*) these contain linear or branched long chain molecules which are not interconnected
(*b*) these have high inherent plasticity which increases as the temperature is raised
(*c*) they do not undergo chemical changes when heated and on cooling, their plasticity is retained because the structure is unchanged
(*d*) these set into a definite shape and can not be made plastic by reheating
(*e*) some common thermoplastics are : polyethylene, polyvinyl chloride, polystyrene, nylon.

109. Pick up the wrong statement about thermosetting materials
(*a*) these usually have a cross-linked network structure which gives them their characteristic hardness and rigidity
(*b*) the cross-linked network structure is established during moulding operation
(*c*) if these are reheated, the network remains intact until a temperature is reached when the plastics disintegrate
(*d*) they lose their rigidity and become plastic
(*e*) some common thermosets are phenol formaldehyde, urea formaldehyde, polyester resin, epoxy resin.

110. Pick up the correct statement
(*a*) materials with face-centred cubic structure are most ductile and the materials with close-packed hexagonal lattice are least ductile
(*b*) zinc and magnesium have face-centred cubic lattice structure
(*c*) aluminium, copper and nickel have closed-packed lattice structure
(*d*) the number of atoms in a body-centred cubic space lattice are twelve
(*e*) the number of atoms in a face centred cubic lattice are nine.

111. Iron has the following lattice structure
(*a*) cubic structure
(*b*) face-centred cubic
(*c*) body-centred cubic
(*d*) hexagonal
(*e*) close-packed hexagonal.

112. The angle θ in Fig. 16 is called
(*a*) major cutting edge angle

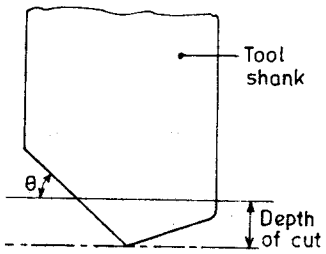


Fig. 16

(*b*) minor cutting edge angle
(*c*) side cutting edge angle
(*d*) flank angle (*e*) tool angle.

113. A twist drill has following number of cutting edges
(*a*) 1 (*b*) 2
(*c*) 3 (*d*) 4
(*e*) none of the above.

114. A reamer is similar to a drill but it has several cutting edges and
(*a*) straight flutes (*b*) inclined flutes
(*c*) helical flutes (*d*) tapered flutes
(*e*) chamfered flutes.

115. Fig. 17 shows a part of the slab milling cutter. Parts A, B, and C are called

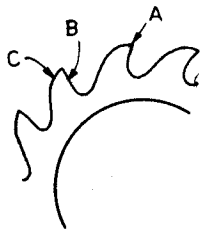


Fig. 17

(*a*) flank, face, cutting edge
(*b*) cutting edge, flank, face
(*c*) face, flank, cutting edge
(*d*) flank, cutting edge, face
(*e*) cutting edge, face, flank.

116. In which of the following machine tool, the motion is applied to the workpiece
(*a*) engine lathe (*b*) vertical borer
(*c*) horizontal borer (*d*) shaper
(*e*) planer.

117. In which of the following machine tool, the feed motion is applied to the tool
(*a*) horizontal miller
(*b*) vertical knee type miller
(*c*) vertical bed type miller
(*d*) shaper (*e*) broacher.

118. The overall efficiency of engine lathe, borer and shaper is of the order of 70%. The overall efficiency of miller is of the order of
(*a*) 85% (*b*) 80%
(*c*) 70% (*d*) 50%
(*e*) 40%.

119. The overall efficiency of grinders is of the order of
(*a*) 100% (*b*) 85%
(*c*) 70% (*d*) 60%
(*e*) 50%.

120. Discontinuous chips are produced when machining
(*a*) most ductile materials, such as wrought iron, copper, etc.
(*b*) ductile materials at very low speeds and high feeds
(*c*) with high friction between the chip and the tool
(*d*) mild steel
(*e*) none of the above.

121. If both the modulus of elasticity and the shearing modulus of a metal are doubled, the Poisson's ratio of metal will
(*a*) get doubled (*b*) become four times
(*c*) get halved (*d*) become one fourth
(*e*) remain unaffected.

122. If the length of a member and its area of cross-section are doubled, then its deflection under load *P* will
(*a*) get doubled (*b*) become four times
(*c*) get halved (*d*) become one fourth
(*e*) remain unaffected.

123. Fig. 18 shows the stress-strain diagrams for a specimen of soft steel. Curve in dotted line is for
(*a*) unit stress (*b*) apparent unit stress

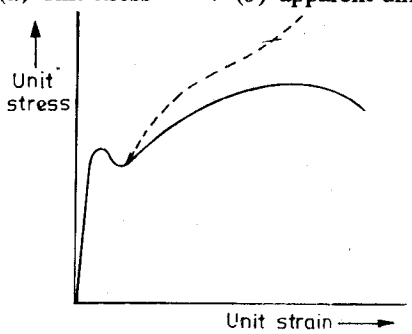


Fig. 18

(*c*) actual unit stress (*d*) log of unit stress
(*e*) not possible.

124. Pick up the wrong statement about properties of materials
(*a*) Stiffness is that property of a material which enables it to absorb energy at high stress without fracture, usually above the elastic limit
(*b*) Malleability is that property of a material that enables it to undergo great change in shape without rupture under compressive stress
(*c*) Hardness is the ability of a material to resist indentation or abrasion
(*d*) Resilience is that property of material which enables it to absorb, without being permanently deformed, the energy produced by the impact of a suddenly applied load or blow
(*e*) Ductility is that property of a material that enables it to be drawn permanently through great change of shape without rupture.

125. If P is the power to be transmitted by a shaft at N r.p.m., then its diameter is proportional to

(*a*) $\frac{P}{N}$ (*b*) $\sqrt{\frac{P}{N}}$
(*c*) $\frac{\sqrt{P}}{\sqrt[3]{N}}$ (*d*) $\sqrt[3]{\frac{P}{N}}$
(*e*) $\frac{\sqrt[3]{P}}{\sqrt{N}}$

126. If the length of a shaft and its polar moment of inertia are both doubled, then under torque T, its angle of twist will
(*a*) double
(*b*) be halved
(*c*) be four times
(*d*) reduce to one fourth
(*e*) remain unaffected.

127. If 100 kW is to be transmitted at 100 rpm by a shaft of diameter d, then for transmitting 100 kW at 800 r.p.m., shaft diameter should be

(*a*) $\sqrt[3]{d}$ (*b*) $\sqrt{d}$
(*c*) $d/2$ (*d*) $d/4$
(*e*) $d/8$.

128. The compression members tend to buckle
(*a*) at centre (*b*) at upper portion
(*c*) at lower portion
(*d*) in the direction of least radius of gyration
(*e*) at the least cross sectional area.

129. In Fig. 19 which is the case of statically indeterminate beam

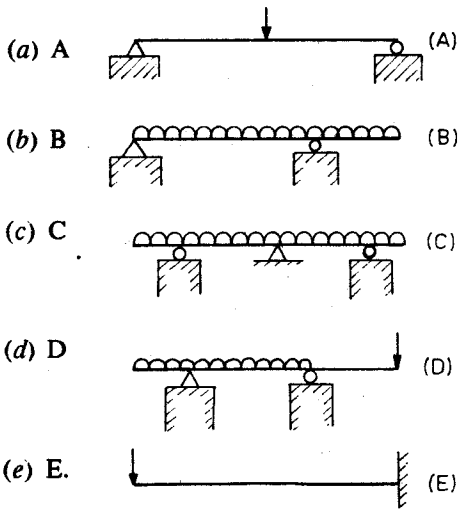


Fig. 19

130. The maximum moment in a simply supported beam of length L, supporting a uniform load (w per unit length) occurs at centre and its magnitude is equal to

(*a*) $\frac{wl}{8}$ (*b*) $\frac{wl^2}{2}$
(*c*) $\frac{wl^2}{4}$ (*d*) $\frac{wl^2}{8}$
(*e*) $\frac{wl^2}{16}$.

131. A critical section in a beam is one at which
(*a*) transverse shear force in zero
(*b*) transverse shear force is maximum
(*c*) bending moment is minimum
(*d*) bending moment is maximum
(*e*) either the transverse force or the bending moment is maximum.

132. The maximum shear stress in beams generally occurs at

(*a*) top (*b*) bottom
(*c*) centroid (*d*) neutral axis
(*e*) middle.

133. If F is the total transverse shear force at a circular beam having cross-sectional area A, then maximum shearing stress is

(*a*) $\frac{4F}{3A}$ (*b*) $\frac{3F}{4A}$

(*c*) $\frac{2F}{3A}$ (*d*) $\frac{3F}{2A}$

(*e*) $\frac{F}{A}$

134. In rectangular and circular cross-sectional beams, the maximum shear stress in comparison to average value is greater by

(*a*) 50% and $33\frac{1}{3}$% respectively

(*b*) $33\frac{1}{3}$% and 50% respectively

(*c*) $67\frac{2}{3}$% and 50% respectively

(*d*) 100% and 50% respectively

(*e*) $67\frac{2}{3}$% and 100% respectively.

135. The chips produced during orthogonal cutting operation are

(*a*) spiral (*b*) snarled

(*c*) needles (*d*) conical helical

(*e*) elemental.

136. The built up edge is formed in the slow speed machining of certain ductile materials. Speed of built-up edge can be reduced by

(*a*) application of a lubricant

(*b*) increase in feed

(*c*) increase in initial hardness of the workpiece material

(*d*) decrease in the rake angle

(*e*) all of the above.

137. Pick up the wrong statement about electrical discharge machining

(*a*) the tool material can be softer than the work material

(*b*) the work material must be an electrical conductor

(*c*) the economical removal rate is independent of the hardness of the work material

(*d*) the inefficient conversion of electrical power to mechanical power is eliminated

(*e*) if metal to be machined is too hard, tool wear increases.

138. In electrical-discharge machining process, the interval between successive sparks, the localised temperature generated by sparks, are of the order of

(*a*) 100 μ sec., 12,000°C (*b*) 10 μ sec., 10,000°C

(*c*) 1 μ sec., 8,000°C (*d*) 1000 μ sec., 15,000°C

(*e*) 100 μ sec., 2,000°C.

139. Fig. 20 illustrates

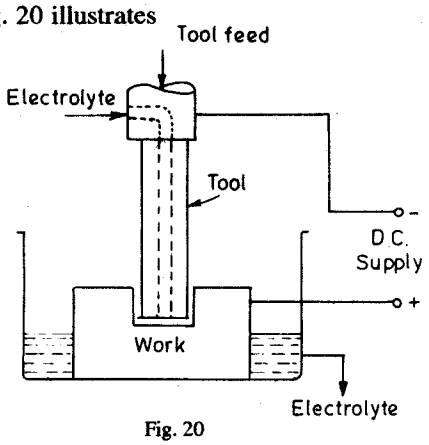


Fig. 20

(*a*) electrical discharge machining process

(*b*) electrochemical machining process

(*c*) electrolytic grinding process

(*d*) ultrasonic machining

(*e*) none of the above.

140. The dielectric fluid used in electrical discharge machining process is

(*a*) NaCl solution (*b*) NaOH solution

(*c*) soap water (*d*) paraffin oil

(*e*) HCl.

141. For drilling deep holes of small diameter by electrical discharge machining the tool is made of

(*a*) brass wire (*b*) copper wire

(*c*) graphite wire (*d*) tungsten wire

(*e*) H.S.S.

142. In electro-chemical machining process, if the density of work material is doubled, then for same metal removal rate, the current should be

(*a*) doubled (*b*) halved

(*c*) increased four times

(*d*) reduced to one fourth

(*e*) made 3 times.

143. In electro-chemical machining process, the lower supply voltage is used for finish machining and the higher voltage for rough machining. The supply voltage commonly used ranges from

(*a*) 1 to 5 V (*b*) 5 to 20 V

(*c*) 20 to 50 V (*d*) 30 to 100 V
(*e*) 100 to 250 V.

144. The concept of "group technology" in production processes
(*a*) makes manufacturing flexible
(*b*) permits more and more automation
(*c*) allows the advantages of mass production techniques to be obtained in batch production
(*d*) enables best plant layout
(*e*) is best suited only for mass production.

145. Pick up the correct statement. The effect of pitch error and angle error is to
(*a*) increase the simple effective diameter of a bolt and decrease that of a nut
(*b*) decrease the simple effective diameter of a bolt and increase that of a nut
(*c*) increase the simple effective diameters of both bolt and nut
(*d*) decrease the simple effective diameters of both bolt and nut
(*e*) have no effect on simple effective diameters of bolt and nut.

146. Pick up the wrong statement about numerically controlled (NC) machines
(*a*) NC machines cannot be used economically for small batch production
(*b*) NC machines involve tape reader, D/A convertor, servomotor, transducer, comparator, etc.
(*c*) Point to point NC system is used in vertical drilling machine
(*d*) Continuous path NC system is used in vertical-milling machine
(*e*) Transducers in NC machines continuously monitor the position of the tool or workpiece.

147. Forced covection heat transfer for turbulent flow through a tube is function of Nusselt number (Nu), Reynold's number (Re), and Prandtl number (Pr). These numbers are represented by
(*a*) $\frac{\alpha l}{\lambda}, \frac{vl}{\nu}, \frac{\mu C_p}{\lambda}$
(*b*) $\frac{vl}{\nu}, \frac{\alpha l}{\lambda}, \frac{\mu C_p}{\lambda}$
(*c*) $\frac{\mu C_p}{\lambda}, \frac{\alpha l}{\lambda}, \frac{vl}{\nu}$
(*d*) $\frac{vl}{\nu}, \frac{\mu C_p}{\lambda}, \frac{\alpha l}{\lambda}$
(*e*) $\frac{\mu C_p}{\lambda}, \frac{vl}{\nu}, \frac{\alpha l}{\lambda}$.

where α = heat transfer coefficient, l = length, v = average velocity of flow, μ = coefficient of dynamic viscosity, ν = kinematic viscosity, C_p = specific heat capacity at constant pressure, λ = thermal conductivity).

148. The heat flow through the wall of a straight tube of circular cross section (external diameter d_o and internal diameter d_i) is a function of
(*a*) $\frac{d_o + d_i}{2}$ (*b*) $\frac{d_o - d_i}{2}$
(*c*) $\frac{d_o}{d_i}$ (*d*) $\log_e \frac{d_o}{d_i}$
(*e*) $\log_e \frac{d_i}{d_o}$.

149. The abbreviation PERT stands for
(*a*) Programme Examination and Review Technology
(*b*) Programme Evaluation and Revision Technique
(*c*) Programme Evaluation and Revaluation Technique
(*d*) Programme Evaluation and Review Technique
(*e*) Programme Examination and Review Technique.

150. The language with which a computer works directly
(*a*) ALGOL (*b*) FORTRAN
(*c*) COBOL (*d*) compiler
(*e*) machine language.

151. Baud in computer terminology is
(*a*) measure of transmission speed
(*b*) number of bits a computer can handle at a time
(*c*) capacity of computer main memory
(*d*) number of different characters that can be encoded
(*e*) none of the above.

152. Fig. 21 shows the front view of a cast iron press frame. The section at A-A, looking from top will be as shown in view
(*a*) A (*b*) B
(*c*) C (*d*) D

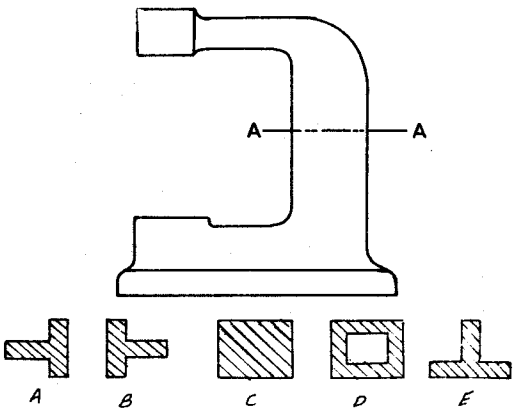


Fig. 21

(*e*) E.

153. Sclerometer is used to measure
(*a*) thickness of material
(*b*) presence of flaws in material
(*c*) creep strength (*d*) strain energy
(*e*) hardness.

154. Charpy specimens are in connection with
(*a*) hardness test (*b*) impact test
(*c*) creep test (*d*) tensile test
(*e*) fatigue test.

155. Herbert Pendulum device is used to determine following property of a material
(*a*) hardness (*b*) impact
(*c*) tensile (*d*) compression
(*e*) toughness.

156. Fig. 22 shows the stress strain curves for four materials. The correct curves for low carbon steel, medium carbon steel, high carbon steel and cast iron are

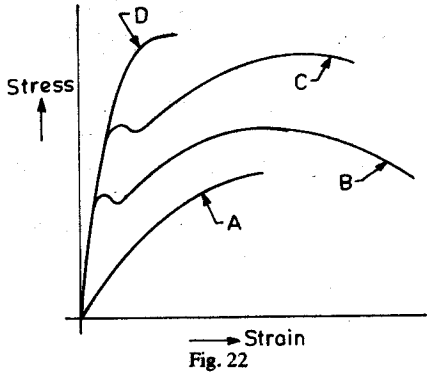


Fig. 22

(*a*) A, B, C, D (*b*) A, C, B, D
(*c*) B, C, D, A (*d*) C, D, A, B
(*e*) B, C, A, D.

157. The toughness of a material on stress-strain diagram is represented by
(*a*) maximum value of stress
(*b*) maximum value of strain
(*c*) scope of stress strain diagram
(*d*) area under stress-strain diagram
(*e*) none of the above.

158. Fig. 24 shows the stress-strain relations in compression. The correct slope for ductile and non-ductile materials are

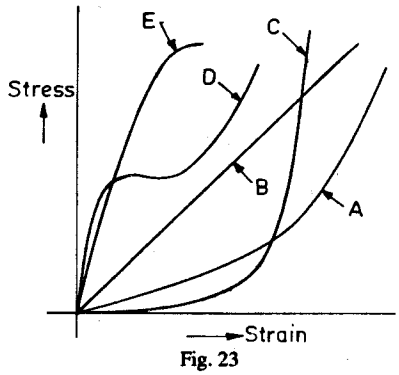


Fig. 23

(*a*) A, B (*b*) B, C
(*c*) C, D (*d*) D, A
(*e*) A, E.

159. Fig. 24 shows a refrigeration cycle on pressure-enthalpy diagram. Identify the condensation, evaporation, expansion and compression processes

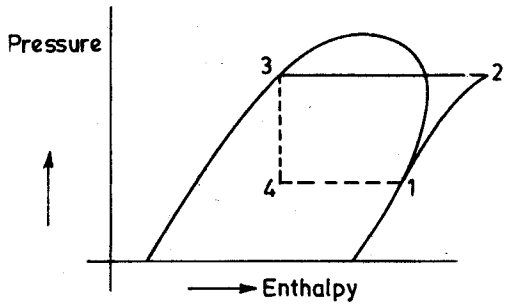


Fig. 24

(*a*) 23, 41, 34, 12 (*b*) 41, 34, 12, 23
(*c*) 32, 34, 14, 12 (*d*) 41, 23, 34, 12
(*e*) 41, 23, 34, 12.

160. Geneva mechanism is used to produce following type of motion
(*a*) slow advance and quick return
(*b*) rotary into straight line harmonic
(*c*) parallel straight line

(*d*) intermittent rotary from continuous rotary
(*e*) rotary rocking from continuous rotary.

161. Scotch yoke mechanism is used to produce following type of motion
(*a*) slow advance and quick return
(*b*) rotary into straight line harmonic
(*c*) parallel straight line
(*d*) intermittent rotary from continuous rotary
(*e*) rotary rocking from continuous rotary.

162. Which thread is used for the translation of load in one direction only
(*a*) square (*b*) Acme
(*c*) Buttress (*d*) BSW
(*e*) Whitworth.

163. In the case of viscous damping, the ratio of successive amplitudes must
(*a*) increase continuously
(*b*) decrease continuously
(*c*) be equal
(*d*) any one of the above
(*e*) none of the above.

164. In a shaft and disc system vibrations, the effect of the axial moment of inertia of shaft can be approximated by following proportion of its value to the axial moment of inertia of the disk
(*a*) $\frac{1}{2}$ (*b*) $\frac{1}{3}$
(*c*) $\frac{2}{3}$ (*d*) $\frac{1}{4}$
(*e*) $\frac{3}{4}$.

165. For a system shown in Fig. 26 the maximum magnification factor occurs at ..... (for damping ratio $\delta \leq 1/\sqrt{2}$)

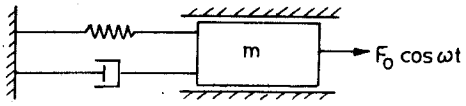


Fig. 25

(*a*) $\sqrt{1-\delta^2}$ (*b*) $\sqrt{1-2\delta^2}$
(*c*) $\frac{1}{2\delta}$ (*d*) $\sqrt{1+2\delta^2}$
(*e*) $\sqrt{1+\delta^2}$.

166. Fig. 26 shows a system of mass, spring and damping. At resonant frequency, the ratio of response x and the prescribed motion y is

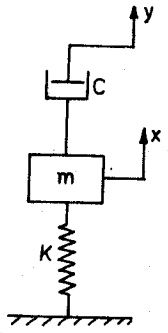


Fig. 26

(*a*) 0.5 (*b*) 2
(*c*) 1 (*d*) α
(*e*) 0.

167. Corresponding to 100% relative humidity, the absolute humidity of air at 40°C is 51.1 g/m^3. At 0°C it will be
(*a*) 100 g/m^3 (*b*) 51.1 g/m^3
(*c*) 20 g/m^3 (*d*) 4.8 g/m^3
(*e*) 0 g/m^3.

168. The SI units of specific thermal resistance, thermal conductivity, and specific heat capacity (three properties of a material) are
(*a*) J/kg°K, W/m°K, m°K/W
(*b*) J/kg°K, m°K/W, W/m°K
(*c*) m°K/W, J/kg°K, W/m°K
(*d*) $\frac{W}{m°K}$, J/kg°K, m°K/W
(*e*) m°K/W, W/m°K, J/kg°K

169. Pick up the wrong statement about nuclear reactors
(*a*) A breeder is a reactor which generates more fissile material than it consumes
(*b*) converter is a reactor which generates less fissile material than it consumes
(*c*) Nuclear fuel is a mixture of fissile and fertile materials
(*d*) Fissile materials are materials which can be split by neutrons
(*e*) Uranium is said to be enriched if it contains a higher proportion of U 235 than the 100% present in natural uranium.

170. Percentage of U 235 in natural uranium is
(*a*) 0.12% (*b*) 0.714%
(*c*) 1.7% (*d*) 5.34%
(*e*) 10%.

171. Pick up the wrong statement about nuclear reactors
(*a*) A moderator is a substance that completely absorbs neutrons
(*b*) Reactor poisons (e.g. boric acid solution) are sprayed into water-moderated reactors to effect an emergency shut down
(*c*) Breeding gain is the ratio of the amount of fissile material consumed to the amount of fissile material generated in a breeder
(*d*) Reactivity is a measure of the critical state of a reactor
(*e*) A breeder is a reactor which generates less fissile material than it consumes.

172. EBCDIC (External Binary Coded Decimal Interchange Code) is a 8-bit code. It can encode following number of different characters.
(*a*) 32 (*b*) 64
(*c*) 128 (*d*) 265
(*e*) 512.

173. Fig. 27 shows the relationship between tool life and cutting-speed. The correct curve is
(*a*) A
(*b*) B
(*c*) C
(*d*) D
(*e*) E.

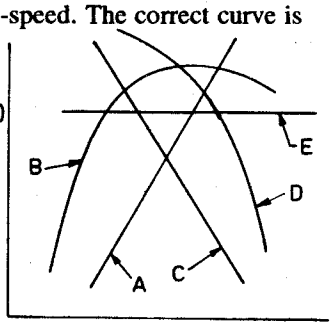


Fig. 27

174. Which curve in Fig. 28 gives best picture of relationship between tool lie and tool rake

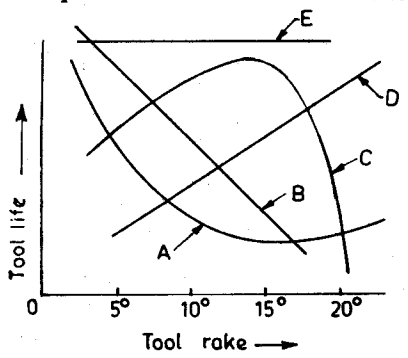


Fig. 28

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) E.

175. Which of the following condition makes a wheel behave soft
(*a*) increase in work surface speed
(*b*) increase in the infeed
(*c*) decrease in the wheel surface speed
(*d*) all of the above (*e*) none of the above.

176. Which curve in Fig. 29 represents the correct relationship for wear of grinding wheel

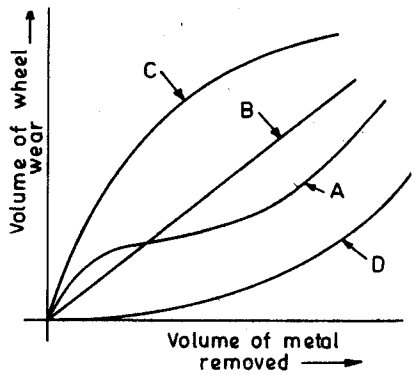


Fig. 29

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) none of the above.

177. Fig. 30 shows the time displacement relations for damped motion. Which of the curves is applicable for under-damped system

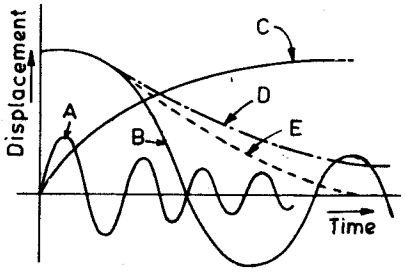


Fig. 30

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) E.

178. Frequency of oscillation of instrument indicating device is a function of
(*a*) mass (*b*) damping
(*c*) sensitivity
(*d*) both damping and sensitivity

(*e*) all of above, *i.e.* mass, damping and sensitivity.

179. Clinometer is used for
(*a*) angular measurement
(*b*) linear measurement
(*c*) bore measurement
(*d*) measurement of environmental conditions
(*e*) measurement of level of flat surfaces.

180. The voltage and current during electrochemical machining are as shown in figure 32
(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) E.

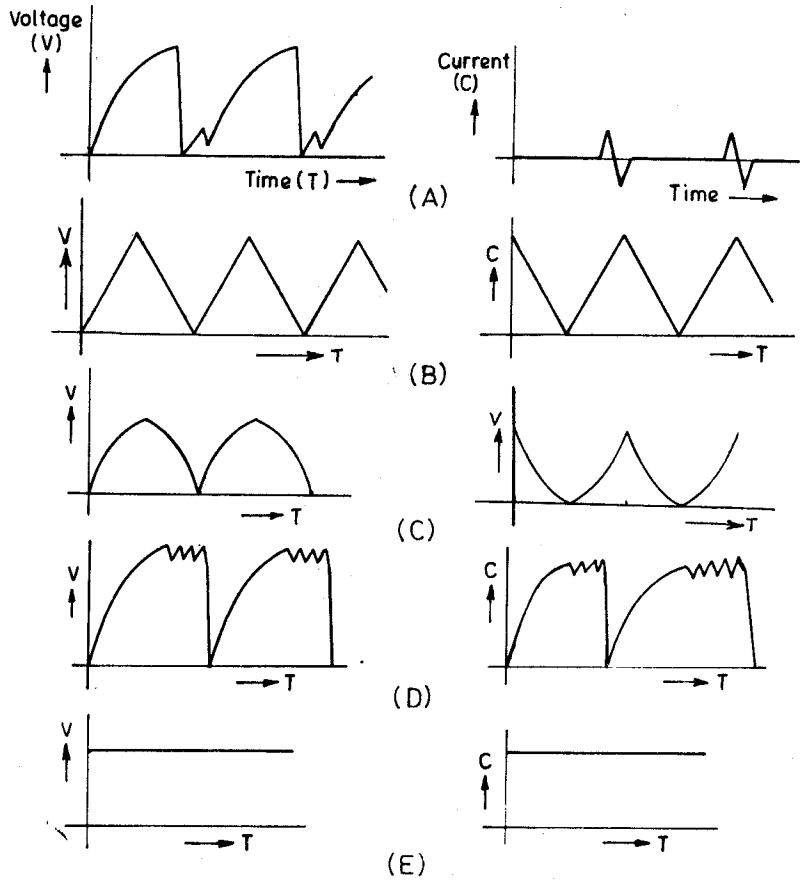


Fig. 32

Model Test Paper–7

Answer all the questions. Each question carries equal marks.
Total time for attempting all the questions is three hours.

1. The shear stress on principal plane is
(*a*) maximum (*b*) minimum
(*c*) average of maximum and minimum principal stresses
(*d*) zero
(*e*) half the difference of maximum and minimum principle stresses.

2. An angle of 2θ on the Mohr's circle corresponds to following angle on the element
(*a*) 2θ (*b*) θ
(*c*) $\theta/2$ (*d*) 4θ
(*e*) $\theta/4$.

3. The planes of maximum shear are always located at following angle from planes of principal stress
(*a*) 90° (*b*) 45°
(*c*) 0° (*d*) 135°
(*e*) $22\frac{1}{2}°$.

4. Materials which show direction dependent properties are called
(*a*) homogeneous (*b*) viscoelastic
(*c*) isotropic (*d*) anisotropic
(*e*) plastic.

5. The true or logarithmic strain is defined as

$$\varepsilon = \int_{L_0}^{L} \frac{dL}{L} = \log \frac{L}{L_0} \log (1 + \varepsilon_0)$$

where L_0 = original length and ε_0 = engineering strain. The concept of true stress and true strain is more informative in examining plastic behaviour. The relation between true stress σ and engineering stress σ_0 is given as

(*a*) $\sigma = \sigma_0 (1 + \varepsilon_0)$ (*b*) $\sigma = \sigma_0 (1 - \varepsilon_0)$

(*c*) $\sigma = \sigma_0 \dfrac{(1 + \varepsilon_0)}{2}$ (*d*) $\sigma = \dfrac{\sigma_0 + \varepsilon_0}{2}$

(*e*) $\sigma = \sigma_0 \left(\dfrac{1 + \varepsilon_0}{1 - \varepsilon_0} \right)$.

6. Modulus of resilience refers to the area under a stress-strain curve upto the
(*a*) elasticity limit
(*b*) yield strength
(*c*) proportional limit
(*d*) maximum point
(*e*) entire area.

7. Modulus of toughness refers to the area under a stress-strain curve upto the
(*a*) elasticity limit (*b*) yield strength
(*c*) proportional limit
(*d*) maximum point
(*e*) entire area.

8. If μ is the Poisson's ratio and E the modulus of elasticity, then G (shear modulus of elasticity) and K (bulk modulus of elasticity) are equal to

(*a*) $G = \dfrac{E}{2(1 + \mu)}, K = \dfrac{E}{3(1 - 2\mu)}$

(*b*) $G = \dfrac{E}{1 + \mu}, E = \dfrac{E}{3(1 - \mu)}$

(*c*) $G = \dfrac{E}{2(1 - \mu)}, K = \dfrac{E}{3(1 + \mu)}$

(*d*) $G = \dfrac{E}{3(1 - \mu)}, K = \dfrac{E}{3(1 + \mu)}$

(*e*) $G = \dfrac{E}{3(1 + 2\mu)}, K = \dfrac{E}{3(2 - \mu)}$

9. The ratio of the unit change in resistance of strain gauge to the unit change in length (strain) is called gauge factor. For strain gauge made from constantan (60% cooper + 40% nickel), gauge factor is approximately
(*a*) 0.1 (*b*) 1

(c) 2 (c) 10
(e) 100.

10. The strain energy stored in a circular uniform bar subjected to oppositely directed twisting moments M at both ends is proportional to
(a) M (b) M^2
(c) M^3 (d) $\sqrt{M}$
(e) $M^{3/2}$.

11. A mild steel bar of uniform cross section A is subjected to an axial tensile load P. The total strain energy stored in the bar is proportional to
(a) P and A (b) P^2 and A
(c) P and $\frac{1}{A}$ (d) P^2 and $\frac{1}{A}$.
(e) P^2 and $\frac{1}{A^2}$.

12. For ductile materials, the most suitable theory of failure applicable is
(a) maximum principle stress theory
(b) maximum shearing stress theory
(c) maximum principal strain theory
(d) maximum energy of distortion theory
(e) all of the above.

13. The flexural rigidity in case of beams is equal to
(a) EI (b) E/I
(c) I/E (d) E^2I
(e) I^2E
where E = modulus of elasticity, and I = moment of inertia.

14. The relation of beam curvature (r = of curvature) to the bending moment M, is known as the Bernoulli-Euler law of elementary bending theory. According to it
(a) $\frac{1}{r}=\frac{M}{EI}$ (b) $\frac{1}{r^2}=\frac{M}{EI}$
(c) $\frac{1}{r}=\frac{E}{MI}$ (d) $r=\frac{M}{EI}$
(e) $\frac{1}{r}=\frac{M^2}{EI}$.

15. The metal cutting wedge is fundamental to the geometry of
(a) hand tools
(b) power driven tools
(c) lathe, shaper and planer tools
(d) grinding wheels
(e) all cutting tools.

16. The point angle of twist drill to drill holes in steel is
(a) 90° (b) 105°
(c) 118° (d) 135°
(e) 148°.

17. The cutting speed of a HSS twist drill to machine cast iron is
(a) 10–20 m/min (b) 25–40 m/mt
(c) 50–70 m/min (d) 80–180 m/mt
(e) 120–180 m/mt.

18. Continuous chips are formed when cutting
(a) brittle materials (b) ductile materials
(c) amorphous plastic materials
(d) free cutting non ferrous alloys only
(e) with high speed steel tools.

19. The rack angle of a cutting tool
(a) controls the chip formation
(b) prevents ribbing
(c) determines the profile of tool
(d) determines whether the cutting action is oblique or orthogonal
(e) increases tool life.

20. Back rake angle for H.S.S. single point cutting tool for machining cutting brass is
(a) 15° (b) 0°
(c) 5° (d) 10°
(e) – 5°.

21. Which of the following processes is chip removing process
(a) sintering (b) extrusion
(c) forging (d) rolling
(e) broaching.

22. Which of the following is non-chip removal process
(a) grinding (b) spinning
(c) thread cutting (d) drilling
(e) tapping.

23. The cutting speed of H.S.S. milling cutter to machine aluminium is
(a) 25–40 m/mt (b) 50–80 m/mt
(c) 100–150 m/mt (d) 180–240 m/mt
(e) 250–350 m/mt.

24. Pick out the false statement
(a) For a given cutting speed cemented carbide tool removes more work material than H.S.S. tool

(*b*) Optimum rake angle of tool is not a function of the properties of work material
(*c*) In oblique cutting the cutting edge of tool is not perpendicular to the cutting direction
(*d*) Chip reduction coefficient is always more than unity
(*e*) Larger value of chip reduction coefficient indicates poor machinability.

25. A twist drill has its point thinned in order to
(*a*) reduce the hole diameter
(*b*) increase the rake angle
(*c*) locate in the centre punch mark
(*d*) reduce the axial (feed) pressure
(*e*) increase the hole diameter.

26. A reamer is used to correct the
(*a*) size and roundness of a drilled hole
(*b*) size and position of a drilled hole
(*c*) finish and position of a drilled hole
(*d*) finish and depth of a drilled hole
(*e*) all of the above.

27. An oversize hole is produced by a drill if
(*a*) lips of drill are of unequal length
(*b*) feed is too high
(*c*) insufficient coolant is used
(*d*) cutting speed is too high
(*e*) drill is hot.

28. Cemented carbide tools are usually provided with
(*a*) Positive back rake angle
(*b*) Neutral back rake angle
(*c*) Negative back rake angle
(*d*) Zero rake angle
(*e*) Any of the above depending on other conditions.

29. State whether the following statements are true or false :
(*a*) The rates of feed and cutting for twist drill are lower than for most other machining operations
(*b*) Like any other cutting tool the twist drill must be provided with correct tool angles
(*c*) A twist drill produces a hole of fine finish and accurate size
(*d*) No cutting fluids are used for carbide tipped milling cutters
(*e*) Decreasing wedge angle of tool decreases its mechanical strength.

30. Discontinuous chips are produced when machining
(*a*) brittle materials at slow cutting speeds
(*b*) Ductile materials with fine feed
(*c*) Mild steel with sharp cutting edge of tool
(*d*) Mild steel with high cutting speed
(*e*) None of the above.

31. Built up chips are produced when machining
(*a*) Ductile materials and high depth of cut
(*b*) Ductile materials with coarse feed
(*c*) Mild steel with low rake angle
(*d*) All of the above
(*e*) None of the above.

32. Friction between chip and tool may be reduced by
(*a*) increased sliding velocity
(*b*) increased shear angle
(*c*) use of low tool finish
(*d*) decreased sliding velocity
(*e*) decreasing shear angle.

33. Pick up the true statement
(*a*) Selection of grinding wheel does not depend on the work piece material
(*b*) Fine grain wheels are used to grind soft ductile materials
(*c*) Hard and brittle materials and finishing cuts require dense structure in grinding wheel
(*d*) Grade of grinding wheel is denoted by a number
(*e*) Structure of grinding wheel is denoted by alphabets.

34. Pick up the false statement
(*a*) Machinability index implies the degree of easiness in machining
(*b*) Free cutting steel cannot be easily machined
(*c*) Heat resisting steels possess low machinability
(*d*) Cast iron does not permit as high a cutting speed as structural carbon steel
(*e*) Aluminium oxide abrasives are used for grinding high strength tensile materials and silicon carbide for low tensile strength materials.

35. Fig. 1 shows a pendulum consisting of light rigid rod of length L pivoted to a fixed point at one end and having a mass m fixed to its other end. A spring of stiffness k is attached as shown. When pendulum is vertical, the

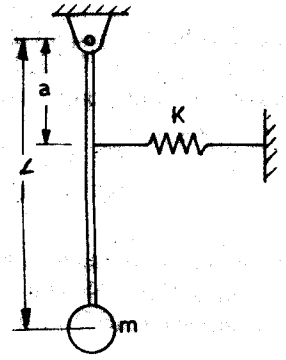


Fig. 1

spring is horizontal and unloaded. If distance 'a' is increased, then the frequency of oscillations will

(a) increase proportional to a

(b) decrease proportional to a

(c) increase proportional to $\sqrt{ka^2}$

(d) increase proportional to $\sqrt{\frac{mgL+ka^2}{mL^2}}$

(e) decrease proportional to $\sqrt{\frac{mgL+ka^2}{mL^2}}$

36. The frequency of vibration of a body of mass m free to move along a fixed horizontal surface and fitted to a spring of stiffness k fixed at one end (Refer Fig. 2) will increase/decrease with change in gravitational force as proportional to

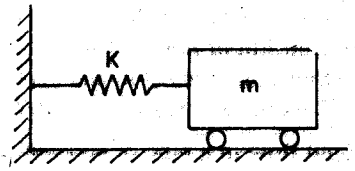


Fig. 2

(a) g (b) $1/g$

(c) $\sqrt{g}$ (d) $\frac{1}{\sqrt{g}}$

(e) no effect.

37. The free damped vibration of a free mass and spring system in vertical direction compared to horizontal direction will be

(a) same

(b) more

(c) less

(d) more/less depending on change in value of gravitational force

(e) more/less depending on air friction.

38. The frequency of vibration of a mass suspended by three springs (of equal stiffness) in parallel when wrongly connected to springs in series will

(a) increase 3 times (b) decrease 3 times

(c) increase $\sqrt{3}$ times

(d) decrease $\sqrt{3}$ times

(e) decrease 6 times.

39. In a stepped shaft used in torsional vibration system, if diameter of one step is increased twice, then for same stiffness the corresponding length has to be

(a) increased twice

(b) increased four times

(c) increased eight times

(d) increased sixteen times

(e) decreased sixteen times.

40. If in a free damped vibration system, it is desired that the displaced body be restored to equilibrium in the shortest possible time, without oscillation or overshoot, then the damping ratio of J should be equal to

(a) 0 (b) 1

(c) < 1 (d) > 1

(e) α.

41. The number of degrees of freedom that a system possesses is equal to the number of

(a) independent co-ordinates necessary to describe the motion of the system

(b) masses connected to it

(c) motions possible *i.e.* lateral, rotary, transverse, etc.

(d) springs in it

(e) mass and spring combinations.

42. Pick up the false statement

(a) The most machinable metal is one which permits fastest removal of largest amount of material per grind of the tool

(b) For the same amount of applied force orthogonal cutting removes more metal

(c) For the same amount of metal removal the shear stress induced in orthogonal cutting is more than in oblique cutting

(d) In oblique cutting the edge of the tool remains inclined to the direction of the work feed

(e) Magnesium alloys exhibit excellent machinability.

43. Pick up the false statement

(*a*) A cutting fluid should have low conductivity
(*b*) Use of cutting fluids promotes a better surface finish
(*c*) Solid lubricants normally used are graphite, molybdenum disulphide, stick waxes etc.
(*d*) Air, CO_2 and argon are used as gaseous cutting fluid
(*e*) Synthetic coolant is used for turning titanium.

44. Pick out the true statement
(*a*) The structure of a grinding wheel indicates the relative spacing of grains in the wheel
(*b*) The grade of a grinding wheel indicates the relative spacing of grains in the wheel
(*b*) The grade of a grinding wheel indicates the relative strength of the bond which hold the abrasive grains in place
(*d*) For grinding softer materials fine grain size is used
(*e*) Coolant is not required during superfinishing.

45. Pick out the false statement
(*a*) Emery is a natural abrasive
(*b*) Silicon carbide is an artificial abrasive
(*c*) Cast iron is often ground dry
(*d*) The workpiece is supported between the centres during cetreless grinding
(*e*) Surface grinder is used to grind flat surfaces.

46. Milling cutter is sharpened on
(*a*) Tool and cutter grinder
(*b*) Centreless grinder
(*c*) Cylindrical grinder
(*d*) Surface grinder
(*e*) Hydraulic grinder.

47. Tick out the true statement
(*a*) In general the surface finish becomes poor with increase in cutting speed
(*b*) An increase in back rake angle of a cutting tool deteriorates surface finish
(*c*) Some degree of roughness which may be extremely small is always present on any machined surface
(*d*) mild steel is the most commonly used material for slide ways
(*e*) Spindles of machine tool are generally made solid.

48. The rise of a column of liquid in a small tube is due to surface tension. There will be no rise or depression of the liquid inside the tube when contact angle is
(*a*) 0° (*b*) $\pi/2$
(*c*) π (*d*) $\pi/4$
(*e*) $3\pi/4$.

49. Fig. 3 shows the viscous behaviour of Dilatant fluid, Bindham fluid, Newtonian fluid, etc. The curve applicable for Newtonian fluid is

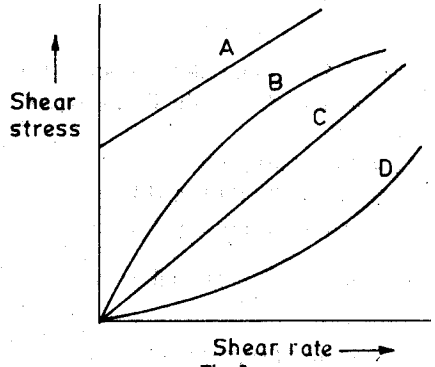


Fig. 3

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) none of the above.

50. Depending on velocity flow, the water flowing in an open channel could be classified as
(*a*) One, two-or three dimensional
(*b*) Laminar or turbulent
(*c*) Uniform or non-uniform
(*d*) Subsonic, transonic and supersonic
(*e*) Subcritical, critical, or supercritical.

51. Liquid flow in a pipe of constant area, and in an open channel of constant width and depth could be classified under following category
(*a*) Laminar (*b*) Three-dimensional
(*c*) Uniform (*d*) Subsonic
(*e*) Critical.

52. Flow with low velocity, highly viscous fluid and through small flow passages can be considered as
(*a*) laminar (*b*) turbulent
c) two-dimensional (*d*) steady
(*e*) uniform.

53. Equations of motion concerned for viscous fluid are known as
(*a*) Newton's equations
(*b*) Navier-Stokes equations

(c) Euler equations (d) Bernoulli equations
(e) Hele-Shaw equations.

54. Which of the following are not dimensionally equivalent
(a) energy per unit mass and velocity squared
(b) time rate of change of energy and force times velocity
(c) head and energy per unit weight
(d) energy per unit volume and dynamic pressure
(e) dynamic viscosity and elastic modulus.

55. The ratio of inertia force and surface tension force is referred to as
(a) Froude number (b) Mach number
(c) Pressure coefficient
(d) Weber number
(e) Reynolds number.

56. For subsonic duct flow, area and Mach number changes are in opposite direction. Subsonic flow occurs for following value of Mach number
(a) = 1 (b) > 1
(c) < 1 (d) > 10
(e) < 10.

57. The condition where the available fluid does not fill the existing space is called
(a) cavitation (b) vacuum
(c) surface tension (d) fluid friction
(e) compressibility.

58. Cavitation noise in a pump may be caused by
(a) a restriction in the inlet line
(b) dirty inlet filter
(c) too high a drive speed
(d) any one of the above
(e) none of the above.

59. Pick up the wrong statement about O–ring seals
(a) These are used for sealing very high pressures
(b) These provide positive seal
(c) These are used in both static and dynamic applications
(d) In installation, these are squeezed at the top and bottom in their groove and against the mating part
(e) Flat gaskets are superior to O–ring seals.

60. In a rectangular open channel uniform flow, the maximum velocity of flow occurs at
(a) top (b) bottom
(c) middle
(d) about one-fifth of the depth below top surface
(e) about one-fifth of the depth above bottom surface.

61. The fluid flow of high viscosity fluid flowing at low speeds, *i.e.* flow with very small Reynolds number is called
(a) creep flow (b) vortex flow
(c) plane potential flow
(d) non uniform flow
(e) unsteady flow.

62. Pick out the false statement
(a) The common ratio ϕ for spindle speeds in G.P. series is selected between 1 and 2
(b) Plain cylindrical bearings have high stiffness and good load carrying capacity
(c) Ball bearings have comparatively high frictional losses than plain cylindrical bearings
(d) Rolling bearings have less maintenance cost
(e) Gear pumps used in hydraulic system are of fixed delivery type.

63. Electron beam machining (E.B.M.) process is quite suitable for a material having
(a) High melting point and high thermal conductivity
(b) High melting point and low thermal conductivity
(c) Low melting point and thermal conductivity
(d) Low melting and high thermal conductivity
(e) None of the above.

64. Pick the odd one out
(a) Twist drill (b) Grinding wheel
(c) Parting tool in lathe
(d) Milling cutter (e) Reamer.

65. Which is the material not grinded by silicon carbide abrasive
(a) bronze (b) cast iron
(c) copper (d) steel
(e) non-metallic materials.

66. The size of abrasive grains in abrasive je machining varies from
(a) 60 to 100 microns
(b) 10 to 50 microns

(c) 1 to 5 microns (d) 0.1 to 1 micron
(e) 0.01 to 1 micron.

67. The propulsion output of aircraft is proportional to
(a) relative aircraft speed (free-stream velocity) v
(b) v^2 (c) v^3
(d) $v^{3/2}$ (e) $\sqrt{v}$.

68. Fig. 4 shows schematic representations of four types of air craft engines. The turbopropeller engine, Ramjet engine, turbosuper-charged aero-engine, and turbojet engine are respectively represented by following parts of Fig. 4

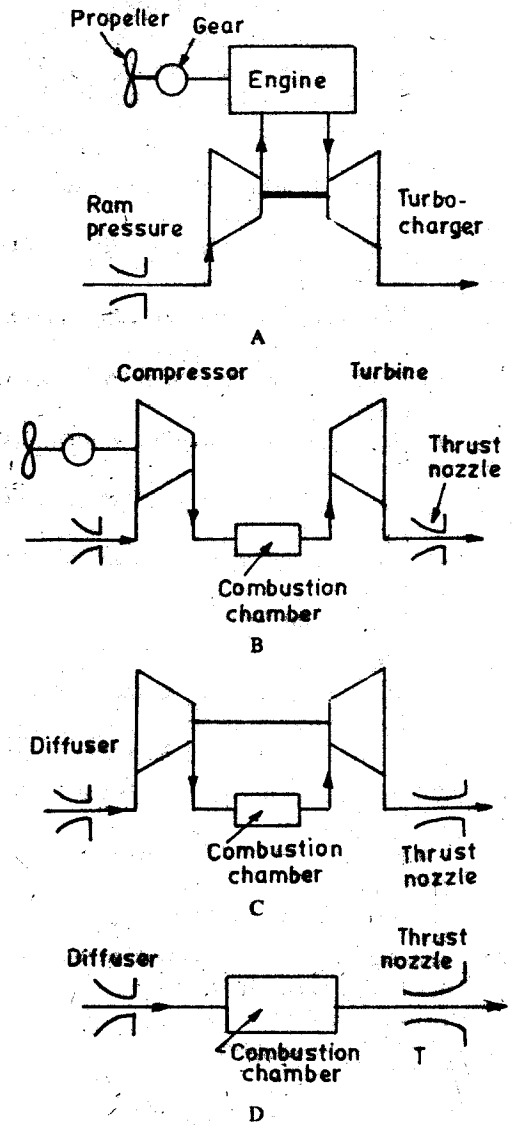
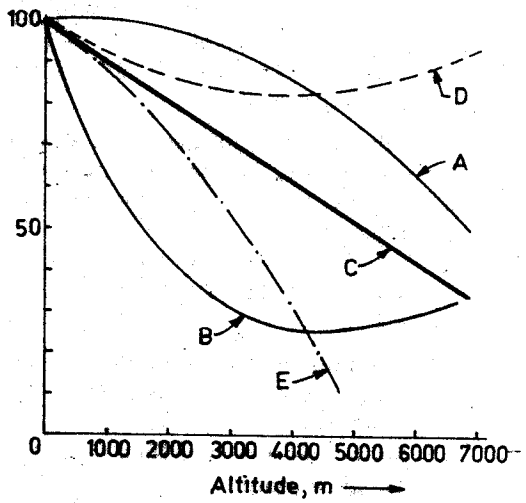


Fig. 4

(a) B, A, C, D (b) B, A, D, C
(c) B, D, C, A (d) C, D, A, B
(e) B, D, A, C.

69. In gas turbine jet propulsion units, when the velocity of discharged jet equals the flight speed, then the propulsion efficiency and thrust become
(a) 100%, 0 (zero) (b) 100%, maximum
(c) 50%, maximum (d) 0%, maximum
(e) 50%, average.

70. Fig. 5 shows the relationship between effective engine output (% of output at sea level) versus altitude for an unsuper-charged engine. The correct curve is



(a) A (b) B
(c) C (d) D
(e) E.

71. Fig. 6 shows three cross sections with same r/d ratio. The preferable sections in order with regard to stress concentration are

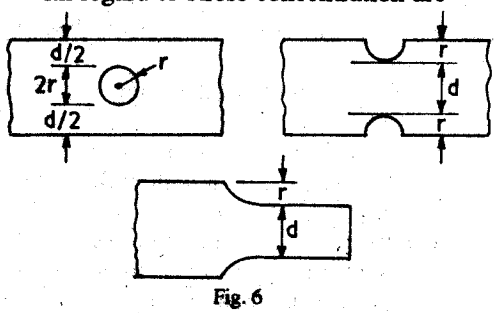


Fig. 6

(a) A, B, C (d) B, C, A
(b) A, C, B (e) C, B, A.
(c) C, A, B

72. Fig. 7 shows the stress-strain relationship for

four materials. The curves for ductile steel, rubber, highly tempered steel, and concrete will be as under

(*a*) A, B, C, D (*d*) B, A, C, D
(*b*) A, D, C, B (*e*) A, D, B, C.
(*c*) A, B, D, C

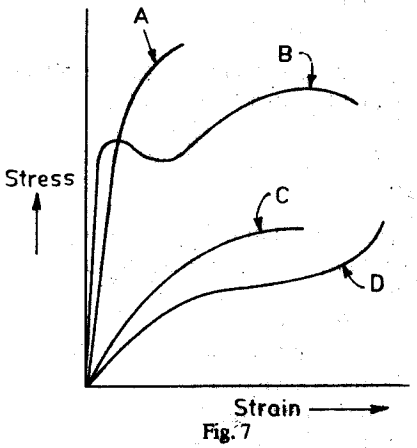
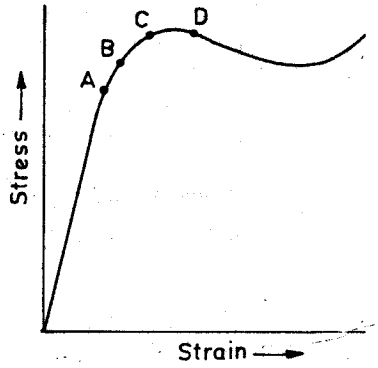


Fig. 7

73. Pick up the wrong statement
(*a*) Proportional limit is the greatest stress that a material can withstand without deviating from the direct proportionality of stress to strain
(*b*) Elastic limit is the maximum stress which a material is capable of withstanding without permanent deformation upon complete release of the stress
(*c*) Yield point is the stress at which there occurs a marked increase in strain without an increase in stress
(*d*) Elasticity is the property of a material to return to its original shape after removal of the load
(*e*) Modulus of elasticity is a measure of material toughness.

74. Fig. 8 shows the stress-strain diagram for mild steel. The elasticity limit, upper yield point, lower yield point, and proportional limit are represented by



(*a*) A, B, C, D (*b*) A, C, D, B
(*c*) B, C, D, A (*d*) C, B, D, A
(*e*) B, C, A, D.

75. Which of the following is not concerned with determination of stress in materials
(*a*) Strain gauge
(*b*) Photoelastic model method
(*c*) Moire's method
(*d*) Fibre optic technique
(*e*) X-ray diffraction.

76. Membrane stresses are those which are
(*a*) calculated by neglecting bending
(*b*) determined by the Moire method
(*c*) determined by membrane technology
(*d*) encountered in spheres
(*e*) encountered at elliptical holes in pressure vessels.

77. The ideal shape of pressure vessel from stress consideration and for minimum material is
(*a*) cylindrical
(*b*) spherical
(*c*) ellisoidal
(*d*) rectangular
(*e*) conical.

78. The dilation, or radial growth, of cylindrical vessel and spherical vessel is proportional to
(*a*) μ, μ (μ = Poisson's ratio)
(*b*) $\mu, \frac{1}{\mu}$
(*c*) $1-\mu, 2-\mu$
(*d*) $2-\mu, 1-\mu$
(*e*) $\frac{1}{1-\mu}, \frac{1}{2-\mu}$.

79. In an ellipsiodal vessel, as the ratio of major to minor axis (a/b) increases, the longitudinal stress is always tensile, but the hoop stress will change from tensile at centre (crown region) to compressive at outer surface (equator) if the ratio a/b exceeds
(*a*) 1 (*b*) 1.32
(*c*) 1.42 (*d*) 2.5
(*e*) 3.25.

80. Fig. 9 shows the efficiency *vs.* compression ratio relationship for constant volume, constant pressure and limited pressure cycles. These are represented respectively by curves
(*a*) A, B, C (*b*) A, C, B

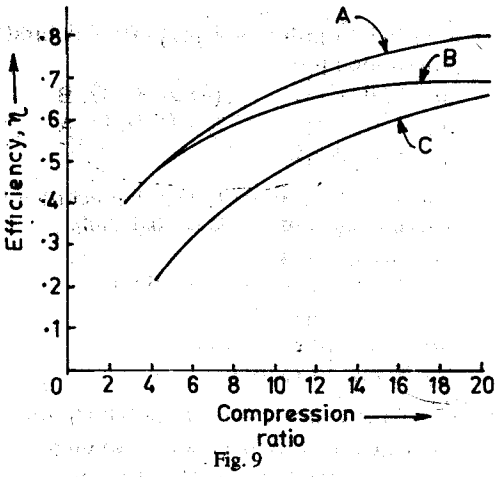


Fig. 9

(*c*) C, B, A (*d*) C, A, B
(*e*) B, A, C.

81. The ratio of mean effective pressure to maximum pressure in the cycle is maximum at all compression ratios for the following cycle
(*a*) constant volume cycle
(*b*) limited pressure cycle
(*c*) constant pressure cycle
(*d*) same for all of above
(*e*) there is no such correlationship.

82. The relationship of volumetric efficiency of I.C. engines with increase in air inlet temperature, and increase in cooling water temperature, respectively is
(*a*) increase, increase
(*b*) decrease, decrease
(*c*) increase, decrease
(*d*) decrease, increase
(*e*) no such correlationship exists.

83. The term scavenging in I.C. engines refers to
(*a*) supplying inlet air at pressure more than atmospheric pressure
(*b*) clearing the cylinder of exhaust gases and filling it more or less completely with fresh mixture
(*c*) adding suitable dopes to fuel
(*d*) increasing compression ratio
(*e*) opening exhaust valve before completion of power stroke.

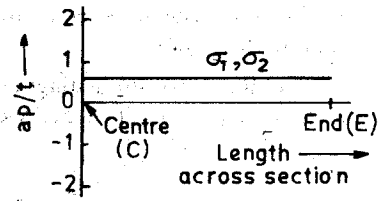
84. In I.C. engines, pumping power is defined as the
(*a*) net work per unit time done by piston on the gases during the inlet and exhaust strokes
(*b*) power taken from the crank shaft to drive a scavenging pump or superchanger
(*c*) power required to drive the auxiliaries
(*d*) power consumed in overcoming friction due to relative motion of various bearing surfaces
(*e*) none of the above.

85. The pumping power for two stroke engines compared to the power developed is
(*a*) 10% (*b*) 20%
(*c*) 25% (*d*) 50%
(*e*) 0%.

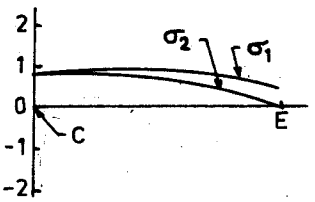
86. Nowadays trend in I.C. engines is to use small stroke–bore ratio (less than unity). The reason for this is
(*a*) less friction
(*b*) better combustion
(*c*) better scavenging
(*d*) higher power ratio
(*e*) better lubrication.

87. The basic reason for superchanging any engine is to
(*a*) reduce the weight and bulk of the power plant for a given output
(*b*) improve combustion
(*c*) generate more power
(*d*) reduce exhaust gases temperature
(*e*) all of the above.

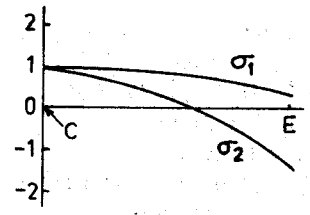
88. Fig. 10 shows the variation in longitudinal stress (σ_1) and hoop stress (σ_2) throughout an ellipsoidal vessel for increasing *a/b* (major axis/minor axis) ratios. Which is the true curve for ratio *a/b* = 3



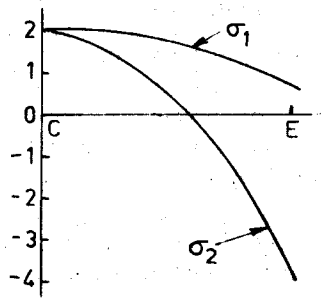
A



B



C



D

(a = major axis, p = internal pressure, k = thickness of vessel)

Fig. 10

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) none of the above.

89. In Fig. 10, the (*B*) portion indicates that the hoop stress tends to be compressive at end. The value of *a/b* for this case is
(*a*) 1.0 (*b*) 1.42
(*c*) 2.0 (*d*) 3.0
(*e*) 4.0.

90. Fig. 11 shows a dished head or torsospherical head used for pressure vessels. This head simulates ellipsoidal shape by compound curve composed of a crown radius and a knuckle radius. The knuckle radius (R_k) should be large in order to minimise the hoop stresses in the region of knuckle. The value of R_k in comparison to crown radius R_c is
(*a*) 6% (*b*) 8%
(*c*) 10% (*d*) 12%
(*e*) 15%.

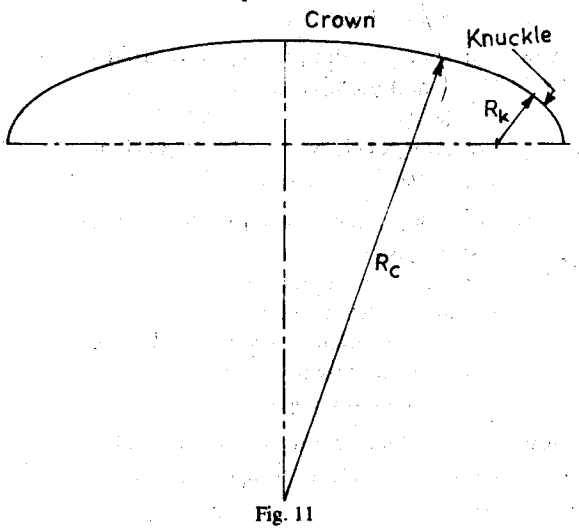


Fig. 11

91. Curves *A*, *B*, *C*, *D*, and *E* in Fig. 12 show the variation of tangential stress through the wall of a thick cylinder. The correct curve for $r_o/r_i = 2$ is

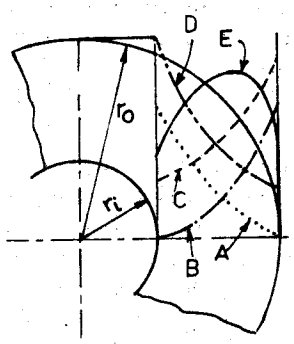


Fig. 12

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) E.

92. Autofretagging technique is used to increase strength of thick cylinders. In this technique
(*a*) cylindrical vessels are reinforced by shrinking on an outer cylindrical liner to produce contact pressure between the two
(*b*) a rope is tightly would around the cylindrical vessel
(*c*) a sufficiently high internal pressure is applied to produce plastic flow in the inner part of cylinder, as a result of which residual stresses persist due to plastic flow and inner part gets compressed and outer part is in tension
(*d*) inner part of cylindrical vessel is subjected to hardening treatment
(*e*) inner part of cylindrical vessel is coated with carbide.

93. When heat flows through the sides of a cylindrical vessel in steady state, the temperature distribution through a cross-section is
(*a*) logarithmic (*b*) straight line
(*c*) parabolic (*d*) hyperbolic
(*e*) exponential.

94. The principle used in design of ultra-high pressure vessel is
(*a*) wedge principle
(*b*) segment principle
(*c*) cascade principle
(*d*) all of the above
(*e*) none of the above.

95. The stiffness of a plate bent like a beam in one plane in comparison to a pure beam action would be around
(*a*) 10% (*b*) 15%
(*c*) 20% (*d*) 25%
(*e*) 30%.

96. A bear market refers to
(*a*) free availability of liquor
(*b*) production higher than demand
(*c*) prices going down in stock market
(*d*) recession in industry
(*e*) restricted availability of commonly used goods.

97. The condition of a battery can be checked
(*a*) by seeing presence of electrolyte
(*b*) by measuring current
(*c*) by measuring voltage
(*d*) by taking a sample of the electrolyte with hydrometer and measuring its specific gravity
(*e*) by seeing salt deposition at terminals.

98. In proximate analysis of fuel, the following components are specified
(*a*) N_2, ash C, H_2, O_2, total sulphur, and gross calorific value
(*b*) SiO_2, K_2O, Na_2O, CaO, MgO, Fe_2O_3, P_2O_5, SO_3 and Cl_2
(*c*) ash, volatile matter, moisture, fixed carbon, sulphur, gross calorific value, and ash fusion temperature
(*d*) calorific value, flash point, pouring point, density, carbon and ash
(*e*) none of the above.

99. In ultimate analysis of fuel, the following components are specified
(*a*) N_2, ash C, H_2, O_2, total sulphur, and gross calorific value
(*b*) SiO_2, K_2O, Na_2O, CaO, MgO, Fe_2O_3, P_2O_5, SO_3 and Cl_2
(*c*) ash, volatile matter, moisture, fixed carbon, sulphur, gross calorific value, and ash fusion temperature
(*d*) calorific value, flash point, pouring point, density, carbon and ash
(*e*) none of the above.

100. The size of materials that can be conveyed by belt conveyors is limited only by the
(*a*) velocity of belt (*b*) power of motor
(*c*) surface characteristics of belt
(*d*) width of the belt (*e*) length of belt.

101. The power of nuclear weapons is measured in equivalents of the explosive energy of TNT. MEGATON explosive is equivalent to following tons of TNT
(*a*) 1 (*b*) 10
(*c*) 100 (*d*) 1000
(*e*) 10,00,000.

102. The unit of absorbed dose of unclear radiation (corresponding to energy absorption of 100 ergs per gm of tissue) is called
(*a*) RAD (*b*) REM
(*c*) ROENTGEN (*d*) KILOTON
(*e*) none of the above.

103. The unit of radiation dose which takes account of the biological effectiveness of different types of radiation is
(*a*) RAD (*b*) REM
(*c*) ROENTGEN (*d*) KILOTON
(*e*) none of the above.

104. The unit of radiation exposure used for only X-ray and gamma rays is
(*a*) RAD (*b*) REM
(*c*) ROENTGEN (*d*) KILOTON
(*e*) none of the above.

105. For acute radiation effects, the units rad, rem, and roentgen
(*a*) are in ascending order
(*b*) are in descending order
(*c*) may be treated approximately equal
(*d*) no relationship exists
(*e*) none of the above.

106. The surface point at or vertically above which a nuclear weapon is detonated is called

(a) ground zero (b) horizontal plane
(c) vertical plane (d) detonating plane
(e) ground infinity.

107. The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays from the nuclei of an unstable isotope is called
(a) fall out (b) fission
(c) shock wave (d) blast wind
(e) radioactivity.

108. A nucleus of helium atom, emitted by certain elements during readioactive decay is called
(a) alpha radiation (b) beta radiation
(c) gamma radiation (d) fallout radiation
(e) radioactivity.

109. The radiation of charged particles of very small mass emitted by certain radioactive elements which may cause skin burns
(a) alpha radiation (b) beta radiation
(c) gamma radiation (d) fallout radiation
(e) radioactivity.

110. High energy photons emitted from certain elements during radioactive disintegration
(a) alpha radiation (b) beta radiation
(c) gamma radiation (d) fallout radiation
(e) radioactivity.

111. Pipe joints which rely on pressure are called
(a) compression joints
(b) tension joints
(c) manipulative joints
(d) capillary joints
(e) solvent welded joints.

112. The noise of water gushing into a tank or cistern can be reduced by
(a) replacing ball float
(b) bending the lever arm
(c) reducing the flow rate
(d) fitting a tube that would take the inflowing water below the level of the water already in the cistern
(e) replacing complete ball valve.

113. In ECM process normal current requirement is
(a) 800 amps/cm^2 of workpiece area
(b) 200 amps/cm^2 of workpiece area
(c) 100 amps/cm^2 of workpiece area
(d) 10 amp/cm^2 of workpiece area
(e) 1 amp/cm^2 of workpiece area.

114. The voltage applied between tool (cathode) and workpiece (anode) in E.C.M. process is
(a) 0.1 to 2 V (b) 3–20 V
(c) 60–90 V (d) 110 -200 V
(e) 240–500 V.

115. Name the electrolytes used in ECM process
(a) NaCl, KCl, $NaNo_3$
(b) HCl, H_2SO_4, HNO_3
(c) water (d) emulsified oil
(e) air.

116. The diameter (D) of a plain milling cutter is approximately related to arbor diameter (d) as
(a) $D = 2.5d$ to $3d$
(b) $D = 4.5d$ to $6d$
(c) $D = 1.5d$ to $2d$
(d) $D = 6.5d$ to $7.5d$
(e) all of above are possible.

117. Pick up the false statement
(a) The larger the cutting angle and the smaller the thickness of uncut chip, the more tightly the chip will curl
(b) Continues chips with built-up edge are formed when machining ductile material with high cutting speed
(c) The use of cutting fluids reduces the radius to which the chip curls
(d) An increase in nose radius leads to greater chip contraction
(e) Greater the cutting angle (or smaller the positive rake angle) the greater is chip contraction.

118. Tool signatures comprise of following elements
(a) 4 (b) 6
(c) 7 (d) 9
(e) none of above.

119. In a collet the included angle of taper is usually
(a) 50° (b) 30°
(c) 20° (d) 10°
(e) 45°.

120. Pick out the true statement
(a) The head stock remains stationary in a swiss type automatic screw machine
(b) Collets are used when the components are to be produced from bar stock
(c) The overhead charges of an engine lathe are more than a turret lathe

(*d*) Multi-spindle automatic screw machines maintain better accuracy than spindle automatic screw machines
(*e*) Aluminium oxide is most efficient when used for grinding soft materials.

121. The condition for the formation of continuous chips with built up edges
(*a*) low rake angle
(*b*) low cutting speed
(*c*) high feed
(*d*) all of the above
(*e*) none of the above.

122. Twist drills are usually considered suitable for machining holes having a length less than
(*a*) Two times their diameter
(*b*) Five times their diameter
(*c*) Ten times their diameter
(*d*) All of the above
(*e*) None of the above.

123. A hard grade grinding wheel is suitable for grinding
(*a*) Hard materials
(*b*) Soft materials
(*c*) Both hard and soft materials
(*d*) Tough materials
(*e*) Brittle materials.

124. Material which can be easily machined by ultrasonic machining process is
(*a*) glass (*b*) ceramic
(*c*) low tensile strength materials
(*d*) all of the above
(*e*) none of the above.

125. In quick return mechanism of shaping machine the ram stroke length is proportional to
(*a*) Slotter arm length
(*b*) Crank length
(*c*) Ram length
(*d*) Crown gear diameter
(*e*) Travel of tool clapper.

126. The usual ratio of forward and return stroke in quick return mechanism of shaping machine is
(*a*) 3 : 2 (*b*) 2 : 3
(*c*) 3 : 1 (*d*) 1 : 2
(*e*) 2 : 1.

127. Which curve in Fig. 13 represents isothermal line on P-V plot
(*a*) curve A (*b*) B

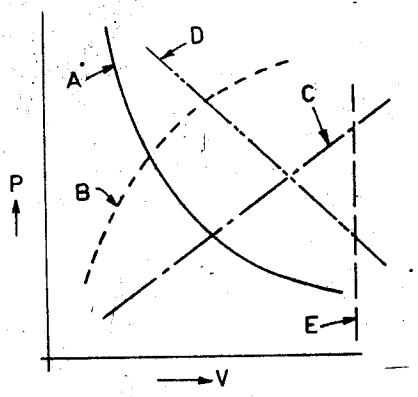


Fig. 13

(*c*) C (*d*) D
(*e*) E.

128. "Equal volumes of perfect gases existing at the same pressure and temperature contain the same number of molecules". This is the statement as per
(*a*) Rankine
(*b*) Kelvin
(*c*) Charles
(*d*) Avogadro
(*e*) Boyle.

129. The sum of the partial pressures of the individual gases is equal to the total pressure of the mixture. This law is as per
(*a*) Dalton
(*b*) Avogadro
(*c*) Kelvin
(*d*) Robert
(*e*) Charles.

130. Which of the following is not the property of the system
(*a*) heat (*b*) specific heat
(*c*) internal energy
(*d*) pressure and temperature
(*e*) entropy.

131. The efficiency of throttling process is
(*a*) 0% (*b*) 50%
(*c*) 100% (*d*) 90%
(*e*) none of the above.

132. Fig. 14 shows an h-s chart (mollier diagram) for steam. Constant pressure, constant temperature, and constant moisture lines are represented by
(*a*) B, A, C
(*b*) C, B, A
(*c*) A, C, B

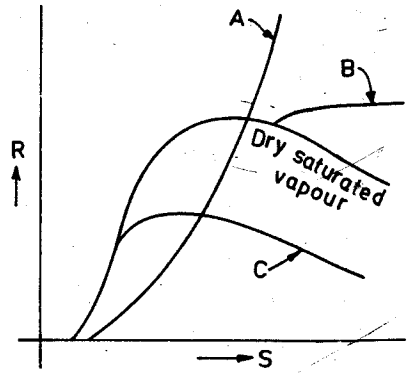


Fig. 14

(*d*) B, C, A
(*e*) A, B, C.

133. The analysis indicating the amount of moisture, volatile matter, fixed carbon, and ash in coal is called
(*a*) coal analysis (*b*) standard analysis
(*c*) ultimate analysis (*d*) chemical analysis
(*e*) proximate analysis.

134. The analysis indicating the percentages by weight of C, H_2, S, O_2, N_2 and ash in coal is called
(*a*) coal analysis (*b*) standard analysis
(*c*) ultimate analysis (*d*) chemical analysis
(*e*) proximate analysis.

135. The absolute unit of X-ray or gamma-ray dosage used for measuring radiation exposure
(*a*) Curie (*b*) Roentgen
(*c*) μS/cm (*d*) Rodent
(*e*) Lux.

136. There is no interaction with the surrounding across the boundaries of the system in
(*a*) closed thermodynamic system
(*b*) flow system
(*c*) isolated system
(*d*) all of the above
(*e*) none of the above.

137. Value of extensive properties of the system depends on the
(*a*) mass of the system
(*b*) process followed by the system
(*c*) boundaries of the system
(*d*) specific volume of the system
(*e*) energy transfer in the system.

138. A reversible polytropic process can be expressed by
(*a*) $pv^n = C$ (*b*) $(pv)^n = C$
(*c*) $p/v^n = C$ (*d*) $\left(\frac{p}{v}\right)^n = C$
(*e*) $p^n v = C$.

139. Work done in adiabatic process between two states depends on
(*a*) the end states only
(*b*) the value of index *n*
(*c*) the heat transfer
(*d*) the path followed between two states
(*e*) energy interaction during the path followed.

140. Reversible adiabatic process may be expressed as
(*a*) $\frac{T_1}{T_2} = \left(\frac{v_2}{v_1}\right)^{\frac{\gamma-1}{\gamma}}$ (*b*) $\frac{T_1}{T_2} = \left(\frac{p_2}{p_2}\right)^{\gamma-1}$
(*c*) $\frac{T_1}{T_2} = \left(\frac{v_1}{v_2}\right)^{\gamma-1}$ (*d*) $\frac{T_1}{T_2} = \left(\frac{p_1}{p_2}\right)^{\frac{\gamma-1}{\gamma}}$
(*e*) $\frac{T_1}{T_2} = \left(\frac{p_1}{p_2}\right)^{\frac{\gamma}{\gamma-1}}$.

141. The curves *A*, *B*, *C*, and *D* in Fig. 15 represent the conditions for *n* =

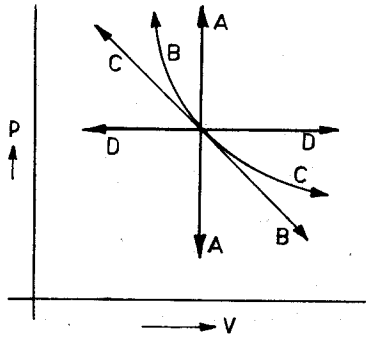


Fig. 15

(*a*) 0, 1, γ, ∝ (*b*) 1, 0, γ, ∝
(*c*) 0, 1, ∝, γ (*d*) γ, ∝, 0, 1
(*e*) ∝, γ, 1, 0.

142. The specific heat for reversible adiabatic process is
(*a*) C_p (*b*) C_v
(*c*) C_p/C_v (*d*) $C_v\left(\frac{\gamma-n}{1-n}\right)$
(*e*) 0.

143. Fig. 16 shows the variation of saturation of temperature with increase in pressure

The correct curve is

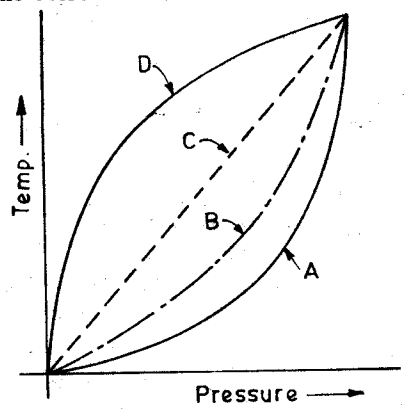


Fig. 16

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) none of the above.

144. A perfect gas at 27°C is heated at constant pressure till its volume is doubled. The final temperature is
(*a*) 54°C (*b*) 540°C
(*c*) 327°C (*d*) 600°C
(*e*) 270°C.

145. The slope of constant pressure line on T-s diagram is given by
(*a*) $\frac{T}{C_p}$ (*b*) $\frac{T}{C_v}$
(*c*) $\frac{s}{T}$ (*d*) $\frac{T}{s}$
(*e*) $\frac{C_p}{C_v}$.

146. 40000 J/sec of heat are supplied to an engine for the net work of 12 kW obtained from it. The thermal efficiency is
(*a*) 30% (*b*) 33.3%
(*c*) 45% (*d*) 50%
(*e*) 60%.

147. COP of carnot refrigerator is 4. For the same temperatures of source sink, the COP of carnot heat pump will be
(*a*) 5 (*b*) 3
(*c*) 2.5 (*d*) 10
(*e*) data are incomplete.

148. The enthalpy of evaporation for water is zero at
(*a*) 225.65 kgf/cm^2
(*b*) 221.2 kg/cm^2
(*c*) 273 kg/cm^2
(*d*) 200 kg/cm^2
(*e*) 100 kg/cm.

149. The saturation temperature/specific volume of steam with increase in pressure
(*a*) decreases/increases rapidly first and then slowly
(*b*) increases/decreases rapidly first and then slowly
(*c*) increases/decreases slowly first and then rapidly
(*d*) decreases/increases slowly first and then rapidly
(*e*) increases/decreases linearly.

150. The work done on air per kg during compression is the least
(*a*) when $n = 1.5$
(*b*) when $n = 1$
(*c*) when $n = 1.4$
(*d*) when $n = 1.0$
(*e*) when $n = \frac{C_p}{C_v}$.

151. Fig 17 shows various processes on *T-s* chart. $PV^n = C$ (where $n > \gamma$ and $n < \gamma$) is represented respectively by curves

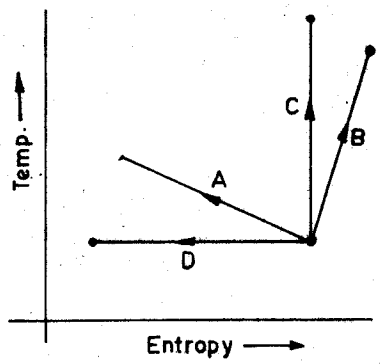


Fig. 17

(*a*) A, L. (*b*) B, C
(*c*) A, B (*d*) B, A
(*e*) B, D.

152. Fig. 18 shows the variation of volumetric efficiency as the delivery pressure of compressor increases.

The correct curve applicable is

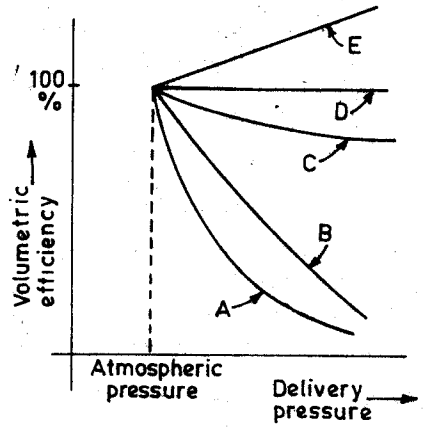


Fig. 18

(*a*) A (*b*) B
(*c*) C (*d*) D
(*e*) E.

153. If p_s is suction pressure of compressor and p_d the delivery pressures, then optimum intermediate pressure with perfect inter-cooling is

(*a*) $\frac{p_s + p_d}{2}$ (*b*) $\sqrt{p_s p_d}$
(*c*) $> \sqrt{p_s p_d}$ (*d*) $< \sqrt{p_s p_d}$
(*e*) $\frac{p_s - p_d}{2}$.

154. Free air delivered as referred to in air compressor is at
(*a*) atmospheric conditions at the place of test
(*b*) 0°C and standard atmospheric conditions
(*c*) 15°C and 1 kgf/cm^2
(*d*) 25°C, 1 kgf/cm^2 and 50% relative humidity
(*e*) N.T.P. condition.

155. For two stage compressor suction pressure is 1 kg/cm^2 and delivery pressure is 9 kgf/cm^2. The optimum intermediate pressure is
(*a*) 3 kgf/cm^2 (*b*) 4.5 kgf/cm^2
(*c*) 5 kgf/cm^2 (*d*) 8 kgf/cm^2
(*e*) none of the above.

156. Main purpose of after-cooler for air compressor is
(*a*) to cool air before use and facilitate handling of air at lower temperature
(*b*) remove moisture or oil vapour from air
(*c*) reduce the volume capacity of receiver
(*d*) power saving
(*e*) improve volumetric efficiency.

157. The best method of controlling compressor during the base/peak load is
(*a*) relief valve/variable speed
(*b*) variable speed/relief valve
(*c*) start-stop motor/constant speed unloader
(*d*) constant speed unloader/start-stop motor
(*e*) start-stop motor/variable speed.

158. In a steam generator installation, the characteristics of convection/radiant superheater with increase in load are
(*a*) drooping/rising
(*b*) linear/horizontal
(*c*) rising/drooping (*d*) horizontal/linear
(*e*) linear/drooping.

159. Octane number and cetane number respectively of the petrol normally used in spark ignition engine vehicles in India are approximately
(*a*) 25 to 30, 80 to 90
(*b*) 50 to 60, 60 to 70
(*c*) 60 to 70, 25 to 30
(*d*) 80 to 90, 15 to 20
(*e*) 35 to 40, 45 to 55.

160. Anit-knock agent for compression ignition engine fuels and spark ignition engine fuels respectively is
(*a*) amyl nitrate, ethylene bromide
(*b*) tetra ethyl lead, napthelene
(*c*) ethylene bromide, tetra ethyl lead
(*d*) napthelene, amyl nitrate
(*e*) none of the above.

161. Relative fuel/air ratio for compression ignition engine and spark ignition engines respectively with load from small part load to full rated load may vary from
(*a*) 0.1 to 0.85, 0.8 to 1.2
(*b*) 0.1 to 1.2, 1 to 1.2
(*c*) 0.8 to 1.2, 0.1 to 0.85
(*d*) 1 to 1.2, 0.1 to 1.2
(*e*) 0.1 to 1.0, 0.1 to 1.0.

162. Morse test is conducted on multi-cylinder internal combustion engines to determine
(*a*) Thermal efficiency
(*b*) Volumetric efficiency
(*c*) BHP of individual cylinders
(*d*) Mechanical efficiency
(*e*) Fuel air ratio used.

163. Reheating in a multi-stage expansion gas turbine cycle
(*a*) improves thermal efficiency
(*b*) improves work ratio
(*c*) reduces compressor work
(*d*) avoids regenerator
(*e*) avoids pollution.

164. For two stage expansion gas turbine cycle and perfect reheating, the intermediate pressure, which is the geometric mean of the lowest and the highest-pressure of the cycle gives
(*a*) Maximum thermal efficiency
(*b*) Maximum work output
(*c*) Minimum work
(*d*) avoids regenerator
(*e*) avoids pollution.

165. The evaporator temperature is $-23°C$ and the condenser temperature is $+27°C$. The Carnot co-efficient of performance of the refrigerator cycle and heat pump respectively will be
(*a*) 5, 5 (*b*) 6, 5
(*c*) 6, 6 (*d*) 5, 6
(*e*) 1.2, 0.2.

166. Spring constant of a spring is defined as
(*a*) Load required to produce unit deflection
(*b*) mean coil diameter/wire diameter
(*c*) length of spring/axial deflection
(*d*) length of wire/number of coils
(*e*) proof load/proof stress.

167. If d is the spring wire diameter and D the coil diameter, then spring stiffness is proportional to
(*a*) $d^2, \frac{1}{D^2}$ (*b*) $d^3, \frac{1}{D^3}$
(*c*) $d^4, \frac{1}{D^4}$ (*d*) $d^4, \frac{1}{D^3}$
(*e*) $d^3, \frac{1}{D^4}$.

168. If L is the length of leaf spring and t the thickness of each leaf and if L is made double then for same stiffness, t should be
(*a*) doubled
(*b*) made four times
(*c*) made eight times
(*d*) halved
(*e*) made three times.

169. For faultless operation of hydraulic braking system, the brake fluid should
(*a*) be pure
(*b*) have high viscosity
(*c*) have lower viscosity
(*d*) have high boiling point
(*e*) none of the above.

170. Ignition advance is expressed in terms of
(*a*) crank angle
(*b*) time in multi seconds
(*c*) piston position in mm before top dead centre
(*d*) any one of the above
(*e*) none of the above.

171. For a four stroke engine the maximum power output is obtained corresponding to air quantity of
(*a*) 5–10% deficient
(*b*) 10–20% deficient
(*c*) 20–30% deficient
(*d*) 5–15% surplus
(*e*) 15–30% surplus.

172. The cylinder of engine of two-stroke vehicles is lubricated by
(*a*) forced lubrication
(*b*) splash lubrication
(*c*) lubrication plug (*d*) greasing
(*e*) mixing lub oil in fuel.

173. Presence of water in lubricating oil aids in
(*a*) oxidation
(*b*) corrosion
(*c*) less pollution
(*d*) formation of sludge
(*e*) decomposition.

174. Dilution of lubricating oil is done by adding fuel. About 5% fuel in lub oil lessens its lubricating ability by
(*a*) 0.1% (*b*) 1%
(*c*) 5% (*d*) 10%
(*e*) 30%.

175. Ignition coil is used to
(*a*) step up current (*b*) step up voltage
(*c*) step up power
(*d*) step up ignition advance
(*e*) all of the above.

176. Gantt chart is associated with
(*a*) production schedule
(*b*) inventory control
(*c*) machine utilisation

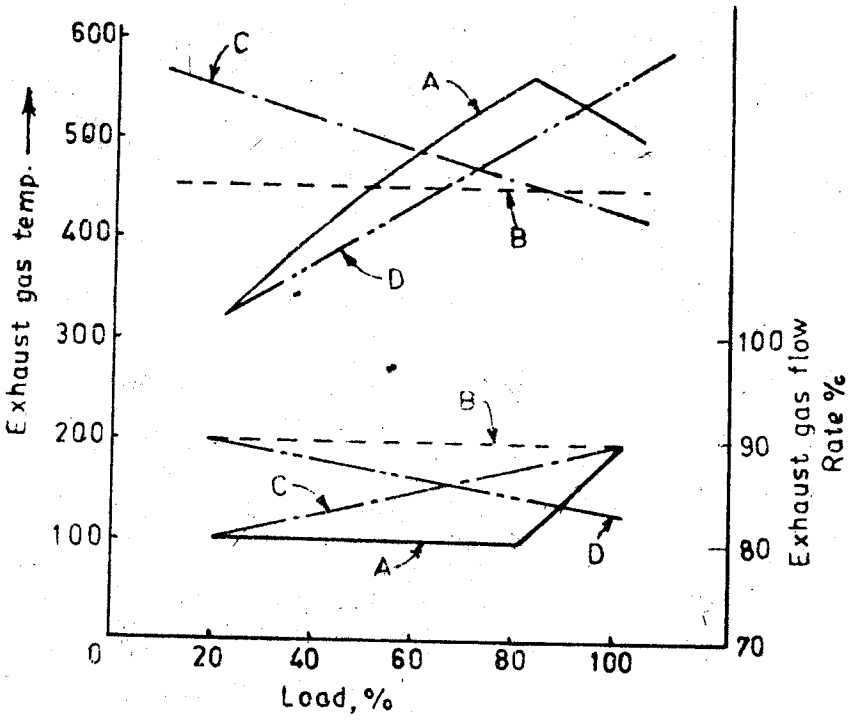
(*d*) forecasting sales
(*e*) machine maintenance schedules.

177. SIMO charts are used for
(*a*) method study (*b*) micromotion study
(*c*) process analysis (*d*) layout analysis
(*e*) all of the above.

178. Sinking fund refers to
(*a*) reserves for future developments
(*b*) compensate for a property's depreciation
(*c*) offset the damage caused by causalities
(*d*) compensate for accidents
(*e*) reduce capitalisation rate of a property.

179. Which of the following is not a job evaluation criteria
(*a*) classification
(*b*) ranking
(*c*) point rating
(*d*) factor of comparison
(*e*) workers ability.

180. Fig. 19 shows the relationship of gas turbine exhaust temperature and of exhaust gas flow with increase in load. The most likely curve applicable for gas turbine is
(*a*) curve A (*b*) curve B
(*c*) curve C (*d*) curve D
(*e*) none of the above.



Model Test Paper–8

Answer all the questions. Each question carries equal marks. *Time : 1 hour*

1. Which pump utilises the momentum of falling water to pump to a greater height a smaller quantity of water
   (*a*) arial plunger pump
   (*b*) rotary shuttle block pump
   (*c*) paracyclic pump (*d*) air lift pump
   (*e*) hydraulic ram.

2. A centrifugal pump with peripheral speed '*V*' was selected for a total lift of 100 m. Actually pump was to be operated for a total lift of 400 m. The peripheral speed should actually be (other conditions remaining same)
   (*a*) 2 V (*b*) 4 V
   (*c*) 8 V (*d*) 1 V
   (*e*) none of the above.

3. Pumps which raise oil or water by the buoyancy of an aerated column of oil or water in a submerged tube are called
   (*a*) air lift pumps (*b*) vacuum pumps
   (*c*) crescent pumps (*d*) paracyclic pumps
   (*e*) arial plunger pumps.

4. Reciprocating pumps are used advantageously for pumping
   (*a*) small volume under high pressure
   (*b*) small volume under small pressure
   (*c*) large volume under small pressure
   (*d*) large volume under high pressure
   (*e*) any one of the above.

5. Pick up the false statement about characteristics of positive displacement pumps
   (*a*) for satisfactory operation, the flow must be kept within a limited range of the best efficiency capacity
   (*b*) the flow rate fluctuates (pluses) between maximum and minimum values for each revolution of crankshaft
   (*c*) the pulsating flow imposes an acceleration head which adds to the net positive inlet pressure required
   (*d*) it is more energy efficient
   (*e*) discharge pressure is a function of system requirement only and is independent of pump capacity.

6. Of the following speed control options for varying the speed of pumps, which has high efficiency over wide range of pump speeds
   (*a*) fluid or magnetic coupling
   (*b*) hydraulic torque converter
   (*c*) variable-frequency motor drive
   (*d*) hydroviscous drive
   (*e*) all of the above.

7. Whenever a centrifugal pump and positive displacement pump are required to be worked together in series for a system, the centrifugal pump always feeds to positive displacement pump and never *vice versa*. Pick up the correct statement for this arrangement
   (*a*) centrifugal pump supplies sufficient pressure to satisfy the suction requirements of the positive displacement pump
   (*b*) flow rate is determined by the positive displacement pump
   (*c*) centrifugal pump must be sized to provide the maximum rate of flow of the positive displacement pump at a pressure high enough to meet the NPSH requirement of the latter
   (*d*) if positive displacement pump feeds to centrifugal pump then the high pressure imposed on the centrifugal pump suction and the amplification of flow pulsations resulting from interaction of the characteristics of the two pumps would be deleterious to both pumps

(*e*) suction stabilisers and discharge dampeners for positive displacement pump are mandatory for this arrangement.

8. Coefficient of performance - (COP) of refrigerating cycle is defined by the ratio of the refrigerating effect to work. For the cycle shown in Fig. 1, COP =

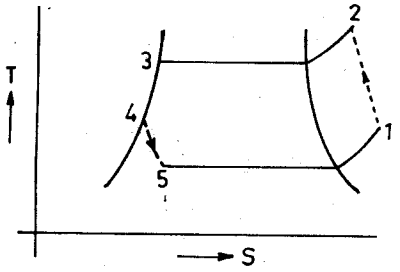


Fig. 1

(*a*) $\frac{T_1}{T_1 - T_2}$ (*b*) $\frac{T_2}{T_1 - T_2}$

(*c*) $\frac{h_1 - h_5}{W}$ (*d*) $\frac{h_2 - h_4}{W}$

(*e*) $\frac{h_2 - h_3}{W}$.

$\left[\text{where } W = \text{work done} = \frac{n}{n-1}(p_1v_1 - p_2v_2)\right]$

9. In the case of radial conduction of heat in a circular cylinder of outside radius r_0 and inside radius r_i, the heat flux varies proportional to

(*a*) $\log_e \frac{r_0}{r_i}$

(*b*) $\frac{r_0}{r_i}$

(*c*) $\frac{r_i}{r_0}$

(*d*) $\log_e \frac{r_i}{r_0}$

(*e*) $\frac{1}{\log_e \frac{r_0}{r_i}}$.

10. The free convection heat transfer can be correlated by the dimensionless parameters — Grashof number N_{G_r}, Nusselt number N_{N_u} and Prandlt number N_{P_r}. The correct relationship shown in Fig. 2 is by curve

(*a*) *A* (*b*) *B*

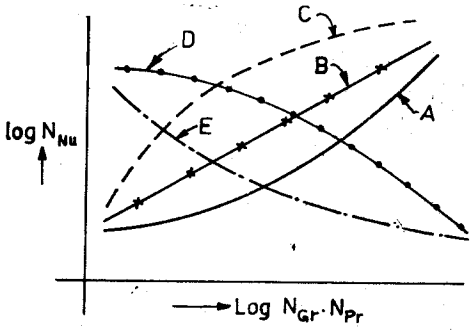


Fig. 2

(*c*) *C* (*d*) *D*

(*e*) *E*.

11. Radiation heat detecotrs measure radiant energy flux by either thermal detectors or by photo-delectors. Pick up false statement regarding these detectors

(*a*) a thermopile is a set of thermocouples connected in series

(*b*) bolometer is a sort of resistance thermometer

(*c*) photovotaic cells produce a voltage when they absorb incident radiation

(*d*) Golay cell is an extremely sensitive gas thermometer designed to respond to very small radiation fluxes

(*e*) photoemissive detectors depend upon the decrease in the electrical resistance of certain semiconductors when exposed to light.

12. The term work ratio is used in conjunction with

(*a*) gas turbines (*b*) I.C. engines

(*c*) steam turbines (*d*) refrigeration cycle

(*e*) carnot engine.

13. The principle of dimensional analysis applied to turbomachinery yields a considerable amount of information with a minimum of detailed knowledge. The most frequently used parameters are

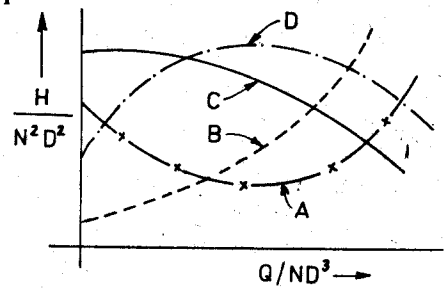


Fig. 3

capacity of flow parameter Q/ND^3
head parameter H/N^2D^2
power parameter $P/\rho N^3D^5$, and
viscosity parameter $\mu/\rho ND^2$

The correct curve in Fig. 3 is
(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) none.

14. For Q. 13 above, the correct curve in Fig. 4 is

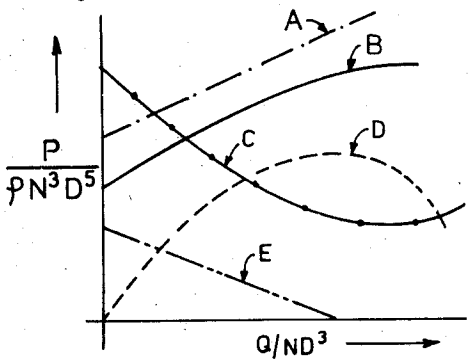


Fig. 4

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E*.

15. If Q be the overall machine flow rate and Q_L the leakage flow (fluid passing through the clearance space between rotor and casing without doing useful work), then the volumetric efficiency of pumps and turbines respectively will be

(*a*) $\eta_{v\,pump} = \dfrac{Q}{Q+Q_L}$, $\eta_{v\,turbine} = \dfrac{Q-Q_L}{Q}$

(*b*) $\eta_{v\,pump} = \dfrac{Q-Q_L}{Q}$, $\eta_{v\,turbine} = \dfrac{Q}{Q+Q_L}$

(*c*) $\eta_{v\,pump} = \dfrac{Q}{Q-Q_L}$, $\eta_{v\,turbine} = \dfrac{Q+Q_L}{Q}$

(*d*) $\eta_{v\,pump} = \dfrac{Q}{Q+Q_L} = \eta_{v\,turbine}$

(*e*) $\eta_{v\,pump} = \dfrac{Q-Q_L}{Q} = \eta_{v\,turbine}$

16. The polytropic efficiency for compression and expansion respectively for an ideal gas is

(*a*) $\eta_{pc} = \dfrac{n-1}{n} \cdot \dfrac{k}{k-1}$, $\eta_{pe} = \dfrac{n}{n-1} \cdot \dfrac{k-1}{k}$

(*b*) $\eta_{pc} = \dfrac{n}{n-1} \cdot \dfrac{k-1}{k}$, $\eta_{pe} = \dfrac{n-1}{n} \cdot \dfrac{k}{k-1}$

(*c*) $\eta_{pc} = \eta_{pe} = \dfrac{n-1}{n} \cdot \dfrac{k}{k-1}$

(*d*) $\eta_{pc} = \eta_{pe} = \dfrac{n}{n-1} \cdot \dfrac{k-1}{k}$

(*e*) $\eta_{pc} = \dfrac{n-1}{n} \cdot \dfrac{k-1}{k}$, $\eta_{pe} = \dfrac{n}{n-1} \cdot \dfrac{k}{k-1}$.

17. Fig. 5 shows the blade shape of a turbomachine. The maximum camber and chord respectively are represented by

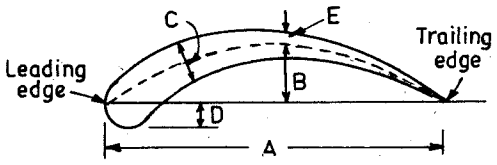


Fig. 5

(*a*) A, C (*b*) A, B
(*c*) B, A (*d*) A, D
(*e*) B, E.

18. Fig. 6 shows three curves *A*, *B* and *C* for relationship between specific energy transfer and the discharge for compressors. Curves *A*, *B*, and *C* respectively are valid for

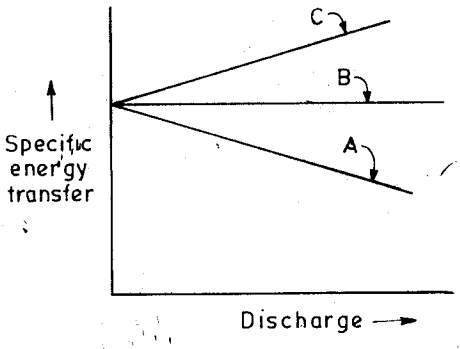


Fig. 6

(*a*) backward-curved vanes (BCV), radial vanes (RV), forward-curved vanes (FCV)
(*b*) FCV, RV, BCV (*c*) FCV, BCV, RV
(*d*) RV, BCV, FCV (*e*) BCV, FCV, RV.

19. The specific speed of pump and turbine respectively are given as

(*a*) $\dfrac{N\sqrt{P}}{H^{5/4}}, \dfrac{N\sqrt{Q}}{H^{3/4}}$ (*b*) $\dfrac{N\sqrt{Q}}{H^{3/4}}, \dfrac{N\sqrt{P}}{H^{5/4}}$

(*c*) $\dfrac{NQ^{3/2}}{H^{5/4}}, \dfrac{NR^{3/2}}{H^{3/4}}$ (*d*) $\dfrac{N\sqrt{P}}{H^{3/4}}, \dfrac{N\sqrt{Q}}{H^{5/4}}$

(*e*) $\dfrac{N\sqrt{Q}}{H^{5/4}}, \dfrac{N\sqrt{P}}{H^{3/4}}$.

20. Utilisation factor in steam turbines has significance for shaft power applications. Fig. 7 shows the relationship between utilisation factor versus $\frac{\text{blade speed}}{\text{nozzle velocity}}$ for steam turbines.

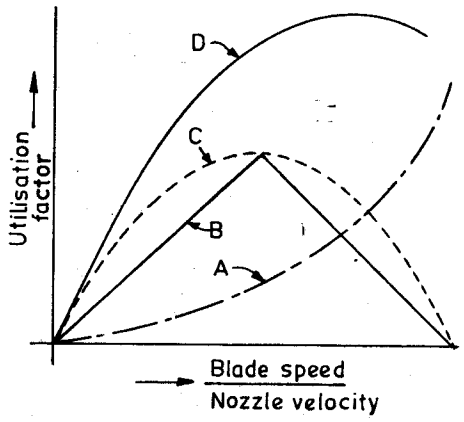


Fig. 7

The correct relationship is shown by the curve
(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) none of the above.

21. The energy levels of fast neutrons and thermal neutrons are of the order of
(*a*) 1000 electron-volt (eV), 1 eV
(*b*) millions of eV, 0.025 eV
(*c*) 1 eV, 0.01 eV
(*d*) 100 eV, 10 eV
(*e*) 10^9 eV, 10^4 eV.

22. The nuclides which are fissionable by neutrons of all energies (from fast neutrons to thermal neutrons) are called fissile nuclides. The following are fissile nuclides
(*a*) ^{235}U, ^{233}U, ^{239}Pu
(*b*) ^{232}Th, ^{238}U
(*c*) ^{235}U, ^{238}U
(*d*) ^{232}Th, ^{239}Pu
(*e*) all of the above.

23. Nuclides which undergo fission with fast neutrons alone and not with slow ones are called fissionable nuclides. Which of the following are fissionable nuclides
(*a*) ^{235}U, ^{233}U, ^{239}Pu
(*b*) ^{232}Th, ^{238}U
(*c*) ^{235}U, ^{238}U
(*d*) ^{232}Th, ^{239}Pu
(*e*) all of the above.

24. The ratio of the number of new fissionable atoms formed in a reactor to the number consumed is called the conversion ratio. A reactor is said to be converter or breeder depending on this conversion ratio to be less than or greater than a certain number. This number is
(*a*) 1 (*b*) 2.5
(*c*) 2.7 (*d*) 2.8
(*e*) 3.

25. A nuclear reactor is basically a furnace where the fissioning of atoms can be controlled and the heat put to useful work. Which of the following comes in contact with the reactor core uranium fuel
(*a*) moderator (*b*) shielding
(*c*) coolant (*d*) pressure vessel
(*e*) control rods.

26. The control system of a nuclear power reactor must provide a means of starting the reactor from a zero rate of fission to the rate corresponding to the desired power level, keeping this power production at a steady level, and shutting the reactor down under normal or emergency conditions. The control method used is
(*a*) addition and removal of fuel
(*b*) addition and removal of the reflector changing the neutron leakage from the reactor
(*c*) addition and removal of neutron-absorbing control rods, or the addition and removal of neutron-absorbing salts, such as boron to the coolant
(*d*) additional and removal of moderating materials
(*e*) all of the above.

27. Even after a nuclear reactor is shut down, the coolant is supplied for a considerable period of time. This is done with a view to
(*a*) cool the reactor
(*b*) purge the reactor
(*c*) remove the radioactivity present in the reactor
(*d*) remove heat produced by the absorption of gamma rays emitted by the radioactive materials in the core
(*e*) test the condition inside the reactor for leakage etc.

28. In pressurised water reactors, water acts as

(*a*) coolant (*b*) moderator
(*c*) shielding material
(*d*) both coolant and moderator
(*e*) control medium.

29. Fig. 8 shows the boiling characteristics as a function of heat flux and temperature difference between heating substance and liquid. The regions *AB, BC, CD,* and *DE* respectively represent

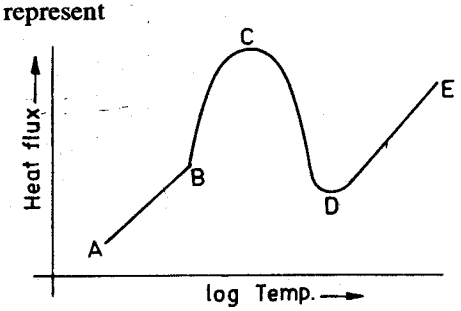


Fig. 8

(*a*) non-boiling (NB), bulk boiling (BB), local boiling (LB), and film boiling (FB)
(*b*) NB, FB, BB, LB
(*c*) NB, LB, BB, FB
(*d*) FB, NB, LB, BB
(*e*) NB, FB, LB, BB.

30. If v is the flight/jet speed ratio, then the propulsive efficiencies for jet engine and rocket respectively would be approximately equal to

(*a*) $\frac{2v}{1+v}, \frac{2v}{1+v^2}$ (*b*) $\frac{v}{1+v}, \frac{v}{1+v^2}$

(*c*) $\frac{2v}{1+v^2}, \frac{2v}{1+v}$ (*d*) $\frac{1}{1+v}, \frac{1}{1+v^2}$

(*e*) $\frac{1}{1+2v}, \frac{1}{1+2v^2}$.

31. The values of Mach numbers for various engines could be considered is

$M < 0.8,$
$0.8 < M < 2.0$
$0.9 < M < 4$
$3 < M < 11.$

These engines respectively are
(*a*) Ramjet, turbojet, turbofan, turboprop
(*b*) Turboprop, turbojet, turbofan, Ramjet
(*c*) Turbofan, turbojet, turboprop, Ramjet
(*d*) Turbofan, turboprop, turbojet, ramjet
(*e*) Turboprop, turbofan, turbojet, Ramjet.

32. Scramjet is
(*a*) liquid propellant rocket
(*b*) supersonic combustion ramjet
(*c*) solid propellent rocket
(*d*) suprsonic turbojet
(*e*) supersonic turbofan.

33. Covalent ionic molecular bonding is relevant to
(*a*) plastics (*b*) metals
(*c*) ceramics (*d*) all of the above
(*e*) none of the above.

34. Which of the following does not pertain to imperfections in metals
(*a*) dislocations
(*b*) vacancies
(*c*) foreign atoms
(*d*) electron compounds
(*e*) interstitials.

35. The large the size of a part, chances are that its fatigue strength would be
(*a*) larger
(*b*) lower
(*c*) may be larger or lower depending on so many factors
(*d*) more or less constant irrespective of size
(*e*) unpredictable.

36. Ammonia and its compounds tend to produce severe intergranular cracking in copper alloys. This phenomenon is usually called
(*a*) stress corrosion (*b*) corrosion fatigue
(*c*) stress corrosion cracking
(*d*) alkali cracking (*e*) season cracking.

37. Pick out the false statement about fatigue loading
(*a*) fatigue strength is defined as the stress at which failure will occur after some definite number of cycles
(*b*) the damaging influence of stress concentration is more marked in ductile materials than in brittle materials
(*c*) most often fatigue failures originate from cracks on the surface, and are due to tensile forces
(*d*) endurance strength is defined as the highest stress at which a material can withstand an infinite number of loading cycles
(*e*) the endurance strength of most materials is markedly increased by inducing compressive stresses by blasting the surface of material (shot peening).

38. Pick out the false statement regarding phases and constituents of iron and carbon
(*a*) alpha iron is the form of iron found at ordinary room temperature under conditions of equilibrium
(*b*) structure of ferrite is face centered cubic
(*c*) face-centered cubic form of iron is known as gamma iron or austenite
(*d*) pearlite exhibits mechanical properties between those of ferrite and cementite
(*e*) pearlite is a eutectoid constituent composed of alternate platelets of ferrite (88%) and cementite (12%).

39. Which point in the iron-iron carbide diagram shown is Fig. 9 represents eutectic reaction

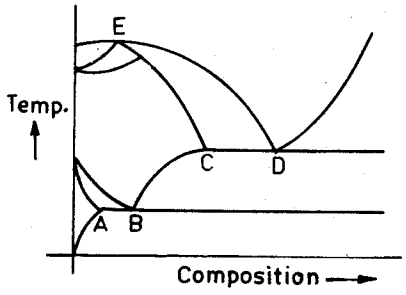


Fig. 9

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E*.

40. Curves *A*, *B*, and *C* in Fig. 10 could be representative of

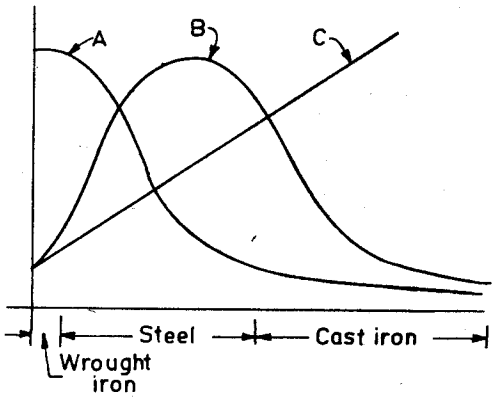


Fig. 10

(*a*) hardness, ductility, tensile strength
(*b*) thermal expansion, coefficient of friction, coefficient of elasticity
(*c*) tensile strength, compressive strength and hardness
(*d*) ductility, tensile strength, hardness
(*e*) tensile strength, ductility, hardness.

41. The microstructure of a cast iron is observed as large pearlite colonies and small pearlite colonies in cementite matrix. This cast iron could be
(*a*) white cast iron (*b*) malleable cast iron
(*c*) gray cast iron (*d*) ductile cast iron
(*e*) nodular cast iron.

42. The properties of a cast iron are found to be brittle, hard, machinable, and with good damping. This cast iron is
(*a*) white cast iron (*b*) malleable cast iron
(*c*) gray cast iron (*d*) ductile cast iron
(*e*) nodular cast iron.

43. Pick out the correct statement about cast irons
(*a*) the presence of silicon strongly retards the decomposition of cementite to graphite and ferrite
(*b*) the structure of white cast iron consists of graphite flakes throughout a matrix of entectoid or hypoeutectoid steel
(*c*) malleable cast irons are produced by prolonged heating of cast iron
(*d*) the cast iron that contains spheroidal graphite is known as gray cast iron
(*e*) the free graphite in malleable cast iron is in the form of flakes rather than nodules.

44. Fig. 11 shows an isothermal transformation diagram for eutectoid steel. The constituents available at *A*, *B*, *C* and *D* respectively are

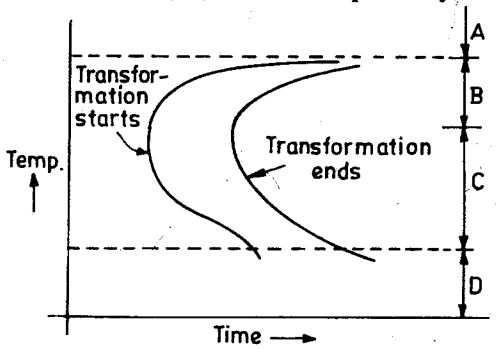


Fig. 11

(*a*) pearlite, austenite, martensite, bainite
(*b*) austenite, pearlite, martensite, bainite
(*c*) pearlite, austenite, bainite, martensite
(*d*) austenite, pearlite, bainite, martensite
(*e*) bainite, austenite, pearlite, martensite.

45. In a heat treatment process, a workpiece was heated close to, but below Ac_1 line for stress relief. The heat treatment process could be
(*a*) full anneal (*b*) process anneal
(*c*) normalising (*d*) shpheroidizing
(*e*) tempering.

46. The microstructure of a heat treated specimen was found to be consisting of Fe_3C spheres in a matrix of ferrite. It should have been subjected to following heat treatment
(*a*) full anneal (*b*) process anneal
(*c*) normalising (*d*) shpheroidizing
(*e*) tempering.

47. In which of the following process of surface hardening, no quenching is called for
(*a*) case carburising (*b*) cyaniding
(*c*) nitriding (*d*) flame hardening
(*e*) induction hardening.

48. Depending on the process of surface hardening, the time of heating could be of the order of 2 -3 sec to upto 75 hours. Which of the following process would call for heating of 2 - 3 sec
(*a*) case carburising (*b*) cyaniding
(*c*) nitriding (*d*) flame hardening
(*e*) induction hardening.

49. Curve *A* in Fig. 12 shows the maximum stress a material can withstand with increased number of stress reversal cycles for no corrosion condition. When corrosion is also present then curve *A* will change to curve

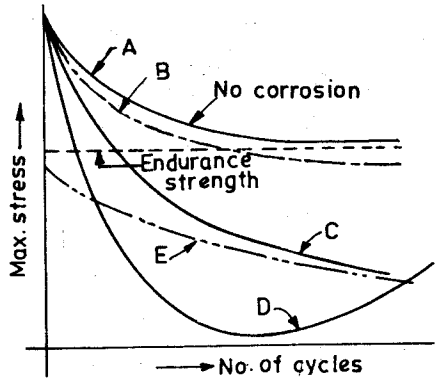


Fig. 12

(*a*) *B* (*b*) *C*
(*c*) *D* (*d*) *E*
(*e*) none of the above.

50. Calorising and sheradising are the surface teratment processes to improve the surface properties like scale resistance, corrosion resistance etc of steel. In these processes the steel part is placed at controlled environment conditions in the powder mixtures of
(*a*) chromium and aluminium respectively
(*b*) Zn and Si respectively
(*c*) Zn and Al respectively
(*d*) Si and Cr respectively
(*e*) Al and Zn respectively.

51. Maximum hardness is attained on the surface by following surface hardening process
(*a*) cyaniding (*b*) case carburising
(*c*) nitriding (*d*) flame hardening
(*e*) induction hardening.

52. Which of the following has excellent resistance to hydrochloric, sulphuric, and other acids
(*a*) constantan (*b*) permalloy
(*c*) monel metal
(*d*) Hastelloy-type alloy
(*e*) invar.

53. Which alloys are being referred to by following statement. "These have their density about 56% that of steel, and excellent corrosion resistance at room temperature, resembling that of platinum"
(*a*) magnesium alloys
(*b*) titanium alloys
(*c*) zirconium alloys
(*d*) nickel alloys
(*e*) lead and tin alloys.

54. Which alloys are being referred to by following statement. "Their low neutron cross section, 0.18 barns, and their resistance to corrosion, make them valueable for use in nuclear reactors"
(*a*) magnesium alloys
(*b*) titanium alloys
(*c*) zirconium alloys
(*d*) nickel alloys
(*e*) lead and tin alloys.

55. Nonmetallic materials used to withstand high temperatures are called refractories. Alumina brick is a
(*a*) silica refractory
(*b*) basic refractory
(*c*) neutral refractory
(*d*) special refractory

(*e*) none of the above.

56. Which of the following refractory material has highest melting temperature and excellent strength at high temperature
(*a*) alumina (*b*) dolomite
(*c*) quartz (*d*) zirconia
(*e*) magnesite.

57. Which of the following constituent is in maximum content in the composition of commercial glass
(*a*) Na_2O (*b*) CaO
(*c*) Al_2O_3 (*d*) SiO_2
(*e*) B_2O_3.

58. Ceramics are finding more and more use in electronics. Pick out false statement about characteristics of various electronic ceramics
(*a*) Cordierite has a very low thermal expansion and can be used where thermal shock is a problem
(*b*) Zircon is used where chemical attack may be expected
(*c*) Alumina has excellent dielectric properties and great strength
(*d*) Stealites are used where dry pressing is the only process economically feasible, but low absorptions and high strengths must be maintained
(*e*) Beryllia has poor dielectric strength but high thermal conductivity.

59. Plasticisers are generally
(*a*) liquids that impart flexibility, softness, and ease of processing to a resin
(*b*) materials used to prevent or minimise degradative effects induced by heat, ultraviolet light, ozone, etc.
(*c*) inert solids added to resin to enhance properties and/or to reduce the cost
(*d*) dyes used to enhance appeal
(*e*) release agents which aid the processing of plastics during milling, extrusion, calendering, etc.

60. Organic phosphate esters, halogenated hydrocarbons, antimony oxide, etc. are additives added to plastics, and these fall under category of
(*a*) plasticisers (*b*) stabilisers
(*c*) flame retardants (*d*) fillers
(*e*) colourants.

61. The following is a generic name for any long-chain polyamide, derived from the condensation of a diamine with a dicarboxylic acid
(*a*) nylon (*b*) polyimides
(*c*) acrylics (*d*) epoxy resins
(*e*) phenolics.

62. For a hollow shaft having outside diameter d_0 and inside diameter d_i, the maximum shear stress induced while transmitting a torque is proportional to
(*a*) d_0 (*b*) d_i
(*c*) $\frac{d_0 + d_i}{2}$ (*d*) $\frac{d_0 + d_i}{2}$
(*e*) $\sqrt{d_0 d_i}$.

63. The shaft stiffness (torsional deflection) is proportional to
(*a*) torque^2 (*d*) $\sqrt{\text{torque} \times \text{length}}$
(*b*) length^3 (*e*) modulus of rigidity.
(*c*) $\frac{1}{(\text{diameter})^4}$

64. Deflection of helical compression spring is proportional to
(*a*) mean diameter (*d*) $\frac{1}{(\text{Polar M.I.})^2}$
(*b*) $(\text{load})^2$
(*c*) number of coils (*e*) modulus of rigidity.

65. Deflection of leaf spring is proportional to
(*a*) $(\text{length})^3$ (*b*) load^2
(*c*) modulus of elasticity
(*d*) thickness^3 (*e*) $\frac{1}{\text{width}^2}$

66. In a typical Belleville spring, the highest stresses occur
(*a*) at top inner edge and bottom outer edge
(*b*) at bottom inner edge and top outer edge
(*c*) in the middle
(*d*) uniform throughout
(*e*) none of the above.

67. The curves *A*, *B* and *C* in Fig. 13 could be applicable respectively for the following prime movers
(*a*) Steam Turbine (ST), Gas Turbine (GT), Diesel Engine (DE)
(*b*) GT, DE, ST
(*c*) DE, GT, ST
(*d*) DE, SE, GT
(*e*) ST, DE, GT.

68. The cycle shown on *PV* diagram in Fig. 14 represents

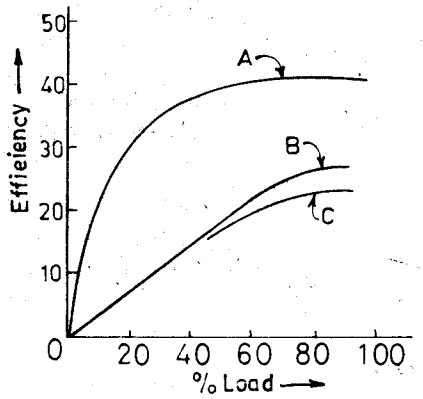


Fig. 13

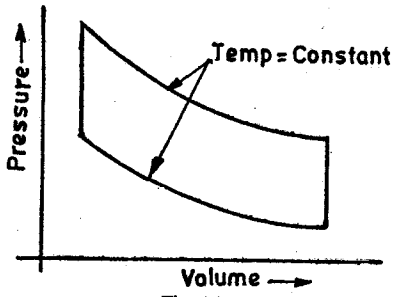


Fig. 14

(*a*) Carnot cycle (*b*) Otto cycle
(*c*) Diesel cycle (*d*) Brayton cycle
(*e*) Striling cycle.

69. For a suppressed weir, *i.e.* a weir so designed by rounding the edges that no contraction of the discharging sheet of liquid occurs, the flow is proportional to
(*a*) height of liquid level (H)
(*b*) $H^{3/2}$ (*c*) H^2
(*d*) $H^{3/4}$ (*e*) $H^{2/3}$.

70. For a trapezoidal channel, the critical depth is proportional to width of channel at water surface (b), and the total head (*i.e.* measured depth + velocity head), and if B is the width at bottom, then critical depth is inversely proportional to
(*a*) $b + B$ (*b*) $2b + B$
(*c*) $3b + B$ (*d*) $4b + B$
(*e*) $5b + B$.

71. Curves A to E in Fig. 15 represent various properties of hot-worked steels for different percentages of carbon upto 1.5%. These curves could respectively be for
(*a*) Charpy Impact (CI), Reduction in Area (RA), Yield, Strength (YS), Brinell Hardness (BH)

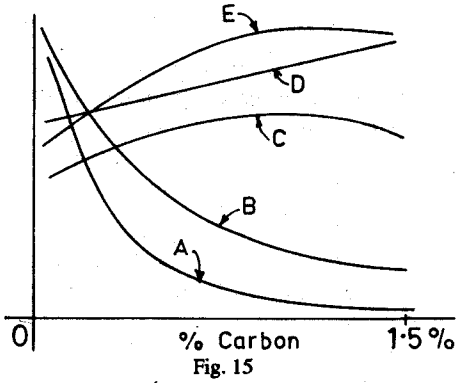


Fig. 15

(*b*) RA, CI, BH, TS, YS
(*c*) CI, RA, YS, TS, BH
(*d*) BH, YS, RA, CI, TS
(*e*) CI, RA, BH, TS, YS.

72. Fig. 16 shows the performance curves of three types of pumps. The curves A, B and C respectively could be for

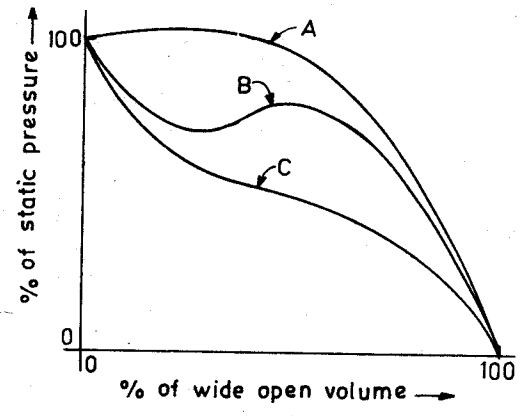


Fig. 16

(*a*) axial flow (AF), backward curved blade centrifugal (BC), and forward-blade centrifugal (FC)
(*b*) FC, AF, BC (*d*) AF, FC, BC
(*c*) BC, FC, AF (*e*) BC, AF, FC.

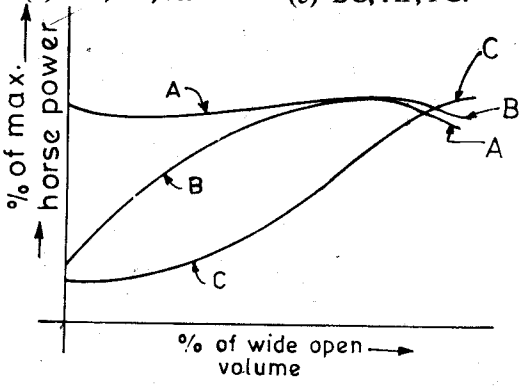


Fig. 17

73. Fig. 17 shows the performance curves of three type of fans. Curves *A,B* and *C* respectively are for

(*a*) axial flow (AF), backward curved blade centrifugal (BC), forward-blade centrifugal (FC)
(*b*) AF, FC, BC (*c*) BC, FC, AF
(*d*) FC, BC, AF (*e*) BC, AF, FC.

74. Fig. 18 (*a*) shows simple beam with uniformly distributed load at one end only. The correct

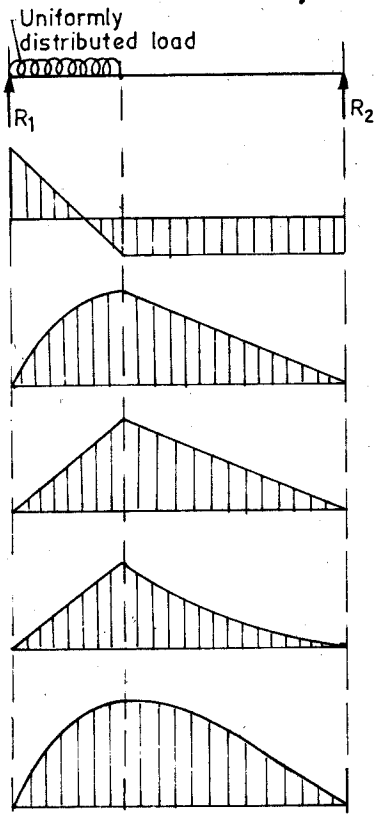


Fig. 18

bending moment diagram for this is as per following part of Fig. 18

(*a*) (*B*) (*b*) (*C*)
(*c*) (*D*) (*d*) (*E*)
(*e*) (*F*).

75. For Fig. 19 the maximum shear, moment, and deflection are proportional to

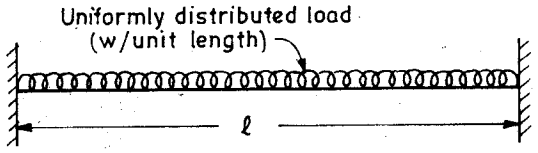


Fig. 19

(*a*) l, l^2, l^3 (*b*) l, l^2, l^4
(*c*) l^2, l^3, l^4 (*d*) l, l^4, l^2
(*e*) l, l^2, l^5.

76. For Fig. 20, the moment of inertia relationship of three sections is as under

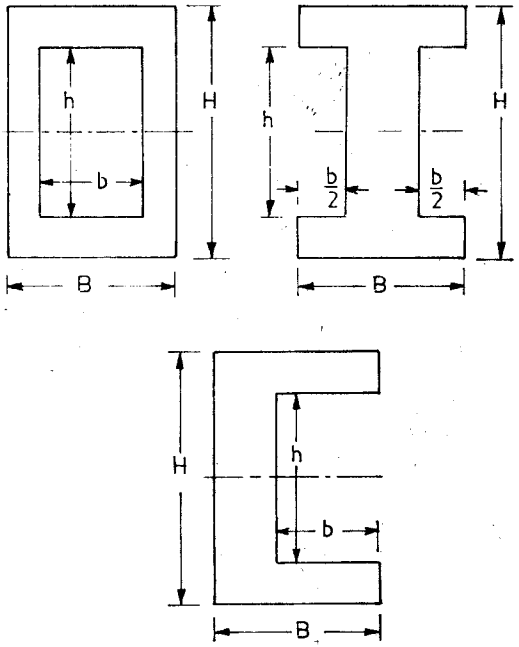


Fig. 20

(*a*) $X > Y > Z$ (*b*) $X < Y < Z$
(*c*) $X < Y > Z$ (*d*) $X > Y < Z$
(*e*) $X = Y = Z$.

77. The radius of gyration of four triangles shown in Fig. 21 are in the following order

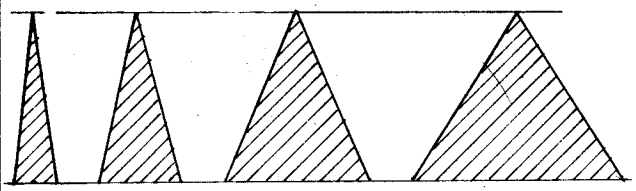


Fig. 21

(*a*) $A > B > C > D$ (*b*) $A < B < C < D$
(*c*) $A > B < C > D$ (*d*) $A < B > C < D$
(*e*) $A = B = C = D$.

78. The radius of gyration of ring shown in Fig. 22 about *XX*-axis is proportional to

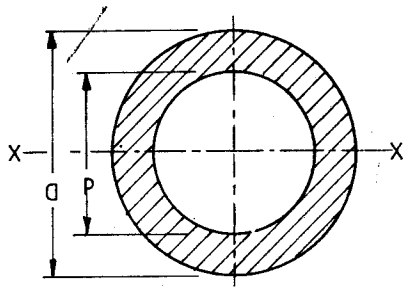


Fig. 22

(*a*) D (*b*) d
(*c*) $\sqrt{D^2 + d^2}$ (*d*) $\sqrt{D^2 - d^2}$
(*e*) $D + d$.

79. In a fluidised bed the fuel together with inert material (sand, silica, alumina, or ash from the fuel) are kept suspended in the lower section of a combustion chamber through the action of fluidised air distributed below the bed. Pick out false statement about fluidised bed boilers
(*a*) fluidisation promotes the turbulent mixing conditions required for good combustion
(*b*) there is less volatilisation of alkali compounds and thus less deposits on boiler-tube surfaces
(*c*) the low combustion temperatures prevent vitrification of the ash particles, causing them to be less abrasive than ash from stokers or pulverised coal fired units
(*d*) SO_2 and NO_x emissions can be controlled within the combustion chamber
(*e*) it requires fuel with low ash content and low moisture content and high calorific value.

80. If δ is the static deflection of a spring caused by a weight W, then its natural frequency is proportional to
(*a*) δ (*b*) $1/\delta$
(*c*) $\sqrt{\delta}$ (*d*) $1/\sqrt{\delta}$
(*e*) $1/\delta^2$.

81. If the polar moment of inertia of a disk is increased 4 times then the period of its torsional vibration will
(*a*) increase 4 times
(*b*) decrease 4 times
(*c*) increase 2 times
(*d*) decrease 2 times
(*e*) none of the above.

82. If the stresses in a thin wall cylinder are to be same, then increasing pressure twice would call for increasing thickness
(*a*) 2 times (*b*) 4 times
(*c*) $\sqrt{2}$ times (*d*) $1/\sqrt{2}$ times
(*e*) 1.5 times.

83. If the length of a long column is increased twice, then for same stresses, its rectangular moment of inertia should be
(*a*) increased 2 times
(*b*) increased 4 times
(*c*) increased $\sqrt{2}$ times
(*d*) increased 8 times
(*e*) reduced 2 times.

84. A solid circular bar of diameter D has a small transverse hole of diameter d (Fig. 23). The stress concentration factor for torsion of shaft will vary as per following curve in Fig. 24

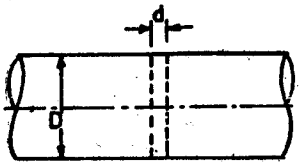


Fig. 23

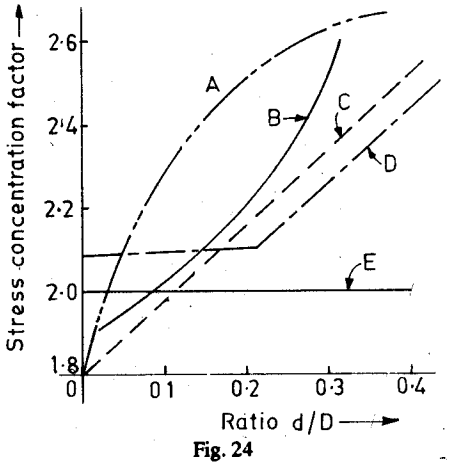


Fig. 24

(*a*) *A*
(*b*) *B*
(*c*) *C*
(*d*) *D*
(*e*) *E*.

85. In problem 84, if same bar is subjected to bending, the stress concentration factor will vary as per curve shown in Fig. 25
(*a*) *A*
(*b*) *B*

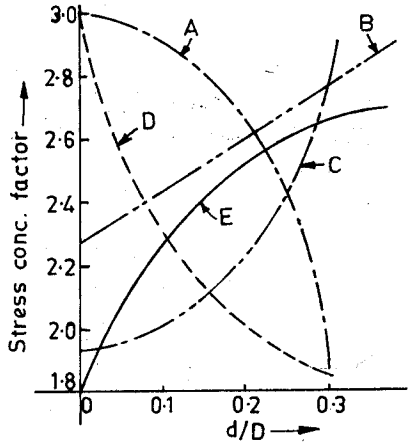


Fig. 25

(*c*) *C* (*d*) *D*
(*e*) *E.*

86. In problem 84, if same bar is subjected to tension, then stress concentration factor will vary as per curve in Fig. 26

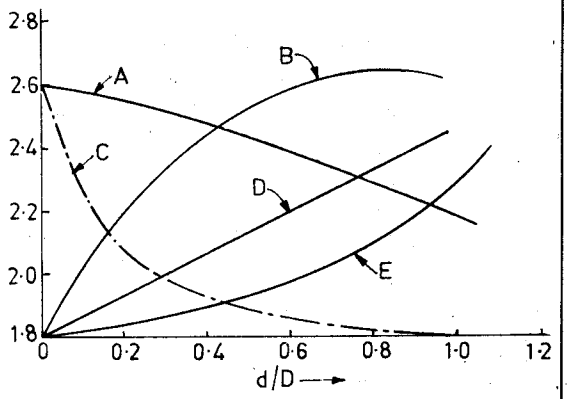


Fig. 26

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E.*

87. Fig. 27 shows the relationship of coefficient of friction with change in parameter *ZN/P* for fluid film bearings. The various zones of importance are boundary lubrication, general zone of whirl instability and turbulence, mixed lubrication, and full fluid-film lubrication. These zones are represented in Fig. 27 by

(*a*) *A, B, C, D*
(*b*) *A, C, B, D*
(*c*) *A, D, B, C*
(*d*) *A, D, C, B*

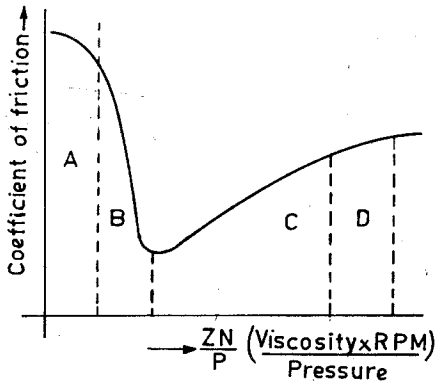


Fig. 27

(*e*) *B, A, D, C.*

88. The Wahl correction factor for a helical spring is $\frac{4C-1}{4C-4}+\frac{0.615}{C}$.

It is represented by following curve in Fig. 28

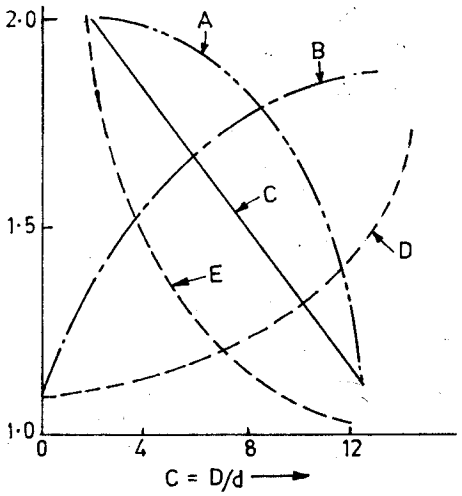


Fig. 28

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E.*

89. Pick out wrong relationship for pump laws

(*a*) Q (flow) $\propto N$ (speed), D (impeller diameter) = constant
(*b*) H (head) $\propto N^2 (D = C)$
(*c*) shaft horse power $\propto N^3$ $(D = C)$
(*d*) $Q \propto D^3$ (N= constant)
(*e*) $H \propto D^4$ (N = constant).

90. Fuel cells convert chemical energy directly into electrical energy. They differ from a dry

cell in following respects. Pick out false statement
(*a*) reactants and reaction products are supplied to remove from the cell but remain intact in dry cell
(*b*) cost per kilowatt is relatively independent of output in fuel cell but not so in case of dry cell
(*c*) a fuel cell can run in reverse but dry cell can't
(*d*) fuel cell could be a device for energy storage but dry cell can't
(*e*) in fuel cell, a chemical reaction produces electrons (oxidation) occurring at one electrode and the reaction that consumes electrons (reduction) occurring at other, but same is not the case in dry cell.

91. DHRUVA in context of Indian Technology is concerned with
(*a*) space research (*b*) oceanography
(*c*) non-conventional energy sources
(*d*) atomic energy
(*e*) information and communication.

92. India depends on following fuel for its nuclear energy programme
(*a*) uranium (*b*) thorium
(*c*) plutonium (*d*) iridium-192
(*e*) molybdenum-99.

93. The advantage of plutonium as fissile fuel is
(*a*) high breeding ratio
(*b*) high fast fusion cross section
(*c*) higher energy release and lower xenon poisoning
(*d*) its ability for high fissibility in both thermal and fast neutron range apart from its reactor adaptability
(*e*) all of the above.

94. Ytterbium, thullium, holmium, dysporosium, erbium are the elements used in alloys for
(*a*) superconducting materials
(*b*) nuclear fuels
(*c*) semiconductors
(*d*) computers
(*e*) radio isotopes.

95. Optical fibres can carry upto ____ times more information than a copper wire of the same diameter
(*a*) 100 (*b*) 1000
(*c*) 10,000 (*d*) 10^9
(*e*) 10^{12}.

96. "Pyroloy 1000" developed at National Metallurgical Laboratory, Jamshedpur is a
(*a*) superconductor material
(*b*) composite for aerospace
(*c*) an alloy to be used as nuclear fuel
(*d*) a heat resistant iron alloy which can replace other costly heat resistant materials in high temperature applications
(*e*) highly abrasion resistant material.

97. Solar cells have been made from
(*a*) flat metalic blue chips made of highly pure silicon
(*b*) polycrystalline silicon wafers
(*c*) amorphous silicons films
(*d*) monocrystalline wafer of high purity silicon
(*e*) all of the above.

98. Direct conversion of thermal energy into electrical energy is possible by
(*a*) photo-voltaic cells
(*b*) biomass techniques
(*c*) biogas technology
(*d*) magneto hydro dynamics technology
(*e*) all of the above.

99. Follow boards in foundries are used
(*a*) to support irregularly shaped patterns which require an irregular parting line between cope and drag
(*b*) when the cope and drag portions of the patterns are mounted on opposite sides of a wooden plate
(*c*) to support sand on moulding boxes
(*d*) when gating system along with the pattern are to be used to eliminate hand cutting
(*e*) when the cope and drag portions of the pattern have to be mounted on separate plates.

100. Draft in pattern making refers to
(*a*) shrinkage allowance
(*b*) machine finish allowance
(*c*) distortion allowance
(*d*) the taper on the vertical walls of the casting
(*e*) corrections for the characteristics of the metal cast.

101. Carbon dioxide process moulds

(*a*) require baking at above 100°C
(*b*) require baking at temperature near melting point of metal
(*c*) require baking at 10–20°C above atmospheric temperature
(*d*) require no baking
(*e*) require baking only on outer surfaces.

102. The accurate casting of highly alloyed steels and of non-ferrous alloys which are impossible to forge and difficult to machine is possible with
(*a*) shell moulding
(*b*) die casting
(*c*) lost-wax casting process
(*d*) slush casting
(*e*) de Lavaud process.

103. In which of the following process the cast metal is allowed partially to solidify next to the mould walls to produce a thin-walled hollow casting when the excess metal is poured out of the permanent mould
(*a*) semi-permanent casting method
(*b*) slush casting (*c*) investment casting
(*d*) pressure casting (*e*) shell moulding.

104. If d is the diameter and h the height of drawn shell, then the approximate diameter of blank for shell is
(*a*) $\sqrt{d^2 + 2dh}$ (*b*) $d + 4dh$
(*c*) $\sqrt{d^2 + 4dh}$ (*d*) $\sqrt{d^2 + dh}$
(*e*) $\sqrt{d^2 + 6dh}$.

105. The wears shown at zone A and B in tool shown in Fig. 29 are called

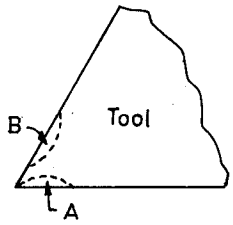


Fig. 29

(*a*) localised wear, flank wear
(*b*) flank wear, crater wear
(*c*) crater wear, flank wear
(*d*) chipping of edge, crater wear
(*e*) concentrated wear, uniform abrasive wear.

106. Cobalt in high-speed steels is used to
(*a*) increase hot hardness
(*b*) increase wear resistance and toughness
(*c*) abrasion resistance
(*d*) as strong carbide-forming element
(*e*) all of the above.

107. Angles α and β of cutting tool shown in Fig. 30 are called

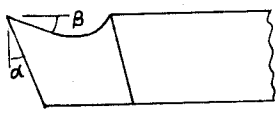


Fig. 30

(*a*) end relief, back rake
(*b*) end relief, side rake
(*c*) side relief, top rake
(*d*) end cutting edge angle, back rake
(*e*) side rake, back rake.

108. A grinding wheel is designated as

51—A—36—L—5—V—23.

Here L stands for
(*a*) abrasive type (*b*) grade
(*c*) grain size (*d*) structure
(*e*) bond type.

109. Fig. 31 shows the deformation characteristics of some fluids. The ideal fluid, newtonean fluid and non-newtonean fluids respectively are represented by curves

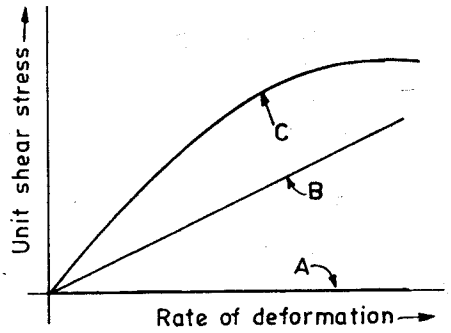


Fig. 31

(*a*) *A, B, C* (*b*) *C, B, A*
(*c*) *C, A, B* (*d*) *A, C, B*
(*e*) *B, A, C.*

110. Fig. 32 shows the capilarity action of various fluids in circular glass tubes. For mercury, tap water, distilled water at lower temperature, and distilled water at higher temperature, the applicable curves are
(*a*) A, B, C, D
(*b*) A, B, D, C

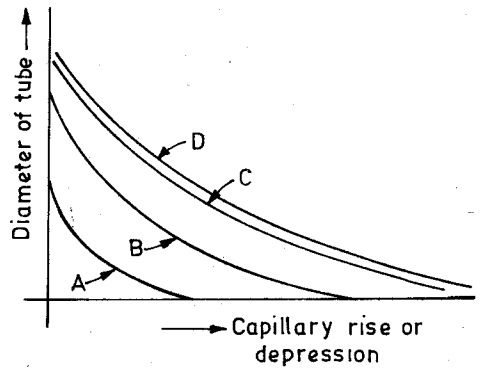


Fig. 32

(*c*) A, C, B, D
(*d*) A, D, B, C
(*e*) D, C, B, A.

111. Weirs are used to measure the flow of liquids in open channels or in conduits which do not flow full. Pick up wrong statement in connection with weirs
(*a*) the sheet of liquid flowing over the weir crest is called the nappe
(*b*) trapezoidal notch, which when designed with end slopes one horizontal to four vertical is called cipolletti weir
(*c*) hyperbolic weir is designed to give a constant coefficient of discharge
(*d*) parabolic weir is designed to give a linear relationship of head to flow
(*e*) when the width of the approach channel is equal to the crest length of weir, it is called contracted weir.

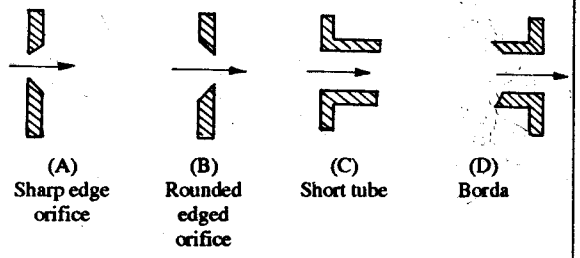


Fig. 33

112. Fig. 33 shows various types of orifices. The minimum coefficient of velocity, minimum coefficient of contraction, and maximum coefficient of discharge occur for
(*a*) *B, D, C* (*b*) *A, C, D*
(*c*) *B, C, D* (*d*) *C, D, B*
(*e*) *C, C, B.*

113. Fig. 34 shows three flat plates with holes, semicircular grooves, and fillets. When these are loaded in tension/compression, the stress concentration factors applicable for them will be as per following curves in the Fig. 35

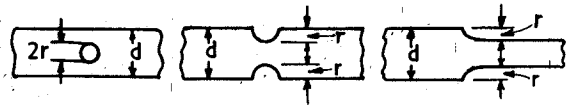


Fig. 34

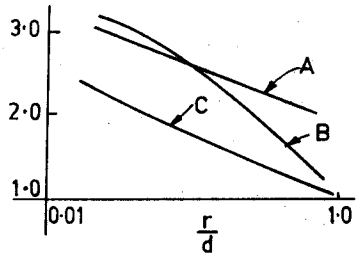


Fig. 35

(*a*) *A, B, C* (*b*) *C, B, A*
(*c*) *A, C, B* (*d*) *B, A, C*
(*e*) *B, C, A.*

114. Fig. 36 shows the relationships of various hardness scales w.r.t. Brinell number. The Vickers, Rockwell B, Rockwell C, and Scleroscope scales are represented by

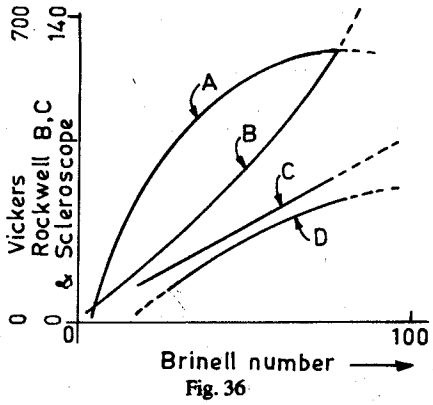


Fig. 36

(*a*) *A, B, C, D* (*b*) *D, C, B, A*
(*c*) *B, A, D, C* (*d*) *B, A, C, D*
(*e*) *D, C, A, B.*

115. Fig. 37 shows various curves for effect of cold working of plain carbon steel by drafting through a wire-drawing die. The correct curves for change in tensile strength and

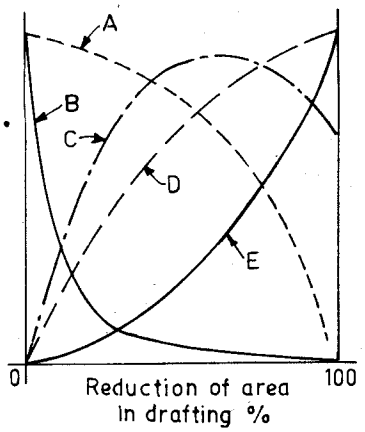


Fig. 37

change in elongation with reduction in area will be represented by curves

(*a*) *D, A* (*b*) *B, D*
(*c*) *E, D* (*d*) *B, E*
(*e*) *E, B.*

116. Fig. 38 shows the stress-temperature application ranges for various alloy types (*viz.* nickel and cobalt superalloys, aluminium alloys, steels, molybdenum alloys, titanium alloys). The correct curves for these alloys in order are represented by

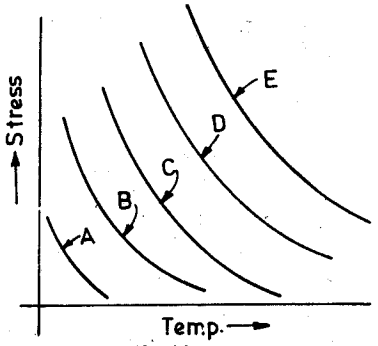


Fig. 38

(*a*) *D, A, B, C, E* (*b*) *E, A, C, B, D*
(*c*) *D, A, C, E, B* (*d*) *B, A, C, D, E*
(*e*) *C, A, D, E, B.*

117. In machining operation, the chips consisting of regions of large and small strain (obtained with low thermal conductivity metals) are called

(*a*) continuous chips
(*b*) discontinuous chips
(*c*) homogeneous chips
(*d*) inhomogeneous chips
(*e*) built-up edge chips.

118. Excellent crater resistance and abrasion resistance in machining is displayed by

(*a*) high speed steel tools
(*b*) cast alloy tools
(*c*) carbide tools
(*d*) ceramic tools
(*e*) all of the above.

119. Arrange the following processes in increasing order of production of smoother texture

(*A*) sawing, (*B*) honing, (*C*) electrolytic grinding, (*D*) electron beam machining, (*E*) chemical milling.

(*a*) *A, E, D, C, B* (*b*) *A, D, E, B, C*
(*c*) *E, A, D, C, B* (*d*) *E, D, A, B, C*
(*e*) *A, E, D, B, C.*

120. Fig. 39 shows the load carrying capacity of journal bearings as related to the surface roughness of the shaft

The correct relationship is as per curve

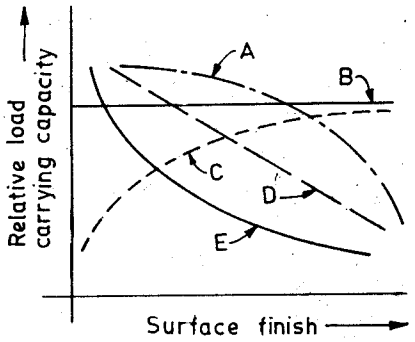


Fig. 39

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E.*

121. Pick out the correct definition and purpose of 'Static Load Rating' used in connection with bearings with rolling contact

(*a*) static load rating corresponds to a total permanent deformation of rolling element and race at the most heavily stressed contact of 0.0001 of the rolling element diameter. This is used as a check to determine if permanent deformation of rolling elements will occur
(*b*) static load rating is the radial load that a ball bearing can withstand for 1 millions revolutions of the inner ring. It is used to determine bearing life for all speeds and load conditions

(*c*) it is the constant stationary radial load which, if applied to a bearing with rotating inner ring and stationary outer ring, would give the same life as that which the bearing will attain under the actual conditions of load and rotation
(*d*) it is the static radial load, if applied, would cause the same total permanent deformation as the most heaviiy stressed ball and race contact as that which occurs under actual conditions of loading
(*e*) none of the above.

122. Pick out false statement about spark advance in automotive engines
(*a*) maximum power air-fuel ratios require the minimum spark advance
(*b*) low speed engines require 10–20° (crank travel) spark advance
(*c*) High-speed automotive engines require 30–40° spark advance
(*d*) racing engines require less spark advance
(*e*) spark advance is controlled automatically by engine speed and manifold vacuum, being more with independent increase in both of these parameters.

123. The percentage of CO in exhaust of engine is a function of the air-fuel ratio. The correct relationship is as per following curve in Fig. 40

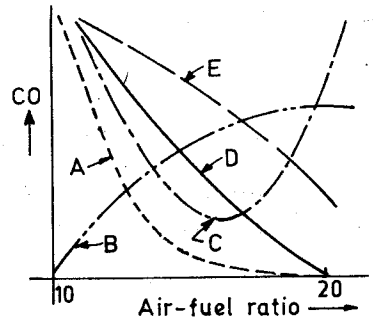


Fig. 40

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E*.

124. In electric-discharge machining (EDM) process, the dielectric fluid is usually
(*a*) water (*b*) air
(*c*) vacuum (*d*) hydrocarbon
(*e*) heavy water.

125. In which of the following process the electrolyte is pumped at high velocities through the tool
(*a*) electric-discharge machining
(*b*) electrochemical machining
(*c*) electric-discharge machining
(*d*) ultrasonic machining
(*e*) abrasive-jet machining.

126. In collar bearing shown in Fig. 41, the torque of friction about axis of shaft is proportional to

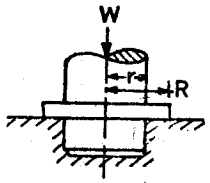


Fig. 41

(*a*) $R - r$ (*b*) $R^2 - r^2$
(*c*) $R^3 - r^3$ (*d*) $\frac{R^3 - r^3}{R^2 - r^2}$
(*e*) $\frac{R^2 - r^2}{R^3 - r^3}$.

127. Resilience is the strain energy which may be recovered from a deformed body when the load causing the stress is removed. Arrange following materials in decreasing order of modulus or resilience

gray cast iron (CI), wrought iron (WI), vanadium steel (VS), high-carbon steel (CS)
(*a*) VS, CS, WI, CI (*b*) VS, WI, CS, CI
(*c*) CI, CS, WI, VS (*d*) CI, WI, CS, VS
(*e*) WI, CS, VS, CI.

128. Fig. 42 shows the shear diagram and moment diagram for a beam. This is possible with
(*a*) fixed beam–concentrated load at centre

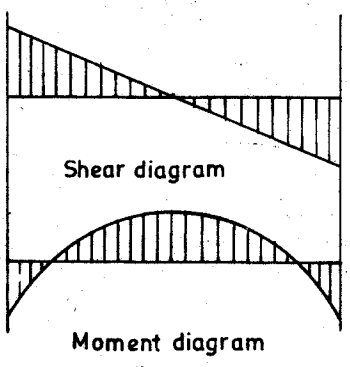


Fig. 42

(*b*) simple beam–load increasing uniformly from supports to centre of span
(*c*) simple beam–load increasing uniformly from one support to the other
(*d*) fixed beam–uniform load
(*e*) cantilever beam–uniform load.

129. For a simple beam (loaded at centre of span) to be of uniform strength when depth is constant, the width must vary as shown in Fig. 43

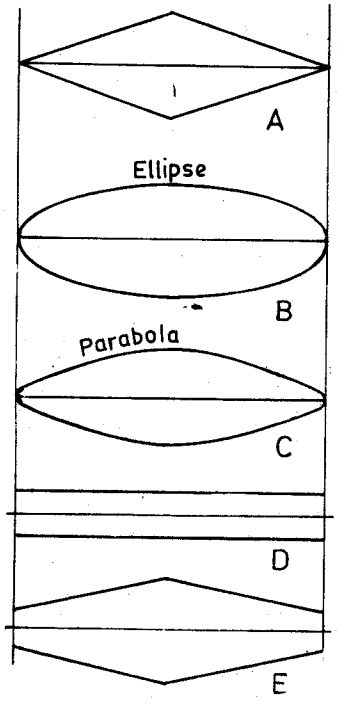


Fig. 43

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E*.

130. The process of forming intermetallic compounds of iron and zinc on the surface of ferrous articles by heating them in the presence of finely divided zinc below its melting point is known as
(*a*) galvanising (*b*) metallising
(*c*) sheradizing (*d*) anodizing
(*e*) parkerizing.

131. The method of strengthening steel by relatively low-temperature heat treatments that form submicroscopic "phase" in steel is known as
(*a*) carburisation
(*b*) age hardening
(*c*) spheroidise annealing
(*d*) pack hardening
(*e*) chronology.

132. Consumable pattern for sand casting consists of
(*a*) wax (*b*) palster of paris
(*c*) aluminium foil (*d*) polystyrene
(*e*) frozen mercury.

133. Foundry facing is used to
(*a*) prevent two parts from sticking together
(*b*) impart binding property
(*c*) give a smooth surface
(*d*) increase life of pattern
(*e*) provide support to mould surface.

134. Small, thin pieces of tin-plated steel for supporting cores or other parts of a mould to prevent sagging or to maintain a particular pour space are called
(*a*) chaplets (*b*) clamps
(*c*) draw spikes (*d*) trowels
(*e*) slicks.

135. The operation of thinning of the walls of deep-drawn articles by reducing the clearance between the punch and the die to less than the thickness of the metal is known as
(*a*) trimming (*b*) shaving
(*c*) notching (*d*) swaging
(*e*) ironing.

136. The operation of drawing or shearing of the irregular edge of the drawn part is called
(*a*) trimming (*b*) slitting
(*c*) slotting (*d*) stamping
(*e*) parting.

137. Which of the following is added to act as bonding agent in making tungsten carbide tools by powder metallurgy
(*a*) zinc stearate (*b*) graphite
(*c*) cobalt (*d*) aluminium powder
(*e*) zirconium.

138. Stellite tool material can cut metals at red heat. It contains following content of ferrous
(*a*) 90% (*b*) 75%
(*c*) 50% (*d*) 10%
(*e*) 0%.

139. Ceramics tools are sintered or hot-pressed from aggregates which are basically
(*a*) tungsten carbide

(*b*) cobalt, chromium and tungsten
(*c*) silicon carbide
(*d*) aluminium oxide
(*e*) diamond dust.

140. Trepanning is the operation of producing
(*a*) a hole by cutting the circumference directly
(*b*) a hole by working a flat sheet into a cylindrical form
(*c*) finished large hole by slow-moving abrasive stones
(*d*) enlarged entrance of a hole on a taper for a short distance
(*e*) finished surface around the area of a screw.

141. Tick the odd one out
(*a*) combination set (*b*) bevel protractor
(*c*) sine bar (*d*) straight edge
(*e*) dividing head.

142. Which of the following is not direct reading type measuring instrument
(*a*) telescoping gauge
(*b*) micrometer
(*c*) bevel protractor
(*d*) dial gauge
(*e*) veriner caliper.

143. Which of the following is not concerned with plane surface measurement
(*a*) straight edge (*b*) surface gauge
(*c*) profilometer (*d*) optical flat
(*e*) combination set.

144. In which process the work is melted and vaporised by intense monochromatic light
(*a*) plasma arc machines
(*b*) ultrasonic machining
(*c*) laser-beam machining
(*d*) electrochemical machining
(*e*) high velocity forming.

145. Pick up false statement about various elements of drill
(*a*) a drill cuts only at the lip
(*b*) the dead centre does no cutting, it merely rubs on the work, creating friction, heat and inaccuracy
(*c*) flute is provided for the purpose of ejecting chips and most drills have three flutes
(*d*) the margin supports the drill in the hole and helps to guide it
(*e*) body clearance gives strength to the drill.

146. The commonly used values of lip clearance angle, point angle, chisel-edge angle, and rake (helix) angle respectively on a twist drill are
(*a*) 8–12°, 59°, 120–135°, 30°
(*b*) 30°, 8–12°, 59°, 120–135°
(*c*) 8–12°, 59°, 30°, 120–135°
(*d*) 30°, 120–135°, 59°, 8–12°
(*e*) 30°, 59°, 120–135°, 8–12°.

147. Which bond on grinding wheels is suitable for high stcok-removal rate at high speeds, keeping the wheel cool
(*a*) resinoid (*b*) rubber
(*c*) shellac (*d*) silicate
(*e*) vitrified.

148. Which of the following gear is equivalent to a right-hand and a left-hand helical gear placed side by side
(*a*) hypoid (*b*) spiroid
(*c*) herringbone (*d*) differential
(*e*) worm.

149. An automatic machine that indexes or transfers the workpiece and its fixtues from station to stone while many operations are performed on it is called
(*a*) machining centre
(*b*) swiss-type automatic screw machine
(*c*) multi spindle automatic
(*d*) transfer machine
(*e*) flexible manufacturing system.

150. The reduction in size of gear reducer unit is possible by
(*a*) use of full hardened and ground gears
(*b*) use of forced lubrication
(*c*) using gears of smaller size
(*d*) use of ball and roller bearings in place of sleeve bearings
(*e*) use of light weight gears of aluminium or reinforced plastic material.

151. Pick up false statement about helical gears
(*a*) helical gears are used when both high speed and high horsepower are required
(*b*) large helix angles (30–45°) impose high thrust loads on bearings when single helicals are used
(*c*) large helix angles increase gear back lash unless precisely cut and installed
(*d*) large helix angels decrease weight

(*e*) smaller helix angles (below 30°) may increase gear wear slightly but improve backlash tolerance and give lower bearing loads.

152. In the differential pulley shown in Fig. 44 using chain engaging sprockets to prevent the slipping of chain on pulley faces, force P to lift weight W is proportional to

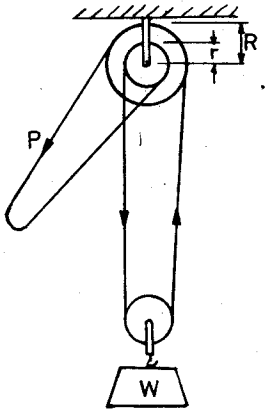


Fig. 44

(*a*) R (*b*) r

(*c*) $R-r$ (*d*) $\frac{R-r}{R}$

(*e*) $\frac{R-r}{r}$.

153. In Fig. 45, the force F to lift weight W is proportional to

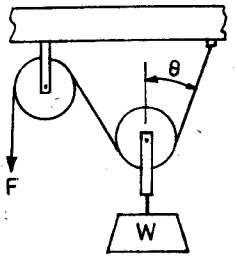


Fig. 45

(*a*) W (*b*) $W/2$

(*c*) $W/2 \sec\theta$ (*d*) $W/2 \cos\theta$

(*e*) $2W \sec\theta$.

154. If the radius and weight of a flywheel are doubled, then to keep the centrifugal forces same, its speed must be

(*a*) halved

(*b*) reduced to one fourth

(*c*) kept same

(*d*) made one-eighth

(*e*) reduced to one third.

155. If a concentrated load carried by a shaft supported in bearings at ends is increased 4 times, the critical speed of shaft will

(*a*) remain same

(*b*) increase two times

(*c*) decrease two times

(*d*) increase four times

(*e*) decrease four times.

156. If pressure and diameter of a spherical shell are doubled, then its thickness

(*a*) should be doubled

(*b*) increased three times

(*c*) increased 4 times

(*d*) increased 6 times

(*e*) increased 8 times.

157. For transmitting the same power by a shaft at half the speed, is diameter should be

(*a*) halved

(*b*) made one fourth of original

(*c*) made $\sqrt[3]{2}$ of original

(*d*) made $\sqrt[3]{0.5}$ of original

(*e*) made $\sqrt[4]{0.5}$ of original.

158. The power transmitting capacity of a shaft of diameter (D) is proportional to

(*a*) D (*b*) D^2

(*c*) D^3 (*d*) $D^{3/2}$

(*e*) D^4.

159. For a solid circular shaft of diameter 'D', the torsional deflection is proportional to

(*a*) $\frac{1}{D}$ (*b*) $\frac{1}{D^2}$

(*c*) $\frac{1}{D^3}$ (*d*) $\frac{1}{D^4}$

(*e*) $\frac{1}{D^6}$.

160. Increasing the thickness of a leaf spring would increase the safe load and decrease the deflection. If thickness is doubled, the corresponding change in safe load and deflection are

(*a*) 4, $\frac{1}{8}$ times (*b*) 2, $\frac{1}{4}$ times

(*c*) 2, $\frac{1}{8}$ times (*d*) 4, $\frac{1}{4}$ times

(*e*) 4, $\frac{1}{2}$ times.

161. The permissible torsional stresses allowed in compression springs are function of the wire

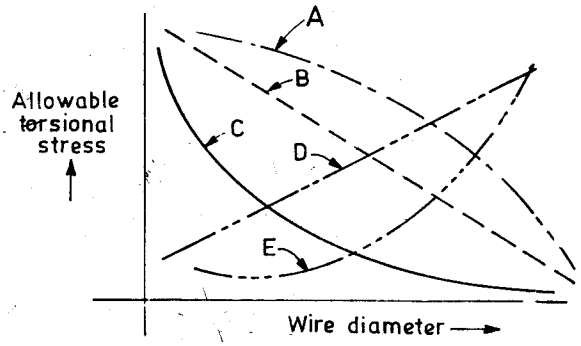


Fig. 46

diameter. The following curve of Fig. 46 is applicable for this purpose

(*a*) *A* (*b*) *B*
(*c*) *C* (*d*) *D*
(*e*) *E*.

162. If L_1 = known rating life of a bearing for a given load F_1, and L_2 = required life for load F_2, then the relationship of L_2/L_1 for ball bearings and roller bearings respectively will be

(*a*) $F_1/F_2, \sqrt{F_1/F_2}$
(*b*) $(F_1/F_2)^2, (F_1/F_2)^3$
(*c*) $(F_1/F_2)^{10/3}, (F_1/F_2)^3$
(*d*) $(F_1/F_2)^2, (F_1/F_2)^{10/3}$
(*e*) $(F_1/F_2)^3, (F_1/F_2)^{10/3}$.

163. The differential band brake shown in Fig. 47, will work automatically (F = 0 or -ve) when

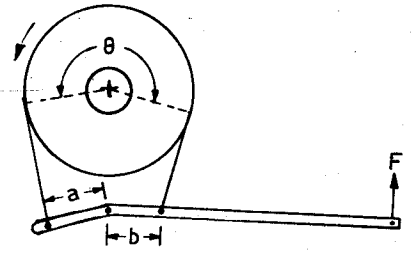


Fig. 47

(*a*) $a = b$ (*b*) $a < b$
(*c*) $a = b \cdot e^{\mu\theta}$ (*d*) $a < be^{\mu\theta}$
(*e*) $a \leq b \cdot e^{\mu\theta}$.

164. As the lead or helix-angle of worm gearing, and the pitch-line velocity increase, the efficiency of worm-gearing

(*a*) increases, increases
(*b*) increases, remains unaffected
(*c*) increases, decreases
(*d*) remains unaffected, decreases
(*e*) decreases, decreases.

165. The following thread (Fig. 48) is applicable where the internally threaded part is made from soft light materials, such as aluminium or magnesium alloys, and the screw is made from high-strength steel.

Fig. 48

This thread is called

(*a*) buttress thread (*b*) stub Acme thread
(*c*) dardelet thread (*d*) aero thread
(*e*) hose coupling screw thread.

166. Fig. 49 shows basic form of ISO-metric with pitch P. Here $H = 0.86603P$. Dimensions A, B, C, and D respectively are

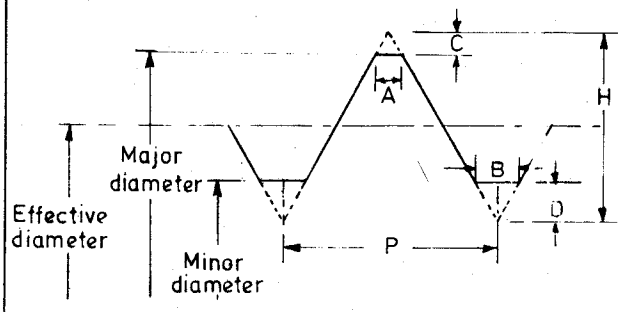


Fig. 49

(*a*) $P/4, P/4, P/8, H/8$
(*b*) $P/4, P/8, H/4, H/8$
(*c*) $H/8, H/8, P/4, P/4$
(*d*) $P/8, P/4, H/8, H/4$
(*e*) $P/8, P/8, H/8, H/8$.

167. Best size wire for checking pitch diameter of screw threads is one which makes pitch line contact. Its value for American thread (60° included angle) and Whitworth thread (55° included angle) respectively are

(*a*) 0.57735 × pitch, 0.56368 × pitch
(*b*) 0.56368 × pitch, 0.57735 × pitch
(*c*) 0.56 × pitch, 0.90 × pitch
(*d*) 0.54 × pitch, 0.76 × pitch
(*e*) 0.54 × pitch, 0.56 × pitch.

168. If D is the diameter of cutter and W the width of cut, then minimum number of teeth on face milling cutter is equal to

(a) $\frac{D}{W}$ (b) $2.4\frac{D}{W}$

(c) $6.3\frac{D}{W}$ (d) $10.8\frac{D}{W}$

(e) $16.9\times\frac{D}{W}$.

169. Normally the cutting speed for spade drill in comparison to an equivalent twist drill is
(a) 30–40% lower (b) 10–15% lower
(c) same (d) 10–15% higher
(e) 30–40% higher.

170. Sub-zero treatment is usually carried out for
(a) rolled sheets
(b) highly stressed parts
(c) highly hardened parts
(d) difficult to machine materials
(e) gauges or precision parts.

171. In oil fired boilers, low-temperature corrosion at the air-heater can be caused by SO_3 in the flue gas. Dew point temperature is related with excess air. Which is the correct curve in Fig. 50 ?

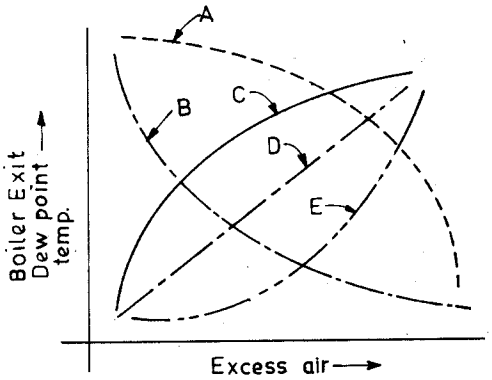


Fig. 50

(a) A (b) B
(c) C (d) D
(e) E .

172. The flow of oil to any oil burner nozzle is a function of
(a) tip pressure (b) oil viscosity
(c) pressure of atomising steam or air
(d) all of the above
(e) none of the above.

173. In a thermal power plant, need to soot blow can be recognised from the following symptom
(a) increase in the economiser gas inlet temperature
(b) increase in the air-heater outlet gas temperature
(c) sluggish control of final steam temperature
(d) changes in the gas pressures in the boiler passes
(e) any one or combination of above.

174. The prime cause of reduction in internal efficiency of steam turbine is
(a) deposition of solids onto the blades
(b) increase in the blade tip clearances due to erosion or physical contact between fixed and moving parts
(c) changes in the blade surface roughness
(d) any one or combinations of the above
(e) none of the above.

175. The vaccum attained in a steam condenser and the cooling water temperature differential (at inlet and outer of condenser) are related as per following curve in Fig. 51

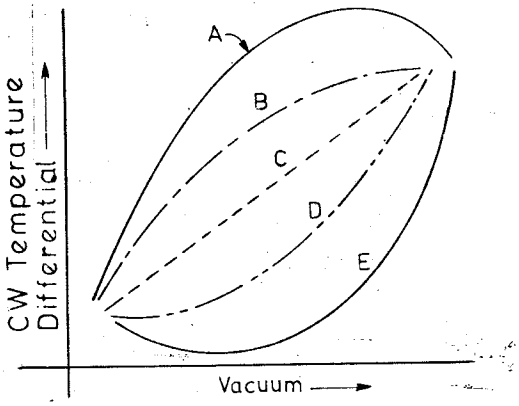


Fig. 51

(a) *A*
(b) *B*
(c) *C*
(d) *D*
(e) *E.*

176. Fig. 52 shows the flow versus lift characteristics of various valves. These are for hyperbolic, linear, square root, equal percentage and quick opening. These are respectively shown by following curves in Fig. 52.
(a) *E, C, B, D, A*
(b) *E, C, A, B, D*
(c) *A, B, C, D, E*

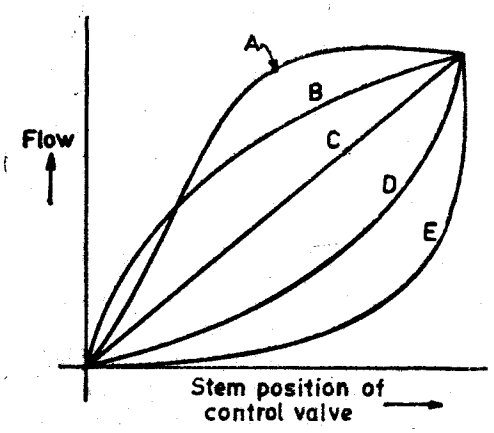


Fig. 52

(*d*) *E, D, C, B, A*
(*e*) *E, C, B, A, D.*

177. A control valve that utilises a rotatable disc or vane as a valve closure member is called
(*a*) cage valve (*b*) butterfly valve
(*c*) globe valve (*d*) ball valve
(*e*) vane valve.

178. An inherent flow characteristics in control valves which provides fine throttling action at low valve plug travel and approximately a linear characteristic for upper portions of valve travel is referred to as
(*a*) equal percentage flow characteristic
(*b*) linear flow characteristic
(*c*) quick opening characteristic
(*d*) modified parabolic characteristic
(*e*) none of the above.

179. The occurrence of cavitation in a control valve is accompanied by following evidence
(*a*) noise
(*b*) vibration
(*c*) physical damage
(*d*) decrease in efficiency
(*e*) one or more of above.

180. The four commonly used flow characteristics of control valves are equal percentage, quick opening, linear, and throttle. The shapes of plug for these characteristics are represented respectively by following curves in Fig. 53

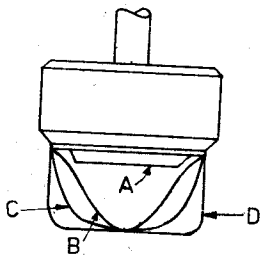


Fig. 53

(*a*) *A, B, C, D* (*b*) *D, C, B, A*
(*c*) *A, D, B, C* (*d*) *D, A, B, C*
(*e*) *D, A, C, B.*

Chapter 1
THERMODYNAMICS

1.1. (*d*)	**1.2.** (*d*)	**1.3.** (*d*)	**1.4.** (*a*)	**1.5.** (*a*)	**1.6.** (*a*)
1.7. (*b*)	**1.8.** (*b*)	**1.9.** (*c*)	**1.10.** (*a*)	**1.11.** (*b*)	**1.12.** (*b*)
1.13. (*c*)	**1.14.** (*d*)	**1.15.** (*c*)	**1.16.** (*a*)	**1.17.** (*a*)	**1.18.** (*b*)
1.19. (*c*)	**1.20.** (*a*)	**1.21.** (*d*)	**1.22.** (*a*)	**1.23.** (*d*)	**1.24.** (*d*)
1.25. (*c*)	**1.26.** (*c*)	**1.27.** (*d*)	**1.28.** (*a*)	**1.29.** (*b*)	**1.30.** (*c*)
1.31. (*c*)	**1.32.** (*d*)	**1.33.** (*c*)	**1.34.** (*d*)	**1.35.** (*b*)	**1.36.** (*b*)
1.37. (*c*)	**1.38.** (*c*)	**1.39.** (*c*)	**1.40.** (*e*)	**1.41.** (*b*)	**1.42.** (*a*)
1.43. (*a*)	**1.44.** (*c*)	**1.45.** (*a*)	**1.46.** (*b*)	**1.47.** (*c*)	**1.48.** (*b*)
1.49. (*b*)	**1.50.** (*d*)*	**1.51.** (*e*)	**1.52.** (*d*)	**1.53.** (*e*)	**1.54.** (*b*)
1.55. (*d*)	**1.56.** (*e*)	**1.57.** (*a*)*	**1.58.** (*c*)	**1.59.** (*b*)	**1.60.** (*e*)
1.61. (*a*)	**1.62.** (*e*)	**1.63.** (*a*)	**1.64.** (*b*)	**1.65.** (*b*)	**1.66.** (*c*)
1.67. (*a*)	**1.68.** (*b*)	**1.69.** (*c*)	**1.70.** (*a*)	**1.71.** (*b*)	**1.72.** (*b*)
1.73. (*a*)	**1.74.** (*c*)	**1.75.** (*a*)	**1.76.** (*d*)	**1.77.** (*a*)	**1.78.** (*c*)
1.79. (*e*)	**1.80.** (*b*)	**1.81.** (*c*)	**1.82.** (*c*)	**1.83.** (*b*)	**1.84.** (*a*)
1.85. (*a*)	**1.86.** (*d*)	**1.87.** (*d*)	**1.88.** (*a*)	**1.89.** (*a*)	**1.90.** (*c*)*
1.91. (*c*)	**1.92.** (*a*)	**1.93.** (*d*)	**1.94.** (*b*)	**1.95.** (*a*)	**1.96.** (*d*)
1.97. (*d*)	**1.98.** (*c*)	**1.99.** (*e*)	**1.100.** (*a*)	**1.101.** (*a*)	**1.102.** (*d*)
1.103. (*e*)	**1.104.** (*c*)	**1.105.** (*d*)	**1.106.** (*a*)	**1.107.** (*b*)	**1.108.** (*b*)
1.109. (*a*)	**1.110.** (*b*)	**1.111.** (*a*)	**1.112.** (*a*)*	**1.113.** (*b*)*	**1.114.** (*e*)
1.115. (*d*)	**1.116.** (*a*)	**1.117.** (*c*)	**1.118.** (*c*)	**1.119.** (*a*)	**1.120.** (*c*)
1.121. (*b*)	**1.122.** (*b*)	**1.123.** (*c*)	**1.124.** (*e*)	**1.125.** (*e*)	**1.126.** (*c*)
1.127. (*b*)	**1.128.** (*d*)	**1.129.** (*d*)	**1.130.** (*a*)	**1.131.** (*d*)	**1.132.** (*a*)
1.133. (*b*)	**1.134.** (*d*)	**1.135.** (*b*)	**1.136.** (*b*)	**1.137.** (*a*)	**1.138.** (*c*)
1.139. (*c*)	**1.140.** (*e*)	**1.141.** (*c*)	**1.142.** (*d*)	**1.143.** (*e*)	**1.144.** (*d*)
1.145. (*c*)	**1.146.** (*b*)	**1.147.** (*b*)	**1.148.** (*a*)	**1.149.** (*b*)	**1.150.** (*b*)
1.151. (*a*)	**1.152.** (*a*)	**1.153.** (*b*)	**1.154.** (*d*)	**1.155.** (*b*)	**1.156.** (*a*)
1.157. (*b*)	**1.158.** (*c*)	**1.159.** (*d*)	**1.160.** (*c*)	**1.161.** (*d*)	**1.162.** (*d*)
1.163. (*e*)	**1.164.** (*d*)	**1.165.** (*b*)	**1.166.** (*b*)*	**1.167.** (*c*)	**1.168.** (*b*)*
1.169. (*a*)	**1.170.** (*a*)	**1.171.** (*c*)	**1.172.** (*e*)	**1.173.** (*c*)	**1.174.** (*e*)
1.175. (*d*)	**1.176.** (*c*)*	**1.177.** (*a*)	**1.178.** (*b*)	**1.179.** (*a*)*	**1.180.** (*c*)*
1.181. (*b*)*	**1.182.** (*a*)*	**1.183.** (*b*)*	**1.184.** (*a*)	**1.185.** (*a*)	**1.186.** (*d*)
1.187. (*c*)*	**1.188.** (*b*)*	**1.189.** (*a*)	**1.190.** (*c*)	**1.191.** (*b*)	**1.192.** (*b*)

* Indicates that explanatory note is given at the end.

1.193. (*c*)	**1.194.** (*b*)	**1.195.** (*c*)	**1.196.** (*b*)	**1.197.** (*a*)	**1.198.** (*c*)
1.199. (*b*)	**1.200.** (*c*)	**1.201.** (*d*)	**1.202.** (*d*)	**1.203.** (*a*)	**1.204.** (*c*)
1.205. (*d*)	**1.206.** (*b*)	**1.207.** (*c*)	**1.208.** (*a*)	**1.209.** (*b*)	**1.210.** (*d*)
1.211. (*b*)	**1.212.** (*a*)	**1.213.** (*c*)	**1.214.** (*a*)	**1.215.** (*b*)	**1.216.** (*b*)
1.217. (*c*)	**1.218.** (*b*)	**1.219.** (*d*)	**1.220.** (*c*)	**1.221.** (*d*)	**1.222.** (*c*)
1.223. (*e*)	**1.224.** (*a*)	**1.225.** (*c*)	**1.226.** (*d*)	**1.227.** (*e*)	**1.228.** (*d*)
1.229. (*b*)	**1.230.** (*a*)	**1.231.** (*a*)	**1.232.** (*e*)	**1.233.** (*b*)	**1.234.** (*c*)
1.235. (*c*)	**1.236.** (*e*)	**1.237.** (*b*)	**1.238.** (*e*)	**1.239.** (*a*)	**1.240.** (*e*)
1.241. (*c*)	**1.242.** (*a*)	**1.243.** (*c*)	**1.244.** (*c*)	**1.245.** (*a*)	**1.246.** (*c*)
1.247. (*d*)	**1.248.** (*c*)	**1.249.** (*c*)	**1.250.** (*d*)	**1.251.** (*e*)	**1.252.** (*c*)
1.253. (*a*)	**1.254.** (*c*)	**1.255.** (*a*)	**1.256.** (*b*)	**1.257.** (*e*)	**1.258.** (*d*)
1.259. (*b*)	**1.260.** (*c*)	**1.261.** (*e*)	**1.262.** (*c*)	**1.263.** (*a*)	**1.264.** (*b*)
1.265. (*b*)	**1.266.** (*c*)	**1.267.** (*d*)	**1.268.** (*a*)	**1.269.** (*c*)	**1.270.** (*c*)
1.271. (*c*)	**1.272.** (*b*)	**1.273.** (*a*)	**1.274.** (*e*)	**1.275.** (*e*)	**1.276.** (*a*)
1.277. (*e*)	**1.278.** (*e*)	**1.279.** (*b*)	**1.280.** (*b*)	**1.281.** (*a*)	**1.282.** (*b*)
1.283. (*d*)	**1.284.** (*e*)	**1.285.** (*c*)	**1.286.** (*c*)	**1.287.** (*d*)	**1.288.** (*a*)
1.289. (*a*)	**1.290.** (*c*)	**1.291.** (*b*)	**1.292.** (*e*)	**1.293.** (*b*)	**1.294.** (*c*)
1.295. (*d*)	**1.296.** (*d*)	**1.297.** (*e*)	**1.298.** (*c*)	**1.299.** (*d*)	**1.300.** (*a*)
1.301. (*e*)	**1.302.** (*c*)	**1.303.** (*b*)	**1.304.** (*a*)	**1.305.** (*c*)	**1.306.** (*c*)
1.307. (*d*)	**1.308.** (*e*)	**1.309.** (*e*)	**1.310.** (*c*)	**1.311.** (*b*)	**1.312.** (*a*)
1.313. (*a*)	**1.314.** (*c*)	**1.315.** (*b*)	**1.316.** (*d*)	**1.317.** (*e*)	**1.318.** (*b*)
1.319. (*d*)	**1.320.** (*a*)	**1.321.** (*c*)	**1.322.** (*d*)	**1.323.** (*e*)	**1.324.** (*b*)
1.325. (*e*)	**1.326.** (*a*)	**1.327.** (*d*)	**1.328.** (*a*)	**1.329.** (*b*)	**1.330.** (*a*)
1.331. (*d*)	**1.332.** (*c*)	**1.333.** (*a*)	**1.334.** (*b*)	**1.335.** (*b*)	**1.336.** (*e*)
1.337. (*c*)	**1.338.** (*b*)	**1.339.** (*a*)	**1.340.** (*e*)	**1.341.** (*d*)	**1.342.** (*d*)
1.343. (*d*)	**1.344.** (*c*)	**1.345.** (*a*)	**1.346.** (*b*)	**1.347.** (*c*)	**1.348.** (*e*)
1.349. (*d*)	**1.350.** (*c*)	**1.351.** (*d*)	**1.352.** (*c*)	**1.353.** (*a*)	**1.354.** (*a*)
1.355. (*c*)	**1.356.** (*b*)	**1.357.** (*b*)	**1.358.** (*c*)	**1.359.** (*d*)	**1.360.** (*e*)
1.361. (*d*)	**1.362.** (*b*)	**1.363.** (*d*)	**1.364.** (*e*)	**1.365.** (*a*)	**1.366.** (*c*)
1.367. (*a*)	**1.368.** (*b*)	**1.369.** (*d*)	**1.370.** (*c*)		

Chapter 2
I.C.ENGINES

2.1. (*c*)	**2.2.** (*c*)	**2.3.** (*d*)	**2.4.** (*a*)	**2.5.** (*b*)	**2.6.** (*c*)
2.7. (*a*)	**2.8.** (*c*)	**2.9.** (*d*)	**2.10.** (*c*)	**2.11.** (*b*)	**2.12.** (*a*)
2.13. (*d*)	**2.14.** (*b*)	**2.15.** (*c*)	**2.16.** (*d*)	**2.17.** (*d*)	**2.18.** (*b*)
2.19. (*a*)	**2.20.** (*b*)	**2.21.** (*e*)	**2.22.** (*d*)	**2.23.** (*b*)	**2.24.** (*e*)
2.25. (*b*)	**2.26.** (*d*)	**2.27.** (*b*)	**2.28.** (*c*)	**2.29.** (*c*)	**2.30.** (*a*)
2.31. (*e*)	**2.32.** (*c*)	**2.33.** (*b*)	**2.34.** (*c*)	**2.35.** (*e*)	**2.36.** (*e*)
2.37. (*e*)	**2.38.** (*e*)	**2.39.** (*a*)	**2.40.** (*a*)	**2.41.** (*a*)	**2.42.** (*e*)
2.43. (*b*)	**2.44.** (*d*)	**2.45.** (*c*)	**2.46.** (*a*)	**2.47.** (*d*)	**2.48.** (*d*)
2.49. (*a*)	**2.50.** (*b*)	**2.51.** (*d*)	**2.52.** (*d*)	**2.53.** (*c*)	**2.54.** (*d*)
2.55. (*a*)	**2.56.** (*c*)	**2.57.** (*c*)	**2.58.** (*e*)	**2.59.** (*b*)	**2.60.** (*c*)
2.61. (*c*)	**2.62.** (*b*)	**2.63.** (*c*)	**2.64.** (*a*)	**2.65.** (*e*)	**2.66.** (*c*)

2.67. (*b*) **2.68.** (*a*) **2.69.** (*c*) **2.70.** (*b*) **2.71.** (*a*) **2.72.** (*b*)
2.73. (*a*) **2.74.** (*d*) **2.75.** (*d*) **2.76.** (*c*) **2.77.** (*a*) **2.78.** (*d*)
2.79. (*c*) **2.80.** (*b*) **2.81.** (*c*) **2.82.** (*c*) **2.83.** (*d*) **2.84.** (*d*)
2.85. (*a*) **2.86.** (*a*) **2.87.** (*e*) **2.88.** (*b*) **2.89.** (*e*) **2.90.** (*c*)
2.91. (*d*) **2.92.** (*d*) **2.93.** (*c*) **2.94.** (*d*) **2.95.** (*b*) **2.96.** (*d*)
2.97. (*b*) **2.98.** (*b*) **2.99.** (*c*) **2.100.** (*c*) **2.101.** (*d*) **2.102.** (*a*)
2.103. (*d*) **2.104.** (*d*) **2.105.** (*e*) **2.106.** (*c*) **2.107.** (*a*) **2.108.** (*c*)
2.109. (*b*) **2.110.** (*d*) **2.111.** (*c*) **2.112.** (*b*) **2.113.** (*a*) **2.114.** (*b*)
2.115. (*c*) **2.116.** (*e*) **2.117.** (*c*) **2.118.** (*b*) **2.119.** (*d*) **2.120.** (*a*)
2.121. (*a*) **2.122.** (*a*) **2.123.** (*b*) **2.124.** (*d*) **2.125.** (*d*) **2.126.** (*c*)
2.127. (*a*) **2.128.** (*c*) **2.129.** (*c*) **2.130.** (*b*) **2.131.** (*a*) **2.132.** (*d*)
2.133. (*e*) **2.134.** (*c*) **2.135.** (*a*) **2.136.** (*d*) **2.137.** (*a*) **2.138.** (*e*)
2.139. (*d*) **2.140.** (*e*) **2.141.** (*a*) **2.142.** (*a*) **2.143.** (*a*) **2.144.** (*b*)
2.145. (*b*) **2.146.** (*b*) **2.147.** (*b*) **2.148.** (*c*) **2.149.** (*d*) **2.150.** (*c*)
2.151. (*e*) **2.152.** (*b*) **2.153.** (*c*) **2.154.** (*d*) **2.155.** (*b*) **2.156.** (*c*)
2.157. (*d*) **2.158.** (*e*) **2.159.** (*c*) **2.160.** (*a*) **2.161.** (*d*) **2.162.** (*a*)
2.163. (*d*) **2.164.** (*c*) **2.165.** (*d*) **2.166.** (*a*) **2.167.** (*b*) **2.168.** (*d*)
2.169. (*b*) **2.170.** (*b*) **2.171.** (*b*) **2.172.** (*d*) **2.173.** (*e*) **2.174.** (*b*)
2.175. (*c*) **2.176.** (*a*) **2.177.** (*e*) **2.178.** (*c*) **2.179.** (*a*) **2.180.** (*b*)
2.181. (*a*) **2.182.** (*b*) **2.183.** (*d*) **2.184.** (*a*) **2.185.** (*c*) **2.186.** (*b*)
2.187. (*b*) **2.188.** (*c*) **2.189.** (*b*) **2.190.** (*e*) **2.191.** (*d*) **2.192.** (*d*)
2.193. (*b*) **2.194.** (*b*) **2.195.** (*b*) **2.196.** (*b*) **2.197.** (*a*) **2.198.** (*c*)
2.199. (*d*) **2.200.** (*d*) **2.201.** (*c*) **2.202.** (*b*) **2.203.** (*d*) **2.204.** (*a*)
2.205. (*e*) **2.206.** (*c*) **2.207.** (*b*) **2.208.** (*c*) **2.209.** (*d*) **2.210.** (*c*)
2.211. (*c*) **2.212.** (*a*) **2.213.** (*a*) **2.214.** (*b*) **2.215.** (*e*) **2.216.** (*d*)
2.217. (*b*) **2.218.** (*d*) **2.219.** (*e*) **2.220.** (*e*) **2.221.** (*c*) **2.222.** (*a*)
2.223. (*a*) **2.224.** (*a*) **2.225.** (*e*) **2.226.** (*c*) **2.227.** (*b*) **2.228.** (*a*)
2.229. (*b*) **2.230.** (*b*) **2.231.** (*b*) **2.232.** (*e*) **2.233.** (*d*) **2.234.** (*d*)
2.235. (*d*) **2.236.** (*a*) **2.237.** (*b*)* **2.238.** (*c*) **2.239.** (*c*) **2.240.** (*d*)
2.241. (*b*) **2.242.** (*a*) **2.243.** (*a*) **2.244.** (*d*) **2.245.** (*d*) **2.246.** (*d*)
2.247. (*a*) **2.248.** (*d*) **2.249.** (*b*) **2.250.** (*b*) **2.251.** (*c*)* **2.252.** (*b*)
2.253. (*e*) **2.254.** (*c*) **2.255.** (*a*) **2.256.** (*c*) **2.257.** (*d*) **2.258.** (*a*)
2.259. (*c*) **2.260.** (*e*) **2.261.** (*c*) **2.262.** (*c*) **2.263.** (*b*) **2.264.** (*d*)
2.265. (*a*) **2.266.** (*d*) **2.267.** (*b*) **2.268.** (*a*) **2.269.** (*d*) **2.270.** (*e*)
2.271. (*b*) **2.272.** (*a*) **2.273.** (*d*) **2.274.** (*a*) **2.275.** (*b*) **2.276.** (*e*)
2.277. (*e*) **2.278.** (*b*) **2.279.** (*d*) **2.280.** (*b*) **2.281.** (*a*) **2.282.** (*d*)
2.283. (*a*) **2.284.** (*a*) **2.285.** (*a*) **2.286.** (*b*) **2.287.** (*a*) **2.288.** (*a*)
2.289. (*e*) **2.290.** (*d*) **2.291.** (*c*) **2.292.** (*d*) **2.293.** (*b*) **2.294.** (*e*)
2.295. (*a*) **2.296.** (*e*) **2.297.** (*c*) **2.298.** (*d*) **2.299.** (*c*) **2.300.** (*c*)
2.301. (*c*) **2.302.** (*d*) **2.303.** (*b*) **2.304.** (*d*) **2.305.** (*b*) **2.306.** (*d*)
2.307. (*d*) **2.308.** (*d*) **2.309.** (*d*) **2.310.** (*c*) **2.311.** (*d*) **2.312.** (*b*)
2.313. (*e*) **2.314.** (*c*) **2.315.** (*a*) **2.316.** (*b*) **2.317.** (*c*) **2.318.** (*d*)
2.319. (*a*) **2.320.** (*a*) **2.321.** (*c*) **2.322.** (*a*) **2.323.** (*b*) **2.324.** (*a*)
2.325. (*e*) **2.326.** (*b*)

Chapter 3
NUCLEAR POWER PLANTS

3.1. (*c*)	**3.2.** (*b*)	**3.3.** (*a*)	**3.4.** (*d*)	**3.5.** (*a*)	**3.6.** (*a*)
3.7. (*d*)	**3.8.** (*d*)	**3.9.** (*d*)	**3.10.** (*e*)	**3.11.** (*a*)	**3.12.** (*c*)
3.13. (*b*)	**3.14.** (*b*)	**3.15.** (*c*)	**3.16.** (*b*)	**3.17.** (*d*)	**3.18.** (*b*)
3.19. (*c*)	**3.20.** (*a*)	**3.21.** (*d*)	**3.22.** (*a*)	**3.23.** (*d*)	**3.24.** (*b*)
3.25. (*d*)	**3.26.** (*a*)	**3.27.** (*b*)	**3.28.** (*c*)	**3.29.** (*e*)	**3.30.** (*d*)
3.31. (*b*)	**3.32.** (*a*)	**3.33.** (*d*)	**3.34.** (*b*)	**3.35.** (*b*)	**3.36.** (*b*)
3.37. (*e*)	**3.38.** (*c*)	**3.39.** (*c*)	**3.40.** (*a*)	**3.41.** (*c*)	**3.42.** (*a*)
3.43. (*c*)	**3.44.** (*a*)	**3.45.** (*a*)	**3.46.** (*c*)	**3.47.** (*a*)	**3.48.** (*b*)
3.49. (*b*)	**3.50.** (*b*)	**3.51.** (*d*)	**3.52.** (*c*)	**3.53.** (*e*)	**3.54.** (*c*)
3.55. (*b*)	**3.56.** (*d*)	**3.57.** (*b*)	**3.58.** (*c*)	**3.59.** (*c*)	**3.60.** (*a*)
3.61. (*a*)	**3.62.** (*b*)	**3.63.** (*c*)	**3.64.** (*c*)	**3.65.** (*b*)	**3.66.** (*a*)
3.67. (*a*)	**3.68.** (*c*)	**3.69.** (*b*)	**3.70.** (*d*)	**3.71.** (*b*)	**3.72.** (*b*)
3.73. (*d*)	**3.74.** (*a*)	**3.75.** (*a*)	**3.76.** (*b*)	**3.77.** (*a*)	**3.78.** (*b*)
3.79. (*d*)	**3.80.** (*a*)	**3.81.** (*d*)	**3.82.** (*d*)	**3.83.** (*d*)	**3.84.** (*a*)
3.85. (*c*)	**3.86.** (*e*)	**3.87.** (*a*)	**3.88.** (*e*)	**3.89.** (*d*)	**3.90.** (*c*)
3.91. (*a*)	**3.92.** (*c*)	**3.93.** (*d*)	**3.94.** (*d*)	**3.95.** (*b*)	

Chapter 4
STEAM BOILERS, ENGINES, NOZZLES AND TURBINES

4.1. (*a*)	**4.2.** (*b*)	**4.3.** (*a*)	**4.4.** (*a*)	**4.5.** (*b*)	**4.6.** (*c*)
4.7. (*c*)	**4.8.** (*b*)	**4.9.** (*c*)	**4.10.** (*a*)	**4.11.** (*c*)	**4.12.** (*b*)
4.13. (*c*)	**4.14.** (*e*)	**4.15.** (*c*)	**4.16.** (*a*)	**4.17.** (*b*)	**4.18.** (*b*)
4.19. (*a*)	**4.20.** (*a*)	**4.21.** (*c*)	**4.22.** (*b*)	**4.23.** (*e*)	**4.24.** (*a*)
4.25. (*a*)	**4.26.** (*a*)	**4.27.** (*b*)	**4.28.** (*b*)	**4.29.** (*a*)	**4.30.** (*c*)
4.31. (*e*)	**4.32.** (*e*)	**4.33.** (*a*)	**4.34.** (*c*)	**4.35.** (*c*)	**4.36.** (*d*)
4.37. (*d*)	**4.38.** (*a*)	**4.39.** (*b*)	**4.40.** (*b*)	**4.41.** (*d*)	**4.42.** (*d*)
4.43. (*a*)	**4.44.** (*a*)	**4.45.** (*a*)	**4.46.** (*a*)	**4.47.** (*d*)	**4.48.** (*a*)
4.49. (*b*)	**4.50.** (*d*)	**4.51.** (*b*)	**4.52.** (*b*)	**4.53.** (*c*)	**4.54.** (*b*)
4.55. (*a*)	**4.56.** (*d*)	**4.57.** (*a*)	**4.58.** (*c*)	**4.59.** (*c*)	**4.60.** (*b*)
4.61. (*b*)	**4.62.** (*b*)	**4.63.** (*a*)	**4.64.** (*c*)	**4.65.** (*e*)	**4.66.** (*e*)
4.67. (*c*)	**4.68.** (*b*)	**4.69.** (*d*)	**4.70.** (*e*)	**4.71.** (*a*)	**4.72.** (*a*)
4.73. (*c*)	**4.74.** (*a*)	**4.75.** (*d*)	**4.76.** (*d*)	**4.77.** (*b*)	**4.78.** (*e*)
4.79. (*a*)	**4.80.** (*e*)	**4.81.** (*d*)	**4.82.** (*a*)	**4.83.** (*a*)	**4.84.** (*e*)
4.85. (*d*)	**4.86.** (*e*)	**4.87.** (*b*)	**4.88.** (*a*)	**4.89.** (*a*)	**4.90.** (*d*)
4.91. (*c*)	**4.92.** (*d*)	**4.93.** (*d*)	**4.94.** (*e*)	**4.95.** (*a*)	**4.96.** (*a*)
4.97. (*c*)	**4.98.** (*a*)	**4.99.** (*a*)	**4.100.** (*d*)	**4.101.** (*c*)	**4.102.** (*b*)
4.103. (*c*)	**4.104.** (*b*)	**4.105.** (*e*)	**4.106.** (*d*)	**4.107.** (*c*)	**4.108.** (*d*)
4.109. (*a*)	**4.110.** (*c*)	**4.111.** (*c*)	**4.112.** (*e*)	**4.113.** (*a*)	**4.114.** (*e*)
4.115. (*c*)	**4.116.** (*c*)	**4.117.** (*a*)	**4.118.** (*e*)	**4.119.** (*d*)	**4.120.** (*a*)
4.121. (*c*)	**4.122.** (*c*)	**4.123.** (*e*)	**4.124.** (*b*)*	**4.125.** (*b*)	**4.126.** (*a*)
4.127. (*c*)*	**4.128.** (*b*)	**4.129.** (*a*)	**4.130.** (*d*)	**4.131.** (*b*)	**4.132.** (*b*)

4.133. (*d*) **4.134.** (*b*) **4.135.** (*c*) **4.136.** (*b*) **4.137.** (*c*) **4.138.** (*e*)
4.139. (*c*) **4.140.** (*e*) **4.141.** (*d*) **4.142.** (*c*) **4.143.** (*c*) **4.144.** (*b*)
4.145. (*d*) **4.146.** (*a*) **4.147.** (*a*) **4.148.** (*d*) **4.149.** (*c*) **4.150.** (*a*)
4.151. (*c*) **4.152.** (*a*) **4.153.** (*b*) **4.154.** (*b*) **4.155.** (*d*) **4.156.** (*c*)
4.157. (*a*) **4.158.** (*a*) **4.159.** (*a*) **4.160.** (*a*) **4.161.** (*c*) **4.162.** (*d*)
4.163. (*e*) **4.164.** (*a*) **4.165.** (*c*) **4.166.** (*b*) **4.167.** (*d*) **4.168.** (*e*)
4.169. (*b*) **4.170.** (*d*) **4.171.** (*a*) **4.172.** (*c*) **4.173.** (*d*) **4.174.** (*a*)
4.175. (*c*) **4.176.** (*c*) **4.177.** (*b*) **4.178.** (*a*) **4.179.** (*c*) **4.180.** (*d*)
4.181. (*d*) **4.182.** (*b*) **4.183.** (*b*) **4.184.** (*c*) **4.185.** (*d*) **4.186.** (*c*)
4.187. (*d*) **4.188.** (*b*) **4.189.** (*c*) **4.190.** (*b*) **4.191.** (*b*) **4.192.** (*b*)
4.193. (*b*) **4.194.** (*d*) **4.195.** (*c*) **4.196.** (*a*) **4.197.** (*b*) **4.198.** (*a*)
4.199. (*d*) **4.200.** (*b*) **4.201.** (*a*) **4.202.** (*e*) **4.203.** (*d*) **4.204.** (*a*)
4.205. (*a*) **4.206.** (*d*) **4.207.** (*c*) **4.208.** (*a*) **4.209.** (*b*) **4.210.** (*b*)
4.211. (*d*) **4.212.** (*e*) **4.213.** (*a*) **4.214.** (*c*) **4.215.** (*b*) **4.216.** (*a*)
4.217. (*b*) **4.218.** (*c*) **4.219.** (*c*) **4.220.** (*b*) **4.221.** (*a*) **4.222.** (*c*)
4.223. (*b*) **4.224.** (*d*) **4.225.** (*b*) **4.226.** (*d*) **4.227.** (*a*) **4.228.** (*b*)
4.229. (*a*) **4.230.** (*a*) **4.231.** (*c*) **4.232.** (*b*) **4.233.** (*c*) **4.234.** (*d*)
4.235. (*c*) **4.236.** (*b*) **4.237.** (*b*) **4.238.** (*e*) **4.239.** (*e*) **4.240.** (*b*)
4.241. (*a*) **4.242.** (*a*) **4.243.** (*b*) **4.244.** (*a*) **4.245.** (*b*) **4.246.** (*d*)
4.247. (*a*) **4.248.** (*c*) **4.249.** (*b*) **4.250.** (*c*) **4.251.** (*a*) **4.252.** (*c*)
4.253. (*b*)* **4.254.** (*c*) **4.255.** (*d*) **4.256.** (*d*) **4.257.** (*a*) **4.258.** (*d*)
4.259. (*a*) **4.260.** (*c*) **4.261.** (*e*) **4.262.** (*b*) **4.263.** (*a*) **4.264.** (*d*)
4.265. (*a*) **4.266.** (*c*) **4.267.** (*d*) **4.268.** (*b*) **4.269.** (*c*) **4.270.** (*b*)
4.271. (*a*) **4.272.** (*b*) **4.273.** (*d*) **4.274.** (*a*) **4.275.** (*b*) **4.276.** (*a*)
4.277. (*a*) **4.278.** (*a*) **4.279.** (*a*) **4.280.** (*a*) **4.281.** (*a*) **4.282.** (*b*)
4.283. (*c*) **4.284.** (*d*) **4.285.** (*a*) **4.286.** (*b*) **4.287.** (*a*) **4.288.** (*a*)
4.289. (*e*) **4.290.** (*e*) **4.291.** (*c*) **4.292.** (*d*) **4.293.** (*c*) **4.294.** (*d*)
4.295. (*a*) **4.296.** (*a*) **4.297.** (*e*) **4.298.** (*e*) **4.299.** (*a*) **4.300.** (*c*)
4.301. (*b*) **4.302.** (*c*) **4.303.** (*a*) **4.304.** (*b*) **4.305.** (*b*) **4.306.** (*a*)
4.307. (*c*) **4.308.** (*d*) **4.309.** (*a*) **4.310.** (*c*) **4.311.** (*d*) **4.312.** (*b*)
4.313. (*a*) **4.314.** (*a*) **4.315.** (*a*) **4.316.** (*d*) **4.317.** (*d*) **4.318.** (*c*)
4.319. (*b*) **4.320.** (*c*) **4.321.** (*a*) **4.322.** (*c*) **4.323.** (*c*) **4.324.** (*b*)
4.325. (*d*) **4.326.** (*e*) **4.327.** (*b*) **4.328.** (*a*) **4.329.** (*c*) **4.330.** (*a*)
4.331. (*d*) **4.332.** (*c*) **4.333.** (*a*) **4.334.** (*b*) **4.335.** (*d*) **4.336.** (*c*)
4.337. (*d*) **4.338.** (*c*) **4.339.** (*d*) **4.340.** (*c*) **4.341.** (*b*) **4.342.** (*c*)
4.343. (*d*) **4.344.** (*d*) **4.345.** (*c*) **4.346.** (*a*) **4.347.** (*b*) **4.348.** (*c*)
4.349. (*d*) **4.350.** (*a*) **4.351.** (*a*) **4.352.** (*a*) **4.353.** (*c*) **4.354.** (*b*)
4.354. (*b*) **4.355.** (*c*) **4.356.** (*d*) **4.357.** (*c*) **4.358.** (*a*) **4.359.** (*b*)
4.360. (*c*) **4.361.** (*c*) **4.362.** (*c*) **4.363.** (*a*) **4.364.** (*b*) **4.365.** (*c*)
4.366. (*a*) **4.367.** (*d*) **4.368.** (*b*) **4.369.** (*a*) **4.370.** (*b*) **4.371.** (*b*)
4.372. (*a*) **4.373.** (*a*) **4.374.** (*e*) **4.375.** (*c*) **4.376.** (*e*) **4.377.** (*b*)
4.378. (*e*) **4.379.** (*d*) **4.380.** (*a*) **4.381.** (*b*) **4.382.** (*a*) **4.383.** (*a*)
4.384. (*c*) **4.385.** (*b*) **4.386.** (*a*) **4.387.** (*d*) **4.388.** (*d*) **4.389.** (*a*)
4.390. (*e*) **4.391.** (*d*) **4.392.** (*a*) **4.393.** (*b*) **4.394.** (*b*) **4.395.** (*c*)
4.396. (*d*) **4.397.** (*b*) **4.398.** (*a*) **4.399.** (*a*) **4.400.** (*c*) **4.401.** (*a*)
4.402. (*b*) **4.403.** (*c*) **4.404.** (*d*) **4.405.** (*a*) **4.406.** (*b*) **4.407.** (*e*)

4.408. (*c*) **4.409.** (*a*) **4.410.** (*c*) **4.411.** (*b*) **4.412.** (*c*) **4.413.** (*a*)
4.414. (*d*) **4.415.** (*e*) **4.416.** (*b*) **4.417.** (*b*) **4.418.** (*a*) **4.419.** (*b*)
4.420. (*a*) **4.421.** (*d*) **4.422.** (*d*) **4.423.** (*a*) **4.424.** (*d*) **4.425.** (*c*)
4.426. (*d*) **4.427.** (*c*) **4.428.** (*c*) **4.429.** (*d*) **4.430.** (*c*) **4.431.** (*a*)
4.432. (*b*) **4.433.** (*a*) **4.434.** (*b*) **4.435.** (*e*) **4.436.** (*b*) **4.437.** (*a*)
4.438. (*c*) **4.439.** (*e*) **4.440.** (*c*) **4.441.** (*d*) **4.442.** (*b*) **4.443.** (*b*)
4.444. (*b*) **4.445.** (*d*) **4.446.** (*e*) **4.447.** (*c*) **4.448.** (*e*) **4.449.** (*b*)
4.450. (*d*) **4.451.** (*b*) **4.452.** (*b*) **4.453.** (*a*) **4.454.** (*a*) **4.455.** (*b*)
4.456. (*d*) **4.457.** (*a*) **4.458.** (*d*) **4.459.** (*a*) **4.460.** (*b*) **4.461.** (*e*)
4.462. (*a*)

Chapter 5
COMPRESSORS, GAS TURBINES AND JET ENGINES

5.1. (*a*) **5.2.** (*b*) **5.3.** (*c*) **5.4.** (*b*) **5.5.** (*b*) **5.6.** (*a*)
5.7. (*a*) **5.8.** (*b*) **5.9.** (*e*) **5.10.** (*b*) **5.11.** (*a*) **5.12.** (*c*)
5.13. (*e*) **5.14.** (*b*) **5.15.** (*b*) **5.16.** (*a*) **5.17.** (*b*) **5.18.** (*a*)
5.19. (*a*) **5.20.** (*d*) **5.21.** (*a*) **5.22.** (*d*) **5.23.** (*b*) **5.24.** (*b*)
5.25. (*e*) **5.26.** (*c*) **5.27.** (*d*) **5.28.** (*b*) **5.29.** (*d*) **5.30.** (*b*)
5.31. (*c*) **5.32.** (*b*) **5.33.** (*d*) **5.34.** (*d*) **5.35.** (*c*) **5.36.** (*a*)
5.37. (*a*) **5.38.** (*c*) **5.39.** (*a*) **5.40.** (*b*)* **5.41.** (*b*) **5.42.** (*c*)
5.43. (*d*) **5.44.** (*b*)* **5.45.** (*c*) **5.46.** (*a*) **5.47.** (*b*) **5.48.** (*d*)
5.49. (*a*) **5.50.** (*c*) **5.51.** (*b*) **5.52.** (*d*) **5.53.** (*b*) **5.54.** (*d*)
5.55. (*a*) **5.56.** (*a*) **5.57.** (*b*) **5.58.** (*c*)* **5.59.** (*b*)* **5.60.** (*b*)*
5.61. (*b*) **5.62.** (*b*) **5.63.** (*a*) **5.64.** (*b*) **5.65.** (*c*) **5.66.** (*b*)
5.67. (*b*) **5.68.** (*b*) **5.69.** (*c*) **5.70.** (*c*) **5.71.** (*a*)* **5.72.** (*a*)
5.73. (*e*) **5.74.** (*b*) **5.75.** (*b*) **5.76.** (*a*) **5.77.** (*a*) **5.78.** (*a*)
5.79. (*d*) **5.80.** (*c*) **5.81.** (*c*) **5.82.** (*c*) **5.83.** (*b*) **5.84.** (*a*)
5.85. (*d*) **5.86.** (*d*) **5.87.** (*c*) **5.88.** (*b*) **5.89.** (*c*) **5.90.** (*e*)
5.91. (*a*) **5.92.** (*a*) **5.93.** (*b*) **5.94.** (*d*) **5.95.** (*a*) **5.96.** (*d*)
5.97. (*d*) **5.98.** (*d*) **5.99.** (*b*) **5.100.** (*b*) **5.101.** (*a*) **5.102.** (*b*)
5.103. (*c*) **5.104.** (*d*) **5.105.** (*c*) **5.106.** (*c*) **5.107.** (*a*) **5.108.** (*d*)
5.109. (*c*) **5.110.** (*c*) **5.111.** (*c*) **5.112.** (*b*) **5.113.** (*d*) **5.114.** (*d*)
5.115. (*b*) **5.116.** (*a*) **5.117.** (*d*) **5.118.** (*a*) **5.119.** (*a*) **5.120.** (*a*)
5.121. (*b*) **5.122.** (*a*) **5.123.** (*e*) **5.124.** (*c*) **5.125.** (*e*) **5.126.** (*c*)
5.127. (*a*) **5.128.** (*d*) **5.129.** (*b*) **5.130.** (*b*) **5.131.** (*c*) **5.132.** (*b*)
5.133. (*a*) **5.134.** (*a*) **5.135.** (*d*) **5.136.** (*a*) **5.137.** (*c*) **5.138.** (*d*)
5.139. (*c*) **5.140.** (*e*) **5.141.** (*b*) **5.142.** (*d*) **5.143.** (*d*) **5.144.** (*b*)
5.145. (*b*) **5.146.** (*b*) **5.147.** (*b*) **5.148.** (*a*) **5.149.** (*c*) **5.150.** (*c*)
5.151. (*a*) **5.152.** (*a*) **5.153.** (*a*) **5.154.** (*b*) **5.155.** (*a*) **5.156.** (*a*)
5.157. (*b*) **5.158.** (*a*) **5.159.** (*c*) **5.160.** (*e*) **5.161.** (*b*) **5.162.** (*a*)
5.163. (*a*) **5.164.** (*b*) **5.165.** (*d*) **5.166.** (*c*) **5.167.** (*c*) **5.168.** (*a*)
5.169. (*d*) **5.170.** (*d*) **5.171.** (*a*) **5.172.** (*c*) **5.173.** (*c*) **5.174.** (*d*)
5.175. (*b*) **5.176.** (*c*) **5.177.** (*d*) **5.178.** (*b*) **5.179.** (*b*) **5.180.** (*d*)
5.181. (*c*) **5.182.** (*c*) **5.183.** (*c*) **5.184.** (*a*) **5.185.** (*a*) **5.186.** (*d*)

5.187. (*e*)	**5.188.** (*c*)	**5.189.** (*a*)	**5.190.** (*d*)	**5.191.** (*d*)	**5.192.** (*e*)
5.193. (*c*)	**5.194.** (*d*)	**5.195.** (*c*)	**5.196.** (*a*)	**5.197.** (*c*)	**5.198.** (*d*)
5.199. (*c*)	**5.200.** (*d*)	**5.201.** (*a*)	**5.202.** (*e*)	**5.203.** (*e*)	**5.204.** (*d*)
5.205. (*d*)	**5.206.** (*e*)	**5.207.** (*b*)	**5.208.** (*d*)	**5.209.** (*b*)	**5.210.** (*a*)
5.211. (*e*)	**5.212.** (*a*)	**5.213.** (*d*)	**5.214.** (*b*)	**5.215.** (*a*)	**5.216.** (*e*)
5.217. (*b*)	**5.218.** (*b*)	**5.219.** (*b*)	**5.220.** (*e*)	**5.221.** (*a*)	**5.222.** (*b*)
5.223. (*b*)	**5.224.** (*a*)	**5.225.** (*e*)	**5.226.** (*e*)	**5.227.** (*b*)	**5.228.** (*b*)

Chapter 6
HEAT TRANSFER

6.1. (*b*)	**6.2.** (*e*)	**6.3.** (*b*)	**6.4.** (*b*)	**6.5.** (*c*)	**6.6.** (*a*)
6.7. (*c*)	**6.8.** (*c*)	**6.9.** (*b*)	**6.10.** (*b*)	**6.11.** (*b*)	**6.12.** (*d*)
6.13. (*c*)	**6.14.** (*c*)	**6.15.** (*a*)	**6.16.** (*e*)	**6.17.** (*d*)	**6.18.** (*d*)
6.19. (*d*)	**6.20.** (*d*)	**6.21.** (*d*)	**6.22.** (*b*)	**6.23.** (*c*)	**6.24.** (*a*)
6.25. (*d*)	**6.26.** (*e*)	**6.27.** (*d*)	**6.28.** (*e*)	**6.29.** (*e*)	**6.30.** (*b*)
6.31. (*e*)	**6.32.** (*d*)	**6.33.** (*a*)	**6.34.** (*d*)	**6.35.** (*e*)	**6.36.** (*c*)
6.37. (*c*)	**6.38.** (*d*)	**6.39.** (*d*)	**6.40.** (*a*)	**6.41.** (*a*)	**6.42.** (*c*)*
6.43. (*d*)	**6.44.** (*c*)	**6.45.** (*b*)	**6.46.** (*d*)	**6.47.** (*a*)	**6.48.** (*c*)
6.49. (*d*)	**6.50.** (*b*)	**6.51.** (*c*)	**6.52.** (*a*)	**6.53.** (*c*)	**6.54.** (*e*)
6.55. (*a*)	**6.56.** (*a*)	**6.57.** (*d*)	**6.58.** (*b*)	**6.59.** (*a*)	**6.60.** (*d*)
6.61. (*a*)	**6.62.** (*e*)	**6.63.** (*d*)	**6.64.** (*d*)	**6.65.** (*d*)	**6.66.** (*c*)
6.67. (*e*)	**6.68.** (*d*)	**6.69.** (*c*)	**6.70.** (*a*)	**6.71.** (*c*)	**6.72.** (*b*)
6.73. (*a*)	**6.74.** (*d*)	**6.75.** (*c*)	**6.76.** (*c*)	**6.77.** (*d*)	**6.78.** (*b*)
6.79. (*c*)	**6.80.** (*a*)	**6.81.** (*c*)	**6.82.** (*a*)	**6.83.** (*d*)	**6.84.** (*a*)
6.85. (*a*)	**6.86.** (*d*)	**6.87.** (*e*)	**6.88.** (*a*)	**6.89.** (*b*)	**6.90.** (*a*)
6.91. (*d*)	**6.92.** (*a*)	**6.93.** (*e*)	**6.94.** (*a*)	**6.95.** (*a*)	**6.96.** (*a*)
6.97. (*c*)	**6.98.** (*b*)	**6.99.** (*e*)	**6.100.** (*c*)	**6.101.** (*a*)	**6.102.** (*b*)
6.103. (*c*)	**6.104.** (*d*)	**6.105.** (*d*)	**6.106.** (*b*)	**6.107.** (*a*)	**6.108.** (*a*)
6.109. (*a*)	**6.110.** (*d*)	**6.111.** (*d*)	**6.112.** (*d*)	**6.113.** (*c*)	**6.114.** (*c*)
6.115. (*d*)	**6.116.** (*a*)	**6.117.** (*e*)	**6.118.** (*c*)	**6.119.** (*b*)	**6.120.** (*d*)
6.121. (*c*)					

Chapter 7
REFRIGERATION AND AIR CONDITIONING

7.1. (*b*)	**7.2.** (*e*)	**7.3.** (*e*)	**7.4.** (*d*)	**7.5.** (*a*)	**7.6.** (*b*)
7.7. (*a*)	**7.8.** (*e*)	**7.9.** (*a*)	**7.10.** (*a*)	**7.11.** (*c*)	**7.12.** (*d*)
7.13. (*b*)	**7.14.** (*e*)	**7.15.** (*c*)	**7.16.** (*c*)	**7.17.** (*a*)	**7.18.** (*a*)
7.19. (*e*)	**7.20.** (*d*)	**7.21.** (*d*)	**7.22.** (*a*)	**7.23.** (*a*)	**7.24.** (*a*)
7.25. (*c*)	**7.26.** (*a*)	**7.27.** (*b*)	**7.28.** (*d*)	**7.29.** (*a*)	**7.30.** (*d*)
7.31. (*d*)	**7.32.** (*e*)	**7.33.** (*d*)	**7.34.** (*d*)	**7.35.** (*b*)	**7.36.** (*a*)
7.37. (*a*)	**7.38.** (*e*)	**7.39.** (*d*)	**7.40.** (*b*)	**7.41.** (*e*)	**7.42.** (*b*)
7.43. (*b*)	**7.44.** (*b*)	**7.45.** (*d*)	**7.46.** (*a*)	**7.47.** (*b*)	**7.48.** (*a*)
7.49. (*c*)	**7.50.** (*b*)	**7.51.** (*c*)	**7.52.** (*d*)	**7.53.** (*c*)	**7.54.** (*b*)

7.55. (*d*)*	**7.56.** (*b*)	**7.57.** (*d*)	**7.58.** (*b*)	**7.59.** (*d*)	**7.60.** (*b*)
7.61. (*d*)	**7.62.** (*b*)	**7.63.** (*a*)	**7.64.** (*c*)	**7.65.** (*b*)	**7.66.** (*b*)
7.67. (*e*)	**7.68.** (*d*)	**7.69.** (*c*)	**7.70.** (*a*)	**7.71.** (*e*)	**7.72.** (*c*)
7.73. (*b*)	**7.74.** (*c*)	**7.75.** (*b*)	**7.76.** (*a*)	**7.77.** (*c*)	**7.78.** (*d*)
7.79. (*a*)	**7.80.** (*a*)	**7.81.** (*b*)	**7.82.** (*d*)	**7.83.** (*a*)	**7.84.** (*c*)
7.85. (*a*)	**7.86.** (*c*)	**7.87.** (*e*)	**7.88.** (*a*)	**7.89.** (*c*)	**7.90.** (*a*)
7.91. (*d*)	**7.92.** (*a*)	**7.93.** (*c*)	**7.94.** (*a*)	**7.95.** (*a*)	**7.96.** (*d*)
7.97. (*b*)	**7.98.** (*d*)	**7.99.** (*c*)	**7.100.** (*e*)	**7.101.** (*e*)	**7.102.** (*b*)
7.103. (*e*)	**7.104.** (*b*)	**7.105.** (*d*)	**7.106.** (*b*)	**7.107.** (*c*)	**7.108.** (*a*)
7.109. (*e*)	**7.110.** (*a*)	**7.111.** (*b*)	**7.112.** (*c*)	**7.113.** (*a*)	**7.114.** (*c*)
7.115. (*c*)	**7.116.** (*c*)	**7.117.** (*c*)	**7.118.** (*c*)	**7.119.** (*a*)	**7.120.** (*a*)
7.121. (*c*)	**7.122.** (*d*)	**7.123.** (*c*)	**7.124.** (*c*)	**7.125.** (*d*)	**7.126.** (*a*)
7.127. (*e*)	**7.128.** (*e*)	**7.129.** (*b*)	**7.130.** (*a*)	**7.131.** (*d*)	**7.132.** (*d*)
7.133. (*a*)	**7.134.** (*e*)	**7.135.** (*d*)	**7.136.** (*c*)	**7.137.** (*d*)	**7.138.** (*d*)
7.139. (*c*)	**7.140.** (*e*)	**7.141.** (*a*)	**7.142.** (*b*)	**7.143.** (*d*)	**7.144.** (*a*)
7.145. (*a*)	**7.146.** (*b*)	**7.147.** (*d*)	**7.148.** (*a*)	**7.149.** (*c*)	**7.150.** (*d*)
7.151. (*a*)	**7.152.** (*b*)	**7.153.** (*b*)	**7.154.** (*a*)	**7.155.** (*a*)	**7.156.** (*d*)
7.157. (*c*)	**7.158.** (*a*)	**7.159.** (*b*)	**7.160.** (*d*)	**7.161.** (*a*)	**7.162.** (*a*)
7.163. (*a*)	**7.164.** (*b*)	**7.165.** (*a*)	**7.166.** (*a*)	**7.167.** (*a*)	**7.168.** (*a*)
7.169. (*a*)	**7.170.** (*c*)	**7.171.** (*c*)	**7.172.** (*c*)	**7.173.** (*e*)	**7.174.** (*d*)
7.175. (*d*)	**7.176.** (*b*)	**7.177.** (*c*)	**7.178.** (*d*)	**7.179.** (*e*)	**7.180.** (*a*)
7.181. (*c*)	**7.182.** (*e*)	**7.183.** (*c*)	**7.184.** (*a*)	**7.185.** (*b*)	**7.186.** (*b*)
7.187. (*c*)	**7.188.** (*a*)	**7.189.** (*b*)	**7.190.** (*a*)	**7.191.** (*e*)	**7.192.** (*b*)
7.193. (*d*)	**7.194.** (*a*)	**7.195.** (*c*)	**7.196.** (*a*)	**7.197.** (*c*)	**7.198.** (*b*)
7.199. (*b*)	**7.200.** (*c*)	**7.201.** (*a*)	**7.202.** (*d*)	**7.203.** (*b*)	**7.204.** (*d*)
7.205. (*c*)	**7.206.** (*d*)	**7.207.** (*a*)	**7.208.** (*d*)	**7.209.** (*c*)	**7.210.** (*b*)
7.211. (*a*)	**7.212.** (*e*)	**7.213.** (*b*)	**7.214.** (*d*)	**7.215.** (*c*)	**7.216.** (*a*)
7.217. (*a*)	**7.218.** (*a*)	**7.219.** (*c*)	**7.220.** (*a*)	**7.221.** (*a*)	**7.222.** (*e*)
7.223. (*c*)	**7.224.** (*d*)	**7.225.** (*b*)	**7.226.** (*a*)	**7.227.** (*d*)	**7.228.** (*a*)
7.229. (*c*)	**7.230.** (*c*)	**7.231.** (*a*)	**7.232.** (*a*)	**7.233.** (*c*)	**7.234.** (*b*)
7.235. (*a*)	**7.236.** (*a*)	**7.237.** (*a*)	**7.238.** (*a*)	**7.239.** (*b*)	**7.240.** (*e*)
7.241. (*a*)	**7.242.** (*c*)	**7.243.** (*c*)	**7.244.** (*b*)	**7.245.** (*a*)	**7.246.** (*a*)
7.247. (*c*)	**7.248.** (*a*)	**7.249.** (*c*)	**7.250.** (*e*)	**7.251.** (*d*)	**7.252.** (*b*)
7.253. (*d*)	**7.254.** (*a*)	**7.255.** (*c*)	**7.256.** (*c*)	**7.257.** (*d*)	**7.258.** (*b*)
7.259. (*b*)	**7.260.** (*b*)	**7.261.** (*b*)	**7.262.** (*d*)	**7.263.** (*a*)	**7.264.** (*b*)
7.265. (*d*)	**7.266.** (*b*)	**7.267.** (*e*)	**7.268.** (*c*)	**7.269.** (*c*)	**7.270.** (*a*)
7.271. (*b*)	**7.272.** (*d*)	**7.273.** (*e*)	**7.274.** (*c*)	**7.275.** (*c*)	**7.276.** (*d*)
7.277. (*b*)	**7.278.** (*d*)	**7.279.** (*b*)			

Chapter 8
FLUID MECHANICS

8.1. (*d*)	**8.2.** (*c*)	**8.3.** (*d*)	**8.4.** (*d*)	**8.5.** (*e*)	**8.6.** (*d*)
8.7. (*e*)	**8.8.** (*c*)	**8.9.** (*e*)	**8.10.** (*c*)	**8.11.** (*d*)	**8.12.** (*d*)
8.13. (*e*)	**8.14.** (*b*)	**8.15.** (*c*)	**8.16.** (*c*)	**8.17.** (*a*)	**8.18.** (*d*)

8.19. (*c*) **8.20.** (*d*) **8.21.** (*d*) **8.22.** (*e*) **8.23.** (*e*) **8.24.** (*a*)
8.25. (*d*) **8.26.** (*a*) **8.27.** (*e*) **8.28.** (*d*) **8.29.** (*d*) **8.30.** (*a*)
8.31. (*b*) **8.32.** (*c*) **8.33.** (*c*) **8.34.** (*a*) **8.35.** (*a*) **8.36.** (*b*)
8.37. (*d*) **8.38.** (*e*) **8.39.** (*d*) **8.40.** (*c*) **8.41.** (*a*) **8.42.** (*a*)
4.43. (*b*) **8.44.** (*b*) **8.45.** (*e*) **8.46.** (*c*) **8.47.** (*d*) **8.48.** (*b*)
8.49. (*a*) **8.50.** (*a*) **8.51.** (*a*) **8.52.** (*a*) **8.53.** (*b*) **8.54.** (*d*)
8.55. (*d*) **8.56.** (*c*) **8.57.** (*b*) **8.58.** (*d*) **8.59.** (*a*) **8.60.** (*c*)
8.61. (*a*) **8.62.** (*c*) **8.63.** (*d*) **8.64.** (*d*) **8.65.** (*b*) **8.66.** (*d*)
8.67. (*c*) **8.68.** (*c*) **8.69.** (*a*) **8.70.** (*c*) **8.71.** (*c*) **8.72.** (*b*)
8.73. (*c*) **8.74.** (*b*) **8.75.** (*d*) **8.76.** (*c*) **8.77.** (*b*) **8.78.** (*d*)
8.79. (*c*) **8.80.** (*a*) **8.81.** (*a*) **8.82.** (*c*) **8.83.** (*c*) **8.84.** (*c*)
8.85. (*b*) **8.86.** (*c*) **8.87.** (*b*) **8.88.** (*e*) **8.89.** (*d*) **8.90.** (*c*)
8.91. (*b*) **8.92.** (*c*) **8.93.** (*a*) **8.94.** (*c*) **8.95.** (*b*) **8.96.** (*c*)
8.97. (*a*) **8.98.** (*c*) **8.99.** (*d*) **8.100.** (*c*) **8.101.** (*d*) **8.102.** (*a*)
8.103. (*a*) **8.104.** (*b*)* **8.105.** (*d*) **8.106.** (*b*) **8.107.** (*d*) **8.108.** (*c*)
8.109. (*d*) **8.110.** (*b*) **8.111.** (*e*) **8.112.** (*e*) **8.113.** (*c*)* **8.114.** (*e*)
8.115. (*b*) **8.116.** (*e*) **8.117.** (*a*) **8.118.** (*c*) **8.119.** (*b*) **8.120.** (*a*)
8.121. (*d*) **8.122.** (*c*) **8.123.** (*d*) **8.124.** (*d*) **8.125.** (*c*) **8.126.** (*a*)
8.127. (*b*) **8.128.** (*a*) **8.129.** (*d*) **8.130.** (*b*) **8.131.** (*a*) **8.132.** (*c*)
8.133. (*b*) **8.134.** (*c*) **8.135.** (*c*) **8.136.** (*a*) **8.137.** (*b*) **8.138.** (*c*)
8.139. (*a*) **8.140.** (*d*) **8.141.** (*a*) **8.142.** (*b*) **8.143.** (*d*)* **8.144.** (*c*)
8.145. (*c*) **8.146.** (*e*) **8.147.** (*a*) **8.148.** (*a*) **8.149.** (*a*) **8.150.** (*a*)
8.151. (*d*) **8.152.** (*b*) **8.153.** (*b*) **8.154.** (*d*) **8.155.** (*b*) **8.156.** (*d*)
8.157. (*d*) **8.158.** (*d*) **8.159.** (*d*) **8.160.** (*d*) **8.161.** (*d*) **8.162.** (*d*)
8.163. (*c*)* **8.164.** (*e*) **8.165.** (*a*)* **8.166.** (*a*) **8.167.** (*e*) **8.168.** (*d*)
8.169. (*a*) **8.170.** (*e*) **8.171.** (*c*) **8.172.** (*c*) **8.173.** (*d*) **8.174.** (*b*)
8.175. (*d*) **8.176.** (*d*) **8.177.** (*b*) **8.178.** (*c*) **8.179.** (*c*) **8.180.** (*c*)
8.181. (*b*) **8.182.** (*b*) **8.183.** (*b*) **8.184.** (*e*) **8.185.** (*a*) **8.186.** (*d*)
8.187. (*c*) **8.188.** (*d*) **8.189.** (*a*) **8.190.** (*d*) **8.191.** (*c*) **8.192.** (*c*)
8.193. (*e*) **8.194.** (*b*) **8.195.** (*c*) **8.196.** (*d*) **8.197.** (*b*) **8.198.** (*a*)
8.199. (*e*) **8.200.** (*c*) **8.201.** (*b*) **8.202.** (*d*) **8.203.** (*b*) **8.204.** (*e*)
8.205. (*a*) **8.206.** (*b*) **8.207.** (*e*) **8.208.** (*c*) **8.209.** (*d*) **8.210.** (*b*)
8.211. (*d*) **8.212.** (*c*) **8.213.** (*d*) **8.214.** (*a*) **8.215.** (*c*)* **8.216.** (*b*)*
8.217. (*c*) **8.218.** (*c*) **8.219.** (*c*) **8.220.** (*d*) **8.221.** (*a*) **8.222.** (*d*)
8.223. (*c*) **8.224.** (*d*) **8.225.** (*d*) **8.226.** (*c*) **8.227.** (*c*) **8.228.** (*a*)
8.229. (*c*) **8.230.** (*d*) **8.231.** (*d*) **8.232.** (*a*) **8.233.** (*c*) **8.234.** (*d*)
8.235. (*b*) **8.236.** (*a*) **8.237.** (*e*) **8.238.** (*a*) **8.239.** (*a*) **8.240.** (*d*)
8.241. (*e*) **8.242.** (*d*) **8.243.** (*e*) **8.244.** (*a*) **8.245.** (*c*) **8.246.** (*c*)
8.247. (*a*) **8.248.** (*d*) **8.249.** (*a*) **8.250.** (*b*) **8.251.** (*d*) **8.252.** (*c*)
8.253. (*a*) **8.254.** (*d*) **8.255.** (*a*) **8.256.** (*a*) **8.257.** (*a*) **8.258.** (*c*)
8.259. (*a*) **8.260.** (*b*) **8.261.** (*d*) **8.262.** (*b*) **8.263.** (*b*) **8.264.** (*a*)
8.265. (*b*) **8.266.** (*c*) **8.267.** (*e*) **8.268.** (*a*) **8.269.** (*d*) **8.270.** ~~(*d*)~~
8.271. (*b*) **8.272.** (*a*) **8.273.** (*e*) **8.274.** (*e*) **8.275.** (*b*) **8.276.** (*d*)
8.277. (*b*) **8.278.** (*d*) **8.279.** (*b*) **8.280.** (*d*) **8.281.** (*c*) **8.282.** (*c*)
8.283. (*a*) **8.284.** (*a*) **8.285.** (*b*) **8.286.** (*d*) **8.287.** (*a*) **8.288.** (*d*)
8.289. (*d*) **8.290.** (*a*) **8.291.** (*e*) **8.292.** (*c*) **8.293.** (*a*) **8.294.** (*b*)

8.295. (*e*) **8.296.** (*c*) **8.297.** (*d*) **8.298.** (*b*) **8.299.** (*d*) **8.300.** (*b*)
8.301. (*a*) **8.302.** (*a*) **8.303.** (*d*) **8.304.** (*e*) **8.305.** (*e*) **8.306.** (*d*)
8.307. (*e*) **8.308.** (*c*) **8.309.** (*a*) **8.310.** (*c*) **8.311.** (*b*) **8.312.** (*a*)
8.313. (*a*) **8.314.** (*c*) **8.315.** (*c*) **8.316.** (*a*) **8.317.** (*d*) **8.318.** (*c*)
8.319. (*d*) **8.320.** (*c*) **8.321.** (*c*) **8.322.** (*d*) **8.323.** (*b*) **8.324.** (*c*)
8.325. (*a*) **8.326.** (*c*) **8.327.** (*d*) **8.328.** (*a*) **8.329.** (*e*) **8.330.** (*a*)
8.331. (*c*) **8.332.** (*a*) **8.333.** (*a*) **8.334.** (*c*) **8.335.** (*c*) **8.336.** (*a*)
8.337. (*d*) **8.338.** (*a*) **8.339.** (*d*) **8.340.** (*b*) **8.341.** (*c*) **8.342.** (*d*)
8.343. (*a*) **8.344.** (*b*) **8.345.** (*d*) **8.346.** (*d*) **8.347.** (*d*) **8.348.** (*d*)
8.349. (*c*) **8.350.** (*d*) **8.351.** (*a*) **8.352.** (*d*) **8.353.** (*b*) **8.354.** (*a*)
8.355. (*e*) **8.356.** (*e*) **8.357.** (*a*) **8.358.** (*b*) **8.359.** (*d*) **8.360.** (*a*)
8.361. (*a*) **8.362.** (*d*) **8.363.** (*c*) **8.364.** (*c*) **8.365.** (*c*) **8.366.** (*c*)
8.367. (*a*) **8.368.** (*a*) **8.369.** (*a*) **8.370.** (*b*) **8.371.** (*a*) **8.372.** (*b*)
8.373. (*a*) **8.374.** (*c*) **8.375.** (*c*) **8.376.** (*c*) **8.377.** (*c*) **8.378.** (*c*)
8.379. (*c*) **8.380.** (*e*) **8.381.** (*b*) **8.382.** (*d*) **8.383.** (*c*) **8.384.** (*d*)
8.385. (*b*) **8.386.** (*a*) **8.387.** (*e*) **8.388.** (*e*) **8.389.** (*c*) **8.390.** (*c*)
8.391. (*b*) **8.392.** (*a*) **8.393.** (*a*) **8.394.** (*d*) **8.395.** (*c*) **8.396.** (*e*)
8.397. (*d*) **8.398.** (*b*) **8.399.** (*e*) **8.400.** (*e*) **8.401.** (*d*) **8.402.** (*a*)
8.403. (*d*) **8.404.** (*b*) **8.405.** (*c*) **8.406.** (*d*) **8.407.** (*a*) **8.408.** (*c*)
8.409. (*b*) **8.410.** (*a*) **8.411.** (*d*) **8.412.** (*e*) **8.413.** (*a*) **8.414.** (*b*)
8.415. (*a*) **8.416.** (*a*) **8.417.** (*a*) **8.418.** (*b*) **8.419.** (*b*) **8.420.** (*a*)
8.421. (*c*) **8.422.** (*b*) **8.423.** (*a*) **8.424.** (*d*) **8.425.** (*a*) **8.426.** (*c*)
8.427. (*a*) **8.428.** (*b*) **8.429.** (*c*) **8.430.** (*b*) **8.431.** (*b*) **8.432.** (*e*)
8.433. (*c*) **8.434.** (*b*) **8.435.** (*c*) **8.436.** (*d*) **8.437.** (*e*) **8.438.** (*a*)
8.439. (*b*) **8.440.** (*c*) **8.441.** (*d*) **8.442.** (*d*) **8.443.** (*d*) **8.444.** (*c*)
8.445. (*b*) **8.446.** (*d*) **8.447.** (*e*) **8.448.** (*a*)* **8.449.** (*c*) **8.450.** (*e*)
8.451. (*c*) **8.452.** (*d*) **8.453.** (*d*) **8.454.** (*d*) **8.455.** (*b*) **8.456.** (*a*)
8.457. (*b*) **8.458.** (*b*) **8.459.** (*c*) **8.460.** (*b*) **8.461.** (*b*) **8.462.** (*d*)
8.463. (*c*)

Chapter 9
HYDRAULIC MACHINES

9.1. (*b*) **9.2.** (*b*) **9.3.** (*b*) **9.4.** (*a*) **9.5.** (*a*) **9.6.** (*a*)
9.7. (*c*) **9.8.** (*e*) **9.9.** (*b*) **9.10.** (*c*) **9.11.** (*c*) **9.12.** (*e*)
9.13. (*a*) **9.14.** (*d*) **9.15.** (*a*) **9.16.** (*b*) **9.17.** (*c*) **9.18.** (*d*)
9.19. (*b*) **9.20.** (*a*) **9.21.** (*b*) **9.22.** (*b*) **9.23.** (*c*) **9.24.** (*d*)
9.25. (*a*) **9.26.** (*b*) **9.27.** (*a*) **9.28.** (*c*) **9.29.** (*b*) **9.30.** (*c*)
9.31. (*b*) **9.32.** (*b*) **9.33.** (*d*) **9.34.** (*a*) **9.35.** (*b*) **9.36.** (*c*)
9.37. (*e*) **9.38.** (*c*) **9.39.** (*e*) **9.40.** (*b*) **9.41.** (*b*) **9.42.** (*c*)
9.43. (*b*) **9.44.** (*c*) **9.45.** (*d*) **9.46.** (*c*) **9.47.** (*b*) **9.48.** (*b*)
9.49. (*a*) **9.50.** (*d*) **9.51.** (*a*) **9.52.** (*a*) **9.53.** (*a*) **9.54.** (*b*)
9.55. (*a*) **9.56.** (*c*) **9.57.** (*c*) **9.58.** (*c*) **9.59.** (*d*) **9.60.** (*b*)
9.61. (*c*) **9.62.** (*c*) **9.63.** (*c*) **9.64.** (*d*) **9.65.** (*c*) **9.66.** (*a*)
9.67. (*d*) **9.68.** (*a*) **9.69.** (*c*) **9.70.** (*b*) **9.71.** (*b*) **9.72.** (*b*)

9.73. (*e*)	**9.74.** (*a*)	**9.75.** (*b*)	**9.76.** (*d*)	**9.77.** (*a*)	**9.78.** (*d*)
9.79. (*d*)	**9.80.** (*b*)	**9.81.** (*c*)	**9.82.** (*a*)	**9.83.** (*b*)	**9.84.** (*b*)
9.85. (*a*)	**9.86.** (*e*)	**9.87.** (*d*)	**9.88.** (*b*)	**9.89.** (*a*)	**9.90.** (*a*)
9.91. (*a*)	**9.92.** (*b*)	**9.93.** (*c*)	**9.94.** (*d*)	**9.95.** (*e*)	**9.96.** (*b*)
9.97. (*b*)	**9.98.** (*a*)	**9.99.** (*c*)	**9.100.** (*a*)	**9.101.** (*b*)	**9.102.** (*c*)
9.103. (*b*)	**9.104.** (*b*)	**9.105.** (*e*)	**9.106.** (*b*)	**9.107.** (*d*)	**9.108.** (*b*)
9.109. (*c*)	**9.110.** (*a*)	**9.111.** (*a*)	**9.112.** (*a*)	**9.113.** (*b*)	**9.114.** (*a*)
9.115. (*c*)	**9.116.** (*b*)	**9.117.** (*d*)	**9.118.** (*b*)	**9.119.** (*d*)	**9.120.** (*c*)
9.121. (*a*)	**9.122.** (*c*)	**9.123.** (*a*)	**9.124.** (*b*)	**9.125.** (*d*)	**9.126.** (*b*)
9.127. (*d*)	**9.128.** (*c*)	**9.129.** (*b*)	**9.130.** (*b*)	**9.131.** (*b*)	**9.132.** (*c*)
9.133. (*b*)	**9.134.** (*c*)	**9.135.** (*c*)	**9.136.** (*b*)	**9.137.** (*a*)	**9.138.** (*c*)
9.139. (*b*)	**9.140.** (*a*)	**9.141.** (*d*)	**9.142.** (*e*)	**9.143.** (*a*)	**9.144.** (*b*)
9.145. (*b*)	**9.146.** (*d*)	**9.147.** (*e*)	**9.148.** (*d*)	**9.149.** (*b*)	**9.150.** (*d*)
9.151. (*e*)	**9.152.** (*b*)	**9.153.** (*d*)	**9.154.** (*a*)	**9.155.** (*a*)	**9.156.** (*b*)
9.157. (*c*)	**9.158.** (*a*)	**9.159.** (*b*)	**9.160.** (*c*)	**9.161.** (*e*)	**9.162.** (*b*)
9.163. (*b*)	**9.164.** (*c*)	**9.165.** (*d*)	**9.166.** (*a*)	**9.167.** (*b*)	**9.168.** (*a*)
9.169. (*b*)	**9.170.** (*d*)	**9.171.** (*b*)	**9.172.** (*c*)	**9.173.** (*a*)	

Chpater 10
ENGINEERING MECHANICS

10.1. (*b*)	**10.2.** (*e*)	**10.3.** (*b*)	**10.4.** (*a*)	**10.5.** (*b*)	**10.6.** (*e*)
10.7. (*d*)	**10.8.** (*d*)	**10.9.** (*b*)	**10.10.** (*b*)	**10.11.** (*d*)	**10.12.** (*d*)
10.13. (*e*)	**10.14.** (*a*)	**10.15.** (*e*)	**10.16.** (*e*)	**10.17.** (*e*)	**10.18.** (*d*)
10.19. (*e*)	**10.20.** (*e*)	**10.21.** (*b*)	**10.22.** (*e*)	**10.23.** (*e*)	**10.24.** (*c*)
10.25. (*c*)	**10.26.** (*c*)	**10.27.** (*c*)	**10.28.** (*c*)	**10.29.** (*b*)	**10.30.** (*a*)
10.31. (*c*)	**10.32.** (*c*)	**10.33.** (*d*)	**10.34.** (*c*)	**10.35.** (*b*)	**10.36.** (*a*)
10.37. (*c*)	**10.38.** (*d*)	**10.39.** (*e*)	**10.40.** (*a*)	**10.41.** (*c*)	**10.42.** (*d*)
10.43. (*b*)	**10.44.** (*c*)	**10.45.** (*a*)	**10.46.** (*c*)	**10.47.** (*b*)	**10.48.** (*b*)
10.49. (*d*)	**10.50.** (*a*)	**10.51.** (*a*)	**10.52.** (*a*)	**10.53.** (*b*)	**10.54.** (*c*)
10.55. (*a*)	**10.56.** (*b*)	**10.57.** (*a*)	**10.58.** (*d*)	**10.59.** (*d*)	**10.60.** (*b*)
10.61. (*b*)	**10.62.** (*d*)	**10.63.** (*c*)	**10.64.** (*c*)	**10.65.** (*a*)	**10.66.** (*a*)
10.67. (*d*)	**10.68.** (*a*)	**10.69.** (*d*)	**10.70.** (*d*)	**10.71.** (*a*)	**10.72.** (*d*)
10.73. (*c*)	**10.74.** (*d*)	**10.75.** (*c*)	**10.76.** (*e*)	**10.77.** (*b*)	**10.78.** (*c*)
10.79. (*c*)	**10.80.** (*c*)	**10.81.** (*d*)	**10.82.** (*c*)	**10.83.** (*a*)	**10.84.** (*b*)
10.85. (*b*)	**10.86.** (*c*)	**10.87.** (*b*)	**10.88.** (*c*)	**10.89.** (*a*)	**10.90.** (*c*)
10.91. (*c*)	**10.92.** (*d*)	**10.93.** (*d*)	**10.94.** (*d*)	**10.95.** (*a*)	**10.96.** (*c*)
10.97. (*d*)	**10.98.** (*a*)	**10.99.** (*b*)	**10.100.** (*d*)	**10.101.** (*a*)	**10.102.** (*a*)
10.103. (*a*)	**10.104.** (*c*)	**10.105.** (*a*)	**10.106.** (*c*)	**10.107.** (*b*)	**10.108.** (*b*)
10.109. (*d*)	**10.110.** (*b*)	**10.111.** (*c*)	**10.112.** (*a*)	**10.113.** (*d*)	**10.114.** (*a*)
10.115. (*a*)	**10.116.** (*a*)	**10.117.** (*a*)	**10.118.** (*b*)	**10.119.** (*d*)	**10.120.** (*b*)
10.121. (*d*)	**10.122.** (*b*)	**10.123.** (*a*)	**10.124.** (*b*)	**10.125.** (*c*)	**10.126.** (*d*)
10.127. (*c*)	**10.128.** (*a*)	**10.129.** (*c*)	**10.130.** (*c*)	**10.131.** (*b*)	**10.132.** (*a*)
10.133. (*d*)	**10.134.** (*c*)	**10.135.** (*a*)	**10.136.** (*b*)	**10.137.** (*d*)	**10.138.** (*c*)
10.139. (*d*)	**10.140.** (*e*)	**10.141.** (*a*)	**10.142.** (*d*)	**10.143.** (*c*)	**10.144.** (*b*)

10.145. (*c*) **10.146.** (*a*) **10.147.** (*d*) **10.148.** (*c*) **10.149.** (*c*) **10.150.** (*c*)
10.151. (*d*) **10.152.** (*a*) **10.153.** (*b*) **10.154.** (*c*) **10.155.** (*b*) **10.156.** (*d*)
10.157. (*d*) **10.158.** (*c*) **10.159.** (*d*) **10.160.** (*a*) **10.161.** (*c*) **10.162.** (*a*)
10.163. (*d*) **10.164.** (*b*) **10.165.** (*a*) **10.166.** (*d*) **10.167.** (*c*) **10.168.** (*b*)
10.169. (*b*) **10.170.** (*b*) **10.171.** (*b*) **10.172.** (*d*) **10.173.** (*a*) **10.174.** (*a*)
10.175. (*c*) **10.176.** (*e*) **10.177.** (*b*) **10.178.** (*b*) **10.179.** (*d*) **10.180.** (*d*)
10.181. (*c*) **10.182.** (*b*) **10.183.** (*a*) **10.184.** (*a*) **10.185.** (*d*) **10.186.** (*d*)
10.187. (*a*)* **10.188.** (*a*) **10.189.** (*e*)* **10.190.** (*d*) **10.191.** (*a*)* **10.192.** (*c*)
10.193. (*a*) **10.194.** (*b*) **10.195.** (*a*)* **10.196.** (*c*)* **10.197.** (*d*) **10.198.** (*d*)*
10.199. (*d*)* **10.200.** (*d*) **10.201.** (*b*) **10.202.** (*b*) **10.203.** (*b*) **10.204.** (*b*)
10.205. (*d*) **10.206.** (*c*) **10.207.** (*d*) **10.208.** (*a*) **10.209.** (*b*) **10.210.** (*b*)
10.211. (*b*) **10.212.** (*d*) **10.213.** (*b*) **10.214.** (*b*) **10.215.** (*a*) **10.216.** (*a*)
10.217. (*d*) **10.218.** (*c*) **10.219.** (*c*) **10.220.** (*c*) **10.221.** (*c*) **10.222.** (*c*)
10.223. (*b*) **10.224.** (*c*) **10.225.** (*a*) **10.226.** (*c*) **10.227.** (*c*) **10.228.** (*d*)
10.229. (*e*) **10.230.** (*c*) **10.231.** (*d*) **10.232.** (*d*) **10.233.** (*c*) **10.234.** (*d*)
10.235. (*c*) **10.236.** (*b*) **10.237.** (*d*) **10.238.** (*c*) **10.239.** (*d*) **10.240.** (*b*)
10.241. (*b*) **10.242.** (*b*) **10.243.** (*c*) **10.244.** (*c*) **10.245.** (*b*) **10.246.** (*a*)
10.247. (*a*) **10.248.** (*a*) **10.249.** (*c*) **10.250.** (*c*) **10.251.** (*c*) **10.252.** (*a*)
10.253. (*d*) **10.254.** (*c*) **10.255.** (*c*) **10.256.** (*b*) **10.257.** (*b*) **10.258.** (*c*)
10.259. (*b*) **10.260.** (*b*) **10.261.** (*e*) **10.262.** (*c*) **10.263.** (*a*) **10.264.** (*a*)
10.265. (*b*) **10.266.** (*b*) **10.267.** (*c*) **10.268.** (*c*) **10.269.** (*c*) **10.270.** (*c*)
10.271. (*e*) **10.272.** (*d*) **10.273.** (*a*) **10.274.** (*a*) **10.275.** (*d*) **10.276.** (*c*)
10.277. (*c*) **10.278.** (*d*) **10.279.** (*c*) **10.280.** (*b*) **10.281.** (*d*) **10.282.** (*c*)
10.283. (*b*) **10.284.** (*c*) **10.285.** (*a*) **10.286.** (*b*) **10.287.** (*b*) **10.288.** (*d*)
10.289. (*b*) **10.290.** (*c*) **10.291.** (*b*) **10.292.** (*c*) **10.293.** (*d*) **10.294.** (*d*)
10.295. (*d*) **10.296.** (*a*) **10.297.** (*a*) **10.298.** (*b*)* **10.299.** (*d*)* **10.300.** (*a*)
10.301. (*c*)* **10.302.** (*c*) **10.303.** (*a*) **10.304.** (*c*)* **10.305.** (*a*) **10.306.** (*a*)
10.307. (*a*) **10.308.** (*d*) **10.309.** (*a*)* **10.310.** (*c*)* **10.311.** (*b*) **10.312.** (*d*)
10.313. (*c*) **10.314.** (*d*)* **10.315.** (*b*)* **10.316.** (*d*)* **10.317.** (*a*) **10.318.** (*a*)
10.319. (*a*) **10.320.** (*a*) **10.321.** (*b*) **10.322.** (*e*) **10.323.** (*c*) **10.324.** (*a*)
10.325. (*e*) **10.326.** (*d*) **10.327.** (*c*) **10.328.** (*b*) **10.329.** (*b*) **10.330.** (*d*)
10.331. (*c*) **10.332.** (*e*) **10.333.** (*a*) **10.334.** (*a*) **10.335.** (*b*) **10.336.** (*a*)
10.337. (*a*) **10.338.** (*e*) **10.339.** (*d*) **10.340.** (*c*) **10.341.** (*c*) **10.342.** (*d*)
10.343. (*d*) **10.344.** (*a*) **10.345.** (*a*) **10.346.** (*c*) **10.347.** (*b*) **10.348.** (*a*)
10.349. (*d*) **10.350.** (*d*) **10.351.** (*b*) **10.352.** (*e*) **10.353.** (*c*) **10.354.** (*b*)
10.355. (*a*) **10.356.** (*d*) **10.357.** (*b*) **10.358.** (*c*) **10.359.** (*d*) **10.360.** (*d*)
10.361. (*b*) **10.362.** (*c*) **10.363.** (*e*) **10.364.** (*b*) **10.365.** (*c*) **10.366.** (*a*)
10.367. (*b*) **10.368.** (*a*) **10.369.** (*d*)

Chapter 11
STRENGTH OF MATERIALS

11.1. (*d*) **11.2.** (*b*) **11.3.** (*c*) **11.4.** (*d*) **11.5.** (*c*) **11.6.** (*b*)
11.7. (*c*) **11.8.** (*d*) **11.9.** (*d*) **11.10.** (*b*) **11.11.** (*c*) **11.12.** (*a*)
11.13. (*d*) **11.14.** (*e*) **11.15.** (*b*) **11.16.** (*b*) **11.17.** (*a*) **11.18.** (*b*)

11.19. (*c*) **11.20.** (*d*) **11.21.** (*b*) **11.22.** (*b*) **11.23.** (*b*) **11.24.** (*d*)
11.25. (*a*) **11.26.** (*b*) **11.27.** (*c*) **11.28.** (*d*) **11.29.** (*b*) **11.30.** (*c*)
11.31. (*d*) **11.32.** (*b*) **11.33.** (*b*) **11.34.** (*c*) **11.35.** (*b*) **11.36.** (*b*)
11.37. (*c*) **11.38.** (*e*) **11.39.** (*a*) **11.40.** (*b*) **11.41.** (*e*) **11.42.** (*e*)
11.43. (*a*) **11.44.** (*a*) **11.45.** (*a*) **11.46.** (*a*) **11.47.** (*d*) **11.48.** (*d*)
11.49. (*e*) **11.50.** (*b*) **11.51.** (*d*) **11.52.** (*a*) **11.53.** (*a*) **11.54.** (*c*)
11.55. (*d*) **11.56.** (*b*) **11.57.** (*c*) **11.58.** (*b*) **11.59.** (*c*) **11.60.** (*c*)
11.61. (*a*) **11.62.** (*d*) **11.63.** (*c*) **11.64.** (*a*) **11.65.** (*c*) **11.66.** (*d*)
11.67. (*a*) **11.68.** (*c*) **11.69.** (*c*) **11.70.** (*b*) **11.71.** (*d*) **11.72.** (*a*)
11.73. (*c*) **11.74.** (*d*) **11.75.** (*b*) **11.76.** (*b*) **11.77.** (*d*) **11.78.** (*a*)
11.79. (*c*) **11.80.** (*b*) **11.81.** (*d*) **11.82.** (*c*) **11.83.** (*b*) **11.84.** (*c*)
11.85. (*a*) **11.86.** (*d*) **11.87.** (*d*) **11.88.** (*a*) **11.89.** (*b*) **11.90.** (*e*)
11.91. (*c*) **11.92.** (*a*) **11.93.** (*d*) **11.94.** (*a*) **11.95.** (*d*) **11.96.** (*b*)
11.97. (*a*) **11.98.** (*d*) **11.99.** (*e*) **11.100.** (*b*) **11.101.** (*b*)* **11.102.** (*d*)
11.103. (*c*) **11.104.** (*c*) **11.105.** (*a*) **11.106.** (*c*) **11.107.** (*a*) **11.108.** (*d*)
11.109. (*a*) **11.110.** (*c*) **11.111.** (*b*) **11.112.** (*a*) **11.113.** (*a*) **11.114.** (*b*)
11.115. (*c*) **11.116.** (*b*) **11.117.** (*d*) **11.118.** (*a*) **11.119.** (*e*) **11.120.** (*b*)
11.121. (*c*) **11.122.** (*b*) **11.123.** (*c*) **11.124.** (*e*) **11.125.** (*c*) **11.126.** (*b*)
11.127. (*e*) **11.128.** (*b*) **11.129.** (*a*) **11.130.** (*d*) **11.131.** (*b*) **11.132.** (*c*)
11.133. (*e*) **11.134.** (*b*) **11.135.** (*a*) **11.136.** (*c*) **11.137.** (*e*) **11.138.** (*b*)
11.139. (*a*) **11.140.** (*d*) **11.141.** (*c*) **11.142.** (*a*) **11.143.** (*b*) **11.144.** (*e*)
11.145. (*a*) **11.146.** (*a*) **11.147.** (*b*) **11.148.** (*b*) **11.149.** (*b*) **11.150.** (*a*)
11.151. (*d*) **11.152.** (*a*) **11.153.** (*a*) **11.154.** (*d*) **11.155.** (*a*) **11.156.** (*c*)*
11.157. (*a*) **11.158.** (*b*) **11.159.** (*c*) **11.160.** (*a*) **11.161.** (*c*) **11.162.** (*b*)
11.163. (*b*)* **11.164.** (*b*)* **11.165.** (*a*)* **11.166.** (*c*)* **11.167.** (*a*) **11.168.** (*a*)*
11.169. (*d*) **11.170.** (*c*) **11.171.** (*a*) **11.172.** (*a*) **11.173.** (*b*) **11.174.** (*a*)
11.175. (*c*) **11.176.** (*d*) **11.177.** (*a*) **11.178.** (*c*) **11.179.** (*a*) **11.180.** (*c*)
11.181. (*a*) **11.182.** (*a*) **11.183.** (*d*) **11.184.** (*b*) **11.185.** (*a*) **11.186.** (*a*)
11.187. (*c*) **11.188.** (*d*) **11.189.** (*d*) **11.190.** (*b*) **11.191.** (*b*) **11.192.** (*d*)
11.193. (*a*) **11.194.** (*b*) **11.195.** (*b*) **11.196.** (*b*) **11.197.** (*a*) **11.198.** (*b*)
11.199. (*c*) **11.200.** (*c*) **11.201.** (*d*) **11.202.** (*a*) **11.203.** (*a*) **11.204.** (*a*)
11.205. (*a*) **11.206.** (*a*) **11.207.** (*d*) **11.208.** (*c*) **11.209.** (*e*) **11.210.** (*e*)
11.211. (*a*) **11.212.** (*c*) **11.213.** (*b*) **11.214.** (*b*) **11.215.** (*c*) **11.216.** (*b*)
11.217. (*a*) **11.218.** (*b*) **11.219.** (*a*) **11.220.** (*b*) **11.221.** (*b*) **11.222.** (*b*)
11.223. (*a*) **11.224.** (*a*) **11.225.** (*a*) **11.226.** (*d*) **11.227.** (*e*) **11.228.** (*d*)
11.229. (*b*) **11.230.** (*a*) **11.231.** (*a*) **11.232.** (*d*) **11.233.** (*d*) **11.234.** (*b*)
11.235. (*b*) **11.236.** (*a*) **11.237.** (*a*) **11.238.** (*a*) **11.239.** (*d*) **11.240.** (*b*)
11.241. (*b*) **11.242.** (*c*) **11.243.** (*b*) **11.244.** (*b*) **11.245.** (*b*) **11.246.** (*c*)
11.247. (*c*) **11.248.** (*b*) **11.249.** (*d*) **11.250.** (*d*) **11.251.** (*d*) **11.252.** (*c*)
11.253. (*d*) **11.254.** (*a*) **11.255.** (*b*) **11.256.** (*d*) **11.257.** (*c*) **11.258.** (*c*)
11.259. (*b*) **11.260.** (*b*) **11.261.** (*b*) **11.262.** (*a*) **11.263.** (*c*) **11.264.** (*a*)
11.265. (*c*) **11.266.** (*c*) **11.267.** (*a*) **11.268.** (*e*) **11.269.** (*e*) **11.270.** (*a*)
11.271. (*d*) **11.272.** (*e*) **11.273.** (*a*) **11.274.** (*a*) **11.275.** (*d*) **11.276.** (*b*)
11.277. (*a*) **11.278.** (*d*) **11.279.** (*a*) **11.280.** (*a*) **11.281.** (*c*) **11.282.** (*a*)
11.283. (*d*) **11.284.** (*c*)* **11.285.** (*b*) **11.286.** (*a*) **11.287.** (*d*) **11.288.** (*c*)
11.289. (*b*) **11.290.** (*c*) **11.291.** (*c*) **11.292.** (*c*) **11.293.** (*a*) **11.294.** (*b*)

11.295. (*d*)	**11.296.** (*d*)	**11.297.** (*a*)	**11.298.** (*d*)	**11.299.** (*b*)	**11.300.** (*a*)
11.301. (*d*)	**11.302.** (*b*)	**11.303.** (*e*)	**11.304.** (*c*)	**11.305.** (*a*)	**11.306.** (*e*)
11.307. (*b*)	**11.308.** (*c*)	**11.309.** (*d*)	**11.310.** (*a*)	**11.311.** (*a*)	**11.312.** (*b*)
11.313. (*c*)	**11.314.** (*a*)	**11.315.** (*e*)	**11.316.** (*a*)	**11.317.** (*a*)	**11.318.** (*a*)
11.319. (*b*)	**11.320.** (*c*)	**11.321.** (*d*)	**11.322.** (*a*)	**11.323.** (*a*)	**11.324.** (*c*)
11.325. (*a*)	**11.326.** (*a*)	**11.327.** (*e*)	**11.328.** (*b*)	**11.329.** (*c*)	**11.330.** (*d*)
11.331. (*d*)	**11.332.** (*c*)	**11.333.** (*d*)	**11.334.** (*c*)	**11.335.** (*a*)	**11.336.** (*b*)
11.337. (*a*)	**11.338.** (*d*)	**11.339.** (*a*)	**11.340.** (*d*)	**11.341.** (*c*)	**11.342.** (*b*)
11.343. (*b*)	**11.344.** (*a*)	**11.345.** (*d*)	**11.346.** (*c*)	**11.347.** (*a*)	**11.348.** (*d*)
11.349. (*c*)	**11.350.** (*e*)	**11.351.** (*c*)	**11.352.** (*c*)	**11.353.** (*a*)	**11.354.** (*d*)
11.355. (*a*)	**11.356.** (*d*)	**11.357.** (*e*)	**11.358.** (*d*)	**11.359.** (*b*)	**11.360.** (*b*)
11.361. (*c*)	**11.362.** (*a*)	**11.363.** (*c*)	**11.364.** (*b*)	**11.365.** (*e*)	**11.366.** (*a*)
11.367. (*b*)	**11.368.** (*a*)	**11.369.** (*b*)	**11.370.** (*b*)	**11.371.** (*a*)	**11.372.** (*e*)
11.373. (*a*)	**11.374.** (*a*)	**11.375.** (*b*)	**11.376.** (*b*)	**11.377.** (*c*)	**11.378.** (*b*)
11.379. (*c*)	**11.380.** (*c*)	**11.381.** (*b*)	**11.382.** (*e*)	**11.383.** (*b*)	**11.384.** (*e*)
11.385. (*b*)	**11.386.** (*d*)	**11.387.** (*b*)	**11.388.** (*a*)	**11.389.** (*b*)	**11.390.** (*a*)
11.391. (*c*)	**11.392.** (*c*)	**11.393.** (*d*)	**11.394.** (*e*)	**11.395.** (*d*)	**11.396.** (*a*)
11.397. (*d*)	**11.398.** (*c*)	**11.399.** (*c*)	**11.400.** (*a*)	**11.401.** (*d*)	**11.402.** (*d*)
11.403. (*b*)	**11.404.** (*b*)	**11.405.** (*c*)	**11.406.** (*d*)	**11.407.** (*b*)	**11.408.** (*a*)
11.409. (*d*)	**11.410.** (*d*)	**11.411.** (*d*)	**11.412.** (*d*)	**11.413.** (*a*)	**11.414.** (*d*)
11.415. (*c*)	**11.416.** (*b*)	**11.417.** (*b*)	**11.418.** (*c*)	**11.419.** (*b*)	**11.420.** (*d*)
11.421. (*d*)	**11.422.** (*b*)	**11.423.** (*d*)	**11.424.** (*c*)	**11.425.** (*a*)	**11.426.** (*c*)
11.427. (*c*)	**11.428.** (*c*)	**11.429.** (*d*)	**11.430.** (*c*)	**11.431.** (*d*)	**11.432.** (*a*)
11.433. (*a*)	**11.434.** (*a*)	**11.435.** (*a*)	**11.436.** (*c*)	**11.437.** (*a*)	**11.438.** (*b*)
11.439. (*b*)	**11.440.** (*a*)	**11.441.** (*c*)	**11.442.** (*b*)	**11.443.** (*b*)	

Chapter 12
THEORY OF MACHINES

12.1. (*d*)	**12.2.** (*e*)	**12.3.** (*a*)	**12.4.** (*a*)	**12.5.** (*d*)	**12.6.** (*e*)
12.7. (*d*)	**12.8.** (*c*)	**12.9.** (*d*)	**12.10.** (*c*)	**12.11.** (*d*)	**12.12.** (*b*)
12.13. (*b*)	**12.14.** (*c*)	**12.15.** (*a*)	**12.16.** (*c*)	**12.17.** (*e*)	**12.18.** (*a*)
12.19. (*a*)	**12.20.** (*a*)	**12.21.** (*c*)	**12.22.** (*c*)	**12.23.** (*d*)	**12.24.** (*b*)
12.25. (*e*)	**12.26.** (*e*)	**12.27.** (*d*)	**12.28.** (*d*)	**12.29.** (*e*)	**12.30.** (*e*)
12.31. (*a*)	**12.32.** (*a*)	**12.33.** (*b*)	**12.34.** (*d*)	**12.35.** (*e*)	**12.36.** (*b*)
12.37. (*c*)	**12.38.** (*c*)	**12.39.** (*c*)	**12.40.** (*a*)	**12.41.** (*a*)	**12.42.** (*a*)
12.43. (*b*)	**12.44.** (*c*)	**12.45.** (*c*)	**12.46.** (*a*)	**12.47.** (*a*)	**12.48.** (*b*)
12.49. (*c*)	**12.50.** (*a*)	**12.51.** (*c*)	**12.52.** (*a*)	**12.53.** (*b*)	**12.54.** (*c*)
12.55. (*d*)	**12.56.** (*d*)	**12.57.** (*a*)	**12.58.** (*c*)	**12.59.** (*c*)	**12.60.** (*d*)
12.61. (*c*)	**12.62.** (*c*)	**12.63.** (*b*)	**12.64.** (*b*)	**12.65.** (*c*)	**12.66.** (*b*)
12.67. (*c*)	**12.68.** (*c*)	**12.69.** (*c*)	**12.70.** (*c*)	**12.71.** (*c*)	**12.72.** (*b*)
12.73. (*c*)	**12.74.** (*e*)	**12.75.** (*d*)	**12.76.** (*e*)	**12.77.** (*c*)	**12.78.** (*d*)
12.79. (*a*)	**12.80.** (*c*)	**12.81.** (*a*)	**12.82.** (*d*)*	**12.83.** (*d*)	**12.84.** (*c*)
12.85. (*b*)	**12.86.** (*e*)	**12.87.** (*a*)	**12.88.** (*d*)	**12.89.** (*c*)	**12.90.** (*a*)
12.91. (*d*)	**12.92.** (*b*)	**12.93.** (*a*)	**12.94.** (*c*)	**12.95.** (*a*)	**12.96.** (*b*)

12.97. (*b*)* **12.98.** (*a*) **12.99.** (*d*) **12.100.** (*b*) **12.101.** (*c*)* **12.102.** (*a*)
12.103. (*c*) **12.104.** (*c*) **12.105.** (*a*) **12.106.** (*c*) **12.107.** (*c*) **12.108.** (*d*)
12.109. (*b*) **12.110.** (*a*) **12.111.** (*c*) **12.112.** (*a*)* **12.113.** (*b*) **12.114.** (*c*)
12.115. (*b*) **12.116.** (*b*) **12.117.** (*a*) **12.118.** (*a*) **12.119.** (*c*) **12.120.** (*d*)
12.121. (*c*)* **12.122.** (*b*) **12.123.** (*a*) **12.124.** (*a*) **12.125.** (*c*) **12.126.** (*c*)
12.127. (*d*) **12.128.** (*c*) **12.129.** (*a*) **12.130.** (*e*) **12.131.** (*d*) **12.132.** (*b*)
12.133. (*d*) **12.134.** (*c*) **12.135.** (*a*) **12.136.** (*e*) **12.137.** (*b*) **12.138.** (*b*)
12.139. (*a*) **12.140.** (*b*) **12.141.** (*b*) **12.142.** (*c*) **12.143.** (*b*) **12.144.** (*a*)
12.145. (*a*) **12.146.** (*c*) **12.147.** (*c*) **12.148.** (*e*) **12.149.** (*b*) **12.150.** (*a*)
12.151. (*a*) **12.152.** (*a*) **12.153.** (*b*) **12.154.** (*c*) **12.155.** (*e*) **12.156.** (*a*)
12.157. (*e*) **12.158.** (*d*) **12.159.** (*b*) **12.160.** (*b*) **12.161.** (*a*) **12.162.** (*e*)
12.163. (*c*) **12.164.** (*d*) **12.165.** (*c*) **12.166.** (*a*) **12.167.** (*a*) **12.168.** (*c*)
12.169. (*b*) **12.170.** (*b*) **12.171.** (*d*) **12.172.** (*b*)* **12.173.** (*a*) **12.174.** (*a*)
12.175. (*b*) **12.176.** (*c*) **12.177.** (*d*) **12.178.** (*d*) **12.179.** (*b*) **12.180.** (*a*)
12.181. (*b*) **12.182.** (*a*) **12.183.** (*b*) **12.184.** (*e*) **12.185.** (*b*) **12.186.** (*d*)
12.187. (*b*) **12.188.** (*c*) **12.189.** (*b*) **12.190.** (*b*) **12.191.** (*a*) **12.192.** (*b*)
12.193. (*a*) **12.194.** (*c*) **12.195.** (*d*) **12.196.** (*e*) **12.197.** (*d*) **12.198.** (*a*)
12.199. (*d*) **12.200.** (*c*) **12.201.** (*b*) **12.202.** (*a*) **12.203.** (*a*) **12.204.** (*d*)
12.205. (*c*) **12.206.** (*d*) **12.207.** (*b*) **12.208.** (*e*) **12.209.** (*a*) **12.210.** (*e*)
12.211. (*e*) **12.212.** (*d*) **12.213.** (*c*) **12.214.** (*b*) **12.215.** (*e*) **12.216.** (*a*)
12.217. (*c*) **12.218.** (*b*) **12.219.** (*a*) **12.220.** (*c*) **12.221.** (*c*) **12.222.** (*b*)
12.223. (*c*) **12.224.** (*d*) **12.225.** (*c*) **12.226.** (*c*) **12.227.** (*c*) **12.228.** (*b*)
12.229. (*a*) **12.230.** (*e*) **12.231.** (*b*) **12.232.** (*a*) **12.233.** (*a*) **12.234.** (*b*)
12.235. (*d*) **12.236.** (*d*) **12.237.** (*d*) **12.238.** (*c*) **12.239.** (*a*) **12.240.** (*b*)
12.241. (*d*) **12.242.** (*d*) **12.243.** (*c*) **12.244.** (*a*) **12.245.** (*b*) **12.246.** (*c*)
12.247. (*c*) **12.248.** (*b*) **12.249.** (*e*) **12.250.** (*b*) **12.251.** (*e*) **12.252.** (*b*)
12.253. (*b*) **12.254.** (*c*) **12.255.** (*a*) **12.256.** (*b*) **12.257.** (*e*) **12.258.** (*e*)
12.259. (*c*) **12.260.** (*d*) **12.261.** (*a*) **12.262.** (*b*) **12.263.** (*d*) **12.264.** (*a*)
12.265. (*e*) **12.266.** (*b*) **12.267.** (*a*) **12.268.** (*b*) **12.269.** (*a*) **12.270.** (*c*)
12.271. (*b*) **12.272.** (*e*) **12.273.** (*b*) **12.274.** (*d*) **12.275.** (*c*) **12.276.** (*b*)
12.277. (*a*) **12.278.** (*c*) **12.279.** (*c*) **12.280.** (*c*) **12.281.** (*a*) **12.282.** (*d*)
12.283. (*b*) **12.284.** (*a*) **12.285.** (*a*) **12.286.** (*b*) **12.287.** (*b*) **12.288.** (*a*)
12.289. (*a*) **12.290.** (*c*) **12.291.** (*c*) **12.292.** (*d*) **12.293.** (*b*) **12.294.** (*b*)
12.295. (*b*) **12.296.** (*c*) **12.297.** (*a*) **12.298.** (*a*) **12.299.** (*d*) **12.300.** (*a*)
12.301. (*a*) **12.302.** (*a*) **12.303.** (*c*) **12.304.** (*d*) **12.305.** (*b*) **12.306.** (*a*)
12.307. (*b*) **12.308.** (*b*) **12.309.** (*a*) **12.310.** (*e*) **12.311.** (*c*) **12.312.** (*d*)
12.313. (*c*) **12.314.** (*c*) **12.315.** (*c*) **12.316.** (*a*) **12.317.** (*d*) **12.318.** (*c*)
12.319. (*c*) **12.320.** (*d*) **12.321.** (*a*) **12.322.** (*b*) **12.323.** (*b*) **12.324.** (*d*)
12.325. (*c*) **12.326.** (*a*) **12.327.** (*c*) **12.328.** (*b*) **12.329.** (*b*) **12.330.** (*d*)
12.331. (*b*) **12.332.** (*c*) **12.333.** (*d*) **12.334.** (*c*) **12.335.** (*e*) **12.336.** (*e*)
12.337. (*e*) **12.338.** (*b*) **12.339.** (*d*) **12.340.** (*d*) **12.341.** (*a*) **12.342.** (*c*)
12.343. (*c*) **12.344.** (*b*) **12.345.** (*a*) **12.346.** (*c*) **12.347.** (*a*) **12.348.** (*a*)
12.349. (*d*) **12.350.** (*a*) **12.351.** (*d*) **12.352.** (*a*) **12.353.** (*c*) **12.354.** (*a*)
12.355. (*d*) **12.356.** (*a*) **12.357.** (*b*) **12.358.** (*c*) **12.359.** (*b*) **12.360.** (*c*)
12.361. (*d*) **12.362.** (*a*) **12.363.** (*d*) **12.364.** (*e*) **12.365.** (*d*) **12.366.** (*c*)
12.367. (*c*) **12.368.** (*b*) **12.369.** (*c*) **12.370.** (*c*) **12.371.** (*a*) **12.372.** (*b*)

12.373. (*a*) **12.374.** (*b*) **12.375.** (*d*) **12.376.** (*d*) **12.377.** (*d*) **12.378.** (*d*)
12.379. (*c*) **12.380.** (*b*) **12.381.** (*a*) **12.382.** (*c*) **12.383.** (*b*) **12.384.** (*a*)
12.385. (*a*) **12.386.** (*c*) **12.387.** (*c*) **12.388.** (*d*) **12.389.** (*c*) **12.390.** (*a*)
12.391. (*c*) **12.392.** (*d*) **12.393.** (*c*) **12.394.** (*b*) **12.395.** (*a*) **12.396.** (*d*)
12.397. (*b*) **12.398.** (*c*) **12.399.** (*d*) **12.400.** (*a*) **12.401.** (*c*) **12.402.** (*d*)
12.403. (*a*) **12.404.** (*c*) **12.405.** (*a*) **12.406.** (*b*) **12.407.** (*d*) **12.408.** (*d*)
12.409. (*b*) **12.410.** (*d*) **12.411.** (*b*) **12.412.** (*c*) **12.413.** (*d*) **12.414.** (*b*)
12.415. (*b*) **12.416.** (*c*) **12.417.** (*a*) **12.418.** (*b*) **12.419.** (*c*) **12.420.** (*d*)
12.421. (*c*) **12.422.** (*b*) **12.423.** (*d*) **12.424.** (*a*) **12.425.** (*b*) **12.426.** (*a*)
12.427. (*c*) **12.428.** (*d*)

Chapter 13
MACHINE DESIGN

13.1. (*c*) **13.2.** (*c*) **13.3.** (*d*) **13.4.** (*b*) **13.5.** (*e*) **13.6.** (*b*)
13.7. (*d*) **13.8.** (*a*) **13.9.** (*d*) **13.10.** (*b*) **13.11.** (*c*) **13.12.** (*b*)
13.13. (*a*) **13.14.** (*a*) **13.15.** (*a*) **13.16.** (*e*) **13.17.** (*a*) **13.18.** (*b*)
13.19. (*a*) **13.20.** (*c*) **13.21.** (*b*) **13.22.** (*c*) **13.23.** (*a*) **13.24.** (*d*)
13.25. (*c*) **13.26.** (*d*) **13.27.** (*d*) **13.28.** (*a*) **13.29.** (*b*) **13.30.** (*c*)
13.31. (*d*) **13.32.** (*b*) **13.33.** (*a*) **13.34.** (*d*) **13.35.** (*d*) **13.36.** (*c*)
13.37. (*d*) **13.38.** (*a*) **13.39.** (*d*) **13.40.** (*c*) **13.41.** (*c*) **13.42.** (*e*)
13.43. (*b*) **13.44.** (*a*) **13.45.** (*a*) **13.46.** (*c*) **13.47.** (*c*) **13.48.** (*a*)
13.49. (*e*) **13.50.** (*b*) **13.51.** (*b*) **13.52.** (*e*) **13.53.** (*c*) **13.54.** (*d*)
13.55. (*e*) **13.56.** (*e*) **13.57.** (*b*) **13.58.** (*a*) **13.59.** (*a*) **13.60.** (*d*)
13.61. (*b*) **13.62.** (*e*) **13.63.** (*c*) **13.64.** (*a*) **13.65.** (*b*) **13.66.** (*d*)
13.67. (*a*) **13.68.** (*d*) **13.69.** (*b*) **13.70.** (*a*) **13.71.** (*c*) **13.72.** (*c*)
13.73. (*d*) **13.74.** (*c*) **13.75.** (*c*) **13.76.** (*c*) **13.77.** (*b*) **13.78.** (*d*)
13.79. (*c*) **13.80.** (*d*) **13.81.** (*d*) **13.82.** (*d*) **13.83.** (*b*) **13.84.** (*c*)
13.85. (*b*) **13.86.** (*a*) **13.87.** (*a*) **13.88.** (*a*) **13.89.** (*a*) **13.90.** (*a*)
13.91. (*e*) **13.92.** (*d*) **13.93.** (*e*) **13.94.** (*a*) **13.95.** (*c*) **13.96.** (*d*)
13.97. (*a*) **13.98.** (*a*) **13.99.** (*c*) **13.100.** (*a*) **13.101.** (*c*) **13.102.** (*e*)
13.103. (*c*) **13.104.** (*e*) **13.105.** (*b*) **13.106.** (*c*) **13.107.** (*b*) **13.108.** (*a*)
13.109. (*d*) **13.110.** (*c*) **13.111.** (*b*) **13.112.** (*b*) **13.113.** (*d*) **13.114.** (*b*)
13.115. (*e*) **13.116.** (*d*) **13.117.** (*d*) **13.118.** (*a*) **13.119.** (*a*) **13.120.** (*d*)
13.121. (*d*) **13.122.** (*b*) **13.123.** (*c*) **13.124.** (*d*) **13.125.** (*c*) **13.126.** (*d*)
13.127. (*a*) **13.128.** (*a*) **13.129.** (*c*) **13.130.** (*b*) **13.131.** (*b*) **13.132.** (*a*)
13.133. (*c*) **13.134.** (*d*) **13.135.** (*c*) **13.136.** (*c*) **13.137.** (*a*) **13.138.** (*e*)
13.139. (*a*) **13.140.** (*c*) **13.141.** (*b*) **13.142.** (*a*) **13.143.** (*c*) **13.144.** (*c*)
13.145. (*b*) **13.146.** (*a*) **13.147.** (*a*) **13.148.** (*d*) **13.149.** (*e*) **13.150.** (*b*)
13.151. (*c*) **13.152.** (*a*) **13.153.** (*a*) **13.154.** (*a*) **13.155.** (*b*) **13.156.** (*b*)
13.157. (*a*) **13.158.** (*a*) **13.159.** (*a*) **13.160.** (*d*) **13.161.** (*e*) **13.162.** (*e*)
13.163. (*c*) **13.164.** (*b*) **13.165.** (*c*) **13.166.** (*c*) **13.167.** (*d*) **13.168.** (*e*)
13.169. (*b*) **13.170.** (*a*) **13.171.** (*b*) **13.172.** (*b*) **13.173.** (*b*) **13.174.** (*b*)
13.175. (*b*) **13.176.** (*c*) **13.177.** (*d*) **13.178.** (*c*) **13.179.** (*d*) **13.180.** (*b*)
13.181. (*d*) **13.182.** (*a*) **13.183.** (*c*) **13.184.** (*a*) **13.185.** (*d*) **13.186.** (*d*)

13.187. (*a*) **13.188.** (*b*) **13.189.** (*c*) **13.190.** (*c*) **13.191.** (*c*) **13.192.** (*c*)
13.193. (*b*) **13.194.** (*a*) **13.195.** (*c*) **13.196.** (*d*) **13.197.** (*b*) **13.198.** (*d*)
13.199. (*e*) **13.200.** (*a*) **13.201.** (*c*) **13.202.** (*c*) **13.203.** (*c*) **13.204.** (*a*)
13.205. (*c*) **13.206.** (*d*) **13.207.** (*c*) **13.208.** (*b*) **13.209.** (*a*) **13.210.** (*b*)
13.211. (*b*) **13.212.** (*c*) **13.213.** (*c*) **13.214.** (*d*) **13.215.** (*d*) **13.216.** (*d*)
13.217. (*c*) **13.218.** (*b*) **13.219.** (*a*) **13.220.** (*e*) **13.221.** (*b*) **13.222.** (*a*)
13.223. (*d*) **13.224.** (*a*) **13.225.** (*a*) **13.226.** (*a*) **13.227.** (*d*) **13.228.** (*d*)
13.229. (*a*) **13.230.** (*c*) **13.231.** (*a*) **13.232.** (*a*) **13.233.** (*a*) **13.234.** (*b*)
13.235. (*a*) **13.236.** (*e*) **13.237.** (*a*) **13.238.** (*d*) **13.239.** (*e*) **13.240.** (*c*)
13.241. (*c*) **13.242.** (*b*) **13.243.** (*c*) **13.244.** (*e*) **13.245.** (*b*) **13.246.** (*d*)
13.247. (*b*) **13.248.** (*d*) **13.249.** (*a*) **13.250.** (*d*) **13.251.** (*b*) **13.252.** (*c*)
13.253. (*d*) **13.254.** (*c*) **13.255.** (*c*) **13.256.** (*c*) **13.257.** (*b*) **13.258.** (*a*)
13.259. (*b*) **13.260.** (*b*) **13.261.** (*c*) **13.262.** (*a*) **13.263.** (*b*) **13.264.** (*a*)
13.265. (*a*) **13.266.** (*b*) **13.267.** (*c*) **13.268.** (*a*) **13.269.** (*d*) **13.270.** (*b*)
13.271. (*b*) **13.272.** (*d*) **13.273.** (*c*) **13.274.** (*a*) **13.275.** (*b*) **13.276.** (*a*)
13.277. (*b*) **13.278.** (*b*) **13.279.** (*c*) **13.280.** (*e*) **13.281.** (*e*) **13.282.** (*d*)
13.283. (*a*) **13.284.** (*a*) **13.285.** (*c*) **13.286.** (*c*) **13.287.** (*b*) **13.288.** (*a*)
13.289. (*a*) **13.290.** (*c*) **13.291.** (*c*) **13.292.** (*d*) **13.293.** (*c*) **13.294.** (*d*)
13.295. (*a*) **13.296.** (*d*) **13.297.** (*d*) **13.298.** (*b*) **13.299.** (*e*) **13.300.** (*b*)
13.301. (*b*) **13.302.** (*d*) **13.303.** (*d*) **13.304.** (*b*) **13.305.** (*c*) **13.306.** (*a*)
13.307. (*e*) **13.308.** (*b*) **13.309.** (*a*) **13.310.** (*b*) **13.311.** (*e*) **13.312.** (*e*)
13.313. (*b*) **13.314.** (*a*) **13.315.** (*d*) **13.316.** (*c*) **13.317.** (*c*) **13.318.** (*d*)
13.319. (*b*) **13.320.** (*b*) **13.321.** (*a*) **13.322.** (*d*) **13.323.** (*d*) **13.324.** (*d*)
13.325. (*a*) **13.326.** (*b*) **13.327.** (*e*) **13.328.** (*b*) **13.329.** (*b*) **13.330.** (*c*)
13.331. (*b*) **13.332.** (*b*) **13.333.** (*b*) **13.334.** (*a*) **13.335.** (*b*) **13.336.** (*b*)
13.337. (*c*) **13.338.** (*a*) **13.339.** (*b*) **13.340.** (*d*) **13.341.** (*a*) **13.342.** (*c*)
13.343. (*b*) **13.344.** (*b*) **13.345.** (*c*) **13.346.** (*b*) **13.347.** (*b*) **13.348.** (*b*)
13.349. (*b*) **13.350.** (*a*) **13.351.** (*c*) **13.352.** (*c*) **13.353.** (*b*) **13.354.** (*e*)
13.355. (*e*) **13.356.** (*a*) **13.357.** (*a*) **13.358.** (*c*) **13.359.** (*b*) **13.360.** (*b*)
13.361. (*c*) **13.362.** (*b*) **13.363.** (*a*) **13.364.** (*d*) **13.365.** (*c*) **13.366.** (*a*)
13.367. (*b*) **13.368.** (*d*) **13.369.** (*a*) **13.370.** (*b*) **13.371.** (*c*) **13.372.** (*d*)
13.373. (*c*) **13.374.** (*a*) **13.375.** (*b*) **13.376.** (*b*) **13.377.** (*a*) **13.378.** (*b*)
13.379. (*c*) **13.380.** (*c*) **13.381.** (*c*) **13.382.** (*a*) **13.383.** (*c*) **13.384.** (*d*)
13.385. (*b*) **13.386.** (*b*) **13.387.** (*d*) **13.388.** (*c*) **13.389.** (*b*) **13.390.** (*d*)
13.391. (*b*) **13.392.** (*b*) **13.393.** (*a*) **13.394.** (*e*) **13.395.** (*c*) **13.396.** (*b*)
13.397. (*a*) **13.398.** (*a*) **13.399.** (*c*) **13.400.** (*b*) **13.401.** (*e*) **13.402.** (*a*)
13.403. (*e*) **13.404.** (*c*) **13.405.** (*d*) **13.406.** (*e*) **13.407.** (*d*) **13.408.** (*e*)
13.409. (*b*) **13.410.** (*e*) **13.411.** (*d*) **13.412.** (*d*) **13.413.** (*d*) **13.414.** (*c*)
13.415. (*b*) **13.416.** (*c*) **13.417.** (*b*) **13.418.** (*b*) **13.419.** (*c*)

Chapter 14
ENGINEERING MATERIALS

14.1. (*c*) **14.2.** (*a*) **14.3.** (*b*) **14.4.** (*c*) **14.5.** (*a*) **14.6.** (*b*)
14.7. (*a*) **14.8.** (*a*) **14.9.** (*c*) **14.10.** (*c*) **14.11.** (*b*) **14.12.** (*a*)

14.13. (*b*) **14.14.** (*a*) **14.15.** (*c*) **14.16.** (*b*) **14.17.** (*a*) **14.18.** (*c*)
14.19. (*d*) **14.20.** (*a*) **14.21.** (*a*) **14.22.** (*a*) **14.23.** (*d*) **14.24.** (*a*)
14.25. (*b*) **14.26.** (*c*) **14.27.** (*d*) **14.28.** (*b*) **14.29.** (*a*) **14.30.** (*a*)
14.31. (*d*) **14.32.** (*d*) **14.33.** (*c*) **14.34.** (*b*) **14.35.** (*d*) **14.36.** (*d*)
14.37. (*c*) **14.38.** (*d*) **14.39.** (*e*) **14.40.** (*c*) **14.41.** (*a*) **14.42.** (*e*)
14.43. (*b*) **14.44.** (*a*) **14.45.** (*a*) **14.46.** (*b*) **14.47.** (*c*) **14.48.** (*e*)
14.49. (*e*) **14.50.** (*b*) **14.51.** (*b*) **14.52.** (*c*) **14.53.** (*a*) **14.54.** (*c*)
14.55. (*b*) **14.56.** (*a*) **14.57.** (*e*) **14.58.** (*a*) **14.59.** (*d*) **14.60.** (*b*)
14.61. (*b*) **14.62.** (*c*) **14.63.** (*a*) **14.64.** (*b*) **14.65.** (*a*) **14.66.** (*d*)
14.67. (*b*) **14.68.** (*a*) **14.69.** (*c*) **14.70.** (*e*) **14.71.** (*d*) **14.72.** (*d*)
14.73. (*a*) **14.74.** (*e*) **14.75.** (*b*) **14.76.** (*c*) **14.77.** (*a*) **14.78.** (*d*)
14.79. (*a*) **14.80.** (*c*) **14.81.** (*a*) **14.82.** (*e*) **14.83.** (*d*) **14.84.** (*b*)
14.85. (*b*) **14.86.** (*a*) **14.87.** (*b*) **14.88.** (*e*) **14.89.** (*c*) **14.90.** (*a*)
14.91. (*d*) **14.92.** (*c*) **14.93.** (*b*) **14.94.** (*b*) **14.95.** (*d*) **14.96.** (*a*)
14.97. (*a*) **14.98.** (*a*) **14.99.** (*a*) **14.100.** (*a*) **14.101.** (*d*) **14.102.** (*d*)
14.103. (*b*) **14.104.** (*a*) **14.105.** (*d*) **14.106.** (*c*) **14.107.** (*d*) **14.108.** (*c*)
14.109. (*d*) **14.110.** (*c*) **14.111.** (*b*) **14.112.** (*b*) **14.113.** (*a*) **14.114.** (*e*)
14.115. (*d*) **14.116.** (*a*) **14.117.** (*d*) **14.118.** (*a*) **14.119.** (*b*) **14.120.** (*b*)
14.121. (*a*) **14.122.** (*b*) **14.123.** (*b*) **14.124.** (*c*) **14.125.** (*b*) **14.126.** (*a*)
14.127. (*a*) **14.128.** (*c*) **14.129.** (*d*) **14.130.** (*c*) **14.131.** (*c*) **14.132.** (*e*)
14.133. (*a*) **14.134.** (*d*) **14.135.** (*c*) **14.136.** (*a*) **14.137.** (*e*) **14.138.** (*a*)
14.139. (*d*) **14.140.** (*a*) **14.141.** (*a*) **14.142.** (*a*) **14.143.** (*b*) **14.144.** (*b*)
14.145. (*a*) **14.146.** (*b*) **14.147.** (*a*) **14.148.** (*b*) **14.149.** (*a*) **14.150.** (*c*)
14.151. (*d*) **14.152.** (*d*) **14.153.** (*a*) **14.154.** (*a*) **14.155.** (*d*) **14.156.** (*b*)
14.157. (*c*) **14.158.** (*c*) **14.159.** (*a*) **14.160.** (*a*) **14.161.** (*a*) **14.162.** (*e*)
14.163. (*e*) **14.164.** (*a*) **14.165.** (*a*) **14.166.** (*b*) **14.167.** (*a*) **14.168.** (*b*)
14.169. (*c*) **14.170.** (*b*) **14.171.** (*e*) **14.172.** (*d*) **14.173.** (*d*) **14.174.** (*a*)
14.175. (*d*) **14.176.** (*c*) **14.177.** (*b*) **14.178.** (*c*) **14.179.** (*b*) **14.180.** (*d*)
14.181. (*e*) **14.182.** (*d*) **14.183.** (*c*) **14.184.** (*e*) **14.185.** (*a*) **14.186.** (*a*)
14.187. (*c*) **14.188.** (*b*) **14.189.** (*d*) **14.190.** (*a*) **14.191.** (*a*) **14.192.** (*d*)
14.193. (*a*) **14.194.** (*b*) **14.195.** (*d*) **14.196.** (*a*) **14.197.** (*b*) **14.198.** (*a*)
14.199. (*b*) **14.200.** (*d*) **14.201.** (*c*) **14.202.** (*c*) **14.203.** (*c*) **14.204.** (*c*)
14.205. (*b*) **14.206.** (*b*) **14.207.** (*a*) **14.208.** (*b*) **14.209.** (*d*) **14.210.** (*b*)
14.211. (*a*) **14.212.** (*a*) **14.213.** (*c*) **14.214.** (*a*) **14.215.** (*b*) **14.216.** (*c*)
14.217. (*a*) **14.218.** (*a*) **14.219.** (*b*) **14.220.** (*d*) **14.221.** (*b*) **14.222.** (*c*)
14.223. (*b*) **14.224.** (*b*) **14.225.** (*c*) **14.226.** (*e*) **14.227.** (*c*) **14.228.** (*c*)
14.229. (*b*) **14.230.** (*d*) **14.231.** (*a*) **14.232.** (*b*) **14.233.** (*e*) **14.234.** (*a*)
14.235. (*d*) **14.236.** (*c*) **14.237.** (*d*) **14.238.** (*a*) **14.239.** (*a*) **14.240.** (*b*)
14.241. (*e*) **14.242.** (*c*) **14.243.** (*d*) **14.244.** (*a*) **14.245.** (*d*) **14.246.** (*a*)
14.247. (*d*) **14.248.** (*a*) **14.249.** (*b*) **14.250.** (*a*) **14.251.** (*d*) **14.252.** (*d*)
14.253. (*e*) **14.254.** (*c*) **14.255.** (*c*) **14.256.** (*a*) **14.257.** (*a*) **14.258.** (*d*)
14.259. (*c*) **14.260.** (*c*) **14.261.** (*b*) **14.262.** (*a*) **14.263.** (*a*) **14.264.** (*d*)
14.265. (*d*) **14.266.** (*d*) **14.267.** (*c*) **14.268.** (*a*) **14.269.** (*a*) **14.270.** (*c*)
14.271. (*b*) **14.272.** (*b*) **14.273.** (*e*) **14.274.** (*b*) **14.275.** (*a*) **14.276.** (*d*)
14.277. (*c*) **14.278.** (*b*) **14.279.** (*a*) **14.280.** (*a*) **14.281.** (*d*) **14.282.** (*b*)
14.283. (*c*) **14.284.** (*c*) **14.285.** (*d*) **14.286.** (*d*) **14.287.** (*a*) **14.288.** (*d*)

14.289. (*e*) **14.290.** (*a*) **14.291.** (*d*) **14.292.** (*b*) **14.293.** (*d*) **14.294.** (*d*)
14.295. (*c*) **14.296.** (*c*) **14.297.** (*a*) **14.298.** (*b*) **14.299.** (*e*) **14.300.** (*b*)
14.301. (*d*) **14.302.** (*d*) **14.303.** (*b*) **14.304.** (*a*) **14.305.** (*e*) **14.306.** (*c*)
14.307. (*b*) **14.308.** (*a*) **14.309.** (*b*) **14.310.** (*c*) **14.311.** (*c*) **14.312.** (*c*)
14.313. (*d*) **14.314.** (*a*) **14.315.** (*d*) **14.316.** (*c*) **14.317.** (*b*) **14.318.** (*a*)
14.319. (*b*) **14.320.** (*b*) **14.321.** (*a*) **14.322.** (*d*) **14.323.** (*b*) **14.324.** (*b*)
14.325. (*d*) **14.326.** (*b*) **14.327.** (*a*) **14.328.** (*a*) **14.329.** (*b*) **14.330.** (*e*)
14.331. (*b*) **14.332.** (*e*) **14.333.** (*c*) **14.334.** (*c*) **14.335.** (*c*) **14.336.** (*c*)
14.337. (*b*) **14.338.** (*c*) **14.339.** (*b*) **14.340.** (*b*) **14.341.** (*a*) **14.342.** (*b*)
14.343. (*c*) **14.344.** (*d*) **14.345.** (*e*) **14.346.** (*a*) **14.347.** (*d*) **14.348.** (*d*)
14.349. (*c*) **14.350.** (*b*) **14.351.** (*d*) **14.352.** (*c*) **14.353.** (*c*) **14.354.** (*c*)
14.355. (*c*) **14.356.** (*c*) **14.357.** (*c*) **14.358.** (*a*) **14.359.** (*d*) **14.360.** (*d*)
14.361. (*d*) **14.362.** (*c*) **14.363.** (*c*) **14.364.** (*a*) **14.365.** (*c*) **14.366.** (*d*)
14.367. (*e*) **14.368.** (*d*) **14.369.** (*a*) **14.370.** (*d*) **14.371.** (*d*) **14.372.** (*b*)
14.373. (*a*) **14.374.** (*b*) **14.375.** (*e*) **14.376.** (*d*) **14.377.** (*d*) **14.378.** (*a*)
14.379. (*d*) **14.380.** (*c*) **14.381.** (*d*) **14.382.** (*d*) **14.383.** (*d*) **14.384.** (*c*)
14.385. (*c*) **14.386.** (*a*) **14.387.** (*a*) **14.388.** (*b*) **14.389.** (*b*) **14.390.** (*c*)
14.391. (*a*) **14.392.** (*a*) **14.393.** (*b*) **14.394.** (*c*) **14.395.** (*b*) **14.396.** (*a*)
14.397. (*a*) **14.398.** (*b*) **14.399.** (*c*) **14.400.** (*d*) **14.401.** (*d*) **14.402.** (*a*)
14.403. (*a*) **14.404.** (*e*) **14.405.** (*c*) **14.406.** (*d*) **14.407.** (*b*) **14.408.** (*e*)
14.409. (*d*) **14.410.** (*d*)

Chapter 15
PRODUCTION TECHNOLOGY

15.1. (*b*) **15.2.** (*e*) **15.3.** (*a*) **15.4.** (*a*) **15.5.** (*c*) **15.6.** (*c*)
15.7. (*d*) **15.8.** (*b*) **15.9.** (*e*) **15.10.** (*c*) **15.11.** (*c*) **15.12.** (*a*)
15.13. (*e*) **15.14.** (*a*) **15.15.** (*a*) **15.16.** (*b*) **15.17.** (*d*) **15.18.** (*d*)
15.19. (*a*) **15.20.** (*d*) **15.21.** (*e*) **15.22.** (*b*) **15.23.** (*d*) **15.24.** (*c*)
15.25. (*e*) **15.26.** (*b*) **15.27.** (*a*) **15.28.** (*c*) **15.29.** (*a*) **15.30.** (*a*)
15.31. (*e*) **15.32.** (*d*) **15.33.** (*d*) **15.34.** (*d*) **15.35.** (*a*) **15.36.** (*d*)
15.37. (*a*) **15.38.** (*c*) **15.39.** (*c*) **15.40.** (*c*) **15.41.** (*a*) **15.42.** (*a*)
15.43. (*e*) **15.44.** (*d*) **15.45.** (*a*) **15.46.** (*c*) **15.47.** (*c*) **15.48.** (*c*)
15.49. (*a*) **15.50.** (*c*) **15.51.** (*a*) **15.52.** (*d*) **15.53.** (*b*) **15.54.** (*e*)
15.55. (*d*) **15.56.** (*a*) **15.57.** (*b*) **15.58.** (*d*) **15.59.** (*e*) **15.60.** (*e*)
15.61. (*b*) **15.62.** (*c*) **15.63.** (*d*) **15.64.** (*e*) **15.65.** (*c*) **15.66.** (*b*)
15.67. (*d*) **15.68.** (*d*) **15.69.** (*d*) **15.70.** (*b*) **15.71.** (*e*) **15.72.** (*b*)
15.73. (*a*) **15.74.** (*c*) **15.75.** (*b*) **15.76.** (*a*) **15.77.** (*b*) **15.78.** (*a*)
15.79. (*a*) **15.80.** (*a*) **15.81.** (*d*) **15.82.** (*a*) **15.83.** (*b*) **15.84.** (*c*)
15.85. (*d*) **15.86.** (*c*) **15.87.** (*c*) **15.88.** (*c*) **15.89.** (*e*) **15.90.** (*b*)
15.91. (*a*) **15.92.** (*d*) **15.93.** (*e*) **15.94.** (*e*) **15.95.** (*a*) **15.96.** (*c*)
15.97. (*c*) **15.98.** (*b*) **15.99.** (*c*) **15.100.** (*c*) **15.101.** (*b*) **15.102.** (*a*)
15.103. (*b*) **15.104.** (*b*) **15.105.** (*e*) **15.106.** (*c*) **15.107.** (*b*) **15.108.** (*d*)
15.109. (*e*) **15.110.** (*b*) **15.111.** (*c*) **15.112.** (*e*) **15.113.** (*c*) **15.114.** (*d*)
15.115. (*d*) **15.116.** (*c*) **15.117.** (*c*) **15.118.** (*a*) **15.119.** (*a*) **15.120.** (*c*)

15.121. (*e*) **15.122.** (*d*) **15.123.** (*d*) **15.124.** (*b*) **15.125.** (*d*) **15.126.** (*e*)
15.127. (*e*) **15.128.** (*b*) **15.129.** (*c*) **15.130.** (*b*) **15.131.** (*c*) **15.132.** (*b*)
15.133. (*c*) **15.134.** (*a*) **15.135.** (*a*) **15.136.** (*d*) **15.137.** (*d*) **15.138.** (*c*)
15.139. (*a*) **15.140.** (*b*) **15.141.** (*e*) **15.142.** (*e*) **15.143.** (*a*) **15.144.** (*b*)
15.145. (*d*) **15.146.** (*a*) **15.147.** (*a*) **15.148.** (*b*) **15.149.** (*b*) **15.150.** (*c*)
15.151. (*d*) **15.152.** (*b*) **15.153.** (*b*) **15.154.** (*b*) **15.155.** (*a*) **15.156.** (*b*)
15.157. (*d*) **15.158.** (*c*) **15.159.** (*a*) **15.160.** (*c*) **15.161.** (*c*) **15.162.** (*d*)
15.163. (*b*) **15.164.** (*b*) **15.165.** (*b*) **15.166.** (*c*) **15.167.** (*a*) **15.168.** (*b*)
15.169. (*b*) **15.170.** (*d*) **15.171.** (*b*) **15.172.** (*e*) **15.173.** (*b*) **15.174.** (*c*)
15.175. (*d*) **15.176.** (*b*) **15.177.** (*c*) **15.178.** (*d*) **15.179.** (*c*) **15.180.** (*d*)
15.181. (*d*) **15.182.** (*c*) **15.183.** (*c*) **15.184.** (*c*) **15.185.** (*b*) **15.186.** (*a*)
15.187. (*b*) **15.188.** (*b*) **15.189.** (*c*) **15.190.** (*e*) **15.191.** (*c*) **15.192.** (*d*)
15.193. (*c*) **15.194.** (*d*) **15.195.** (*d*) **15.196.** (*d*) **15.197.** (*c*) **15.198.** (*d*)
15.199. (*c*) **15.200.** (*d*) **15.201.** (*b*) **15.202.** (*d*) **15.203.** (*a*) **15.204.** (*c*)
15.205. (*b*) **15.206.** (*c*) **15.207.** (*b*) **15.208.** (*c*) **15.209.** (*b*) **15.210.** (*a*)
15.211. (*b*) **15.212.** (*a*) **15.213.** (*b*) **15.214.** (*d*) **15.215.** (*c*) **15.216.** (*b*)
15.217. (*a*) **15.218.** (*b*) **15.219.** (*d*) **15.220.** (*c*) **15.221.** (*d*) **15.222.** (*b*)
15.223. (*c*) **15.224.** (*c*) **15.225.** (*d*) **15.226.** (*b*) **15.227.** (*d*) **15.228.** (*e*)
15.229. (*e*) **15.230.** (*b*) **15.231.** (*d*) **15.232.** (*b*) **15.233.** (*d*) **15.234.** (*b*)
15.235. (*c*) **15.236.** (*c*) **15.237.** (*c*) **15.238.** (*a*) **15.239.** (*a*) **15.240.** (*a*)
15.241. (*b*) **15.242.** (*a*) **15.243.** (*c*) **15.244.** (*d*) **15.245.** (*d*) **15.246.** (*a*)
15.247. (*e*) **15.248.** (*a*) **15.249.** (*e*) **15.250.** (*c*) **15.251.** (*c*) **15.252.** (*e*)
15.253. (*a*) **15.254.** (*c*) **15.255.** (*c*) **15.256.** (*e*) **15.257.** (*e*) **15.258.** (*e*)
15.259. (*c*) **15.260.** (*d*) **15.261.** (*c*) **15.262.** (*b*) **15.263.** (*a*) **15.264.** (*d*)
15.265. (*d*) **15.266.** (*a*) **15.267.** (*c*) **15.268.** (*c*) **15.269.** (*e*) **15.270.** (*c*)
15.271. (*c*) **15.272.** (*d*) **15.273.** (*e*) **15.274.** (*d*) **15.275.** (*b*) **15.276.** (*d*)
15.277. (*b*) **15.278.** (*d*) **15.279.** (*d*) **15.280.** (*c*) **15.281.** (*d*) **15.282.** (*c*)
15.283. (*a*) **15.284.** (*a*) **15.285.** (*b*) **15.286.** (*e*) **15.287.** (*a*) **15.288.** (*b*)
15.289. (*e*) **15.290.** (*b*) **15.291.** (*b*) **15.292.** (*c*) **15.293.** (*c*) **15.294.** (*d*)
15.295. (*a*) **15.296.** (*c*) **15.297.** (*d*) **15.298.** (*b*) **15.299.** (*c*) **15.300.** (*d*)
15.301. (*a*) **15.302.** (*c*) **15.303.** (*c*) **15.304.** (*a*) **15.305.** (*d*) **15.306.** (*d*)
15.307. (*a*) **15.308.** (*e*) **15.309.** (*b*) **15.310.** (*a*) **15.311.** (*b*) **15.312.** (*b*)
15.313. (*c*) **15.314.** (*d*) **15.315.** (*a*) **15.316.** (*a*) **15.317.** (*b*) **15.318.** (*d*)
15.319. (*b*) **15.320.** (*a*) **15.321.** (*b*) **15.322.** (*e*) **15.323.** (*a*) **15.324.** (*c*)
15.325. (*d*) **15.326.** (*b*) **15.327.** (*c*) **15.328.** (*d*) **15.329.** (*d*) **15.330.** (*b*)
15.331. (*d*) **15.332.** (*e*) **15.333.** (*d*) **15.334.** (*d*) **15.335.** (*c*) **15.336.** (*c*)
15.337. (*d*) **15.338.** (*d*) **15.339.** (*a*) **15.340.** (*a*) **15.341.** (*b*) **15.342.** (*b*)
15.343. (*c*) **15.344.** (*a*) **15.345.** (*c*) **15.346.** (*b*) **15.347.** (*d*) **15.348.** (*d*)
15.349. (*b*) **15.350.** (*a*) **15.351.** (*b*) **15.352.** (*b*) **15.353.** (*d*) **15.354.** (*e*)
15.355. (*b*) **15.356.** (*a*) **15.357.** (*c*) **15.358.** (*c*) **15.359.** (*d*) **15.360.** (*e*)
15.361. (*d*) **15.362.** (*c*) **15.363.** (*e*) **15.364.** (*b*) **15.365.** (*b*) **15.366.** (*c*)
15.367. (*d*) **15.368.** (*c*) **15.369.** (*d*) **15.370.** (*c*) **15.371.** (*b*) **15.372.** (*d*)
15.373. (*a*) **15.374.** (*c*) **15.375.** (*d*) **15.376.** (*b*) **15.377.** (*e*) **15.378.** (*d*)
15.379. (*c*) **15.380.** (*a*) **15.381.** (*b*) **15.382.** (*d*) **15.383.** (*a*) **15.384.** (*c*)
15.385. (*c*) **15.386.** (*c*) **15.387.** (*a*) **15.388.** (*b*) **15.389.** (*c*) **15.390.** (*c*)
15.391. (*d*) **15.392.** (*b*) **15.393.** (*a*) **15.394.** (*c*) **15.395.** (*d*) **15.396.** (*b*)

15.397. (*a*)	**15.398.** (*a*)	**15.399.** (*b*)	**15.400.** (*d*)	**15.401.** (*e*)	**15.402.** (*e*)
15.403. (*c*)	**15.404.** (*b*)	**15.405.** (*a*)	**15.406.** (*c*)	**15.407.** (*c*)	**15.408.** (*b*)
15.409. (*e*)	**15.410.** (*d*)	**15.411.** (*d*)	**15.412.** (*b*)	**15.413.** (*d*)	**15.414.** (*c*)
15.415. (*b*)	**15.416.** (*c*)	**15.417.** (*a*)	**15.418.** (*b*)	**15.419.** (*b*)	**15.420.** (*b*)
15.421. (*b*)	**15.422.** (*d*)	**15.423.** (*d*)	**15.424.** (*a*)	**15.425.** (*c*)	**15.426.** (*a*)
15.427. (*b*)	**15.428.** (*b*)	**15.429.** (*b*)	**15.430.** (*a*)	**15.431.** (*b*)	**15.432.** (*a*)
15.433. (*b*)	**15.434.** (*c*)	**15.435.** (*b*)	**15.436.** (*b*)	**15.437.** (*a*)	**15.438.** (*c*)
15.439. (*b*)	**15.440.** (*b*)	**15.441.** (*a*)	**15.442.** (*d*)	**15.443.** (*c*)	**15.444.** (*d*)
15.445. (*d*)	**15.446.** (*a*)	**15.447.** (*e*)	**15.448.** (*c*)	**15.449.** (*d*)	**15.450.** (*d*)
15.451. (*c*)	**15.452.** (*e*)	**15.453.** (*d*)	**15.454.** (*c*)	**15.455.** (*d*)	**15.456.** (*a*)
15.457. (*b*)	**15.458.** (*e*)	**15.459.** (*c*)	**15.460.** (*c*)	**15.461.** (*d*)	**15.462.** (*a*)
15.463. (*c*)	**15.464.** (*d*)	**15.465.** (*c*)	**15.466.** (*d*)	**15.467.** (*a*)	**15.468.** (*a*)
15.469. (*e*)	**15.470.** (*b*)	**15.471.** (*b*)	**15.472.** (*c*)	**15.473.** (*c*)	**15.474.** (*d*)
15.475. (*c*)	**15.476.** (*c*)	**15.477.** (*d*)	**15.478.** (*b*)	**15.479.** (*d*)	**15.480.** (*a*)
15.481. (*d*)	**15.482.** (*a*)	**15.483.** (*b*)	**15.484.** (*b*)	**15.485.** (*e*)	**15.486.** (*b*)
15.487. (*d*)	**15.488.** (*b*)	**15.489.** (*c*)	**15.490.** (*d*)	**15.491.** (*b*)	**15.492.** (*c*)
15.493. (*d*)	**15.494.** (*b*)	**15.495.** (*d*)	**15.496.** (*d*)	**15.497.** (*e*)	**15.498.** (*b*)
15.499. (*b*)	**15.500.** (*b*)	**15.501.** (*b*)	**15.502.** (*c*)	**15.503.** (*d*)	**15.504.** (*b*)
15.505. (*c*)	**15.506.** (*d*)	**15.507.** (*c*)	**15.508.** (*b*)	**15.509.** (*d*)	**15.510.** (*a*)
15.511. (*c*)	**15.512.** (*c*)	**15.513.** (*d*)	**15.514.** (*e*)	**15.515.** (*b*)	**15.516.** (*b*)
15.517. (*e*)	**15.518.** (*c*)	**15.519.** (*d*)	**15.520.** (*d*)	**15.521.** (*b*)	**15.522.** (*a*)
15.523. (*b*)	**15.524.** (*d*)	**15.525.** (*e*)	**15.526.** (*b*)	**15.527.** (*a*)	**15.528.** (*c*)
15.529. (*b*)	**15.530.** (*c*)	**15.531.** (*b*)	**15.532.** (*c*)	**15.533.** (*c*)	**15.534.** (*c*)
15.535. (*e*)	**15.536.** (*b*)	**15.537.** (*e*)	**15.538.** (*a*)	**15.539.** (*a*)	**15.540.** (*c*)
15.541. (*b*)	**15.542.** (*c*)	**15.543.** (*d*)	**15.544.** (*d*)	**15.545.** (*c*)	**15.546.** (*a*)
15.547. (*b*)	**15.548.** (*d*)	**15.549.** (*c*)	**15.550.** (*a*)	**15.551.** (*b*)	**15.552.** (*a*)
15.553. (*b*)	**15.554.** (*d*)	**15.555.** (*e*)	**15.556.** (*d*)	**15.557.** (*b*)	**15.558.** (*a*)
15.559. (*e*)	**15.560.** (*e*)	**15.561.** (*b*)	**15.562.** (*d*)	**15.563.** (*c*)	**15.564.** (*d*)
15.565. (*e*)	**15.566.** (*a*)	**15.567.** (*d*)	**15.568.** (*a*)	**15.569.** (*b*)	**15.570.** (*b*)
15.571. (*d*)	**15.572.** (*a*)	**15.573.** (*a*)	**15.574.** (*e*)	**15.575.** (*a*)	**15.576.** (*d*)
15.577. (*d*)	**15.578.** (*b*)	**15.579.** (*d*)	**15.580.** (*d*)	**15.581.** (*d*)	**15.582.** (*d*)
15.583. (*b*)	**15.584.** (*c*)	**15.585.** (*b*)	**15.586.** (*d*)	**15.587.** (*b*)	**15.588.** (*c*)
15.589. (*a*)	**15.590.** (*d*)	**15.591.** (*a*)	**15.592.** (*a*)	**15.593.** (*e*)	**15.594.** (*b*)
15.595. (*a*)	**15.596.** (*c*)	**15.597.** (*e*)	**15.598.** (*c*)	**15.599.** (*c*)	**15.600.** (*c*)
15.601. (*b*)	**15.602.** (*d*)	**15.603.** (*e*)	**15.604.** (*b*)	**15.605.** (*c*)	**15.606.** (*b*)
15.607. (*d*)	**15.608.** (*c*)	**15.609.** (*c*)	**15.610.** (*e*)	**15.611.** (*b*)	**15.612.** (*a*)
15.613. (*c*)	**15.614.** (*e*)	**15.615.** (*e*)	**15.616.** (*e*)	**15.617.** (*a*)	**15.618.** (*b*)
15.619. (*d*)	**15.620.** (*e*)	**15.621.** (*d*)	**15.622.** (*b*)	**15.623.** (*b*)	**15.624.** (*d*)
15.625. (*a*)	**15.626.** (*a*)	**15.627.** (*c*)	**15.628.** (*a*)	**15.629.** (*a*)	**15.630.** (*a*)
15.631. (*d*)	**15.632.** (*b*)	**15.633.** (*c*)	**15.634.** (*c*)	**15.635.** (*a*)	**15.636.** (*d*)
15.637. (*a*)	**15.638.** (*e*)	**15.639.** (*a*)	**15.640.** (*c*)	**15.641.** (*b*)	**15.642.** (*b*)
15.643. (*e*)	**15.644.** (*a*)	**15.645.** (*b*)	**15.646.** (*d*)	**15.647.** (*c*)	**15.648.** (*b*)
15.649. (*d*)	**15.650.** (*e*)	**15.651.** (*a*)	**15.652.** (*c*)	**15.653.** (*b*)	**15.654.** (*e*)
15.655. (*e*)	**15.656.** (*c*)	**15.657.** (*a*)	**15.658.** (*d*)	**15.659.** (*e*)	**15.660.** (*a*)
15.661. (*d*)	**15.662.** (*b*)	**15.663.** (*a*)	**15.664.** (*b*)	**15.665.** (*e*)	**15.666.** (*c*)
15.667. (*b*)	**15.668.** (*a*)	**15.669.** (*a*)	**15.670.** (*a*)	**15.671.** (*b*)	**15.672.** (*c*)

15.673. (*b*) **15.674.** (*c*) **15.675.** (*c*) **15.676.** (*d*) **15.677.** (*d*) **15.678.** (*d*)
15.679. (*c*) **15.680.** (*b*) **15.681.** (*b*) **15.682.** (*d*) **15.683.** (*d*) **15.684.** (*b*)
15.685. (*e*) **15.686.** (*a*) **15.687.** (*c*) **15.688.** (*b*) **15.689.** (*a*) **15.690.** (*a*)
15.691. (*b*) **15.692.** (*b*) **15.693.** (*e*) **15.694.** (*c*) **15.695.** (*b*) **15.696.** (*c*)
15.697. (*c*) **15.698.** (*d*) **15.699.** (*a*) **15.700.** (*a*) **15.701.** (*c*) **15.702.** (*a*)
15.703. (*b*) **15.704.** (*a*) **15.705.** (*c*) **15.706.** (*d*) **15.707.** (*b*) **15.708.** (*a*)
15.709. (*b*) **15.710.** (*b*) **15.711.** (*b*) **15.712.** (*d*) **15.713.** (*a*) **15.714.** (*e*)
15.715. (*c*) **15.716.** (*a*) **15.717.** (*e*) **15.718.** (*c*) **15.719.** (*c*) **15.720.** (*c*)
15.721. (*b*) **15.722.** (*d*) **15.723.** (*a*) **15.724.** (*d*) **15.725.** (*c*) **15.726.** (*e*)
15.727. (*d*) **15.728.** (*b*) **15.729.** (*e*) **15.730.** (*b*) **15.731.** (*d*) **15.732.** (*a*)
15.733. (*b*) **15.734.** (*d*) **15.735.** (*d*) **15.736.** (*a*) **15.737.** (*a*) **15.738.** (*d*)
15.739. (*d*) **15.740.** (*e*) **15.741.** (*b*) **15.742.** (*a*) **15.743.** (*b*) **15.744.** (*b*)
15.745. (*a*) **15.746.** (*b*) **15.747.** (*a*) **15.748.** (*c*) **15.749.** (*a*) **15.750.** (*b*)
15.751. (*d*) **15.752.** (*c*) **15.753.** (*d*) **15.754.** (*e*) **15.755.** (*c*) **15.756.** (*b*)
15.757. (*e*) **15.758.** (*a*) **15.759.** (*c*) **15.760.** (*c*) **15.761.** (*b*) **15.762.** (*c*)
15.763. (*c*) **15.764.** (*d*) **15.765.** (*d*) **15.766.** (*b*) **15.767.** (*e*) **15.768.** (*b*)
15.769. (*c*) **15.770.** (*a*) **15.771.** (*b*) **15.772.** (*c*) **15.773.** (*b*) **15.774.** (*e*)
15.775. (*b*) **15.776.** (*d*) **15.777.** (*b*) **15.778.** (*e*) **15.779.** (*d*) **15.780.** (*c*)
15.781. (*e*) **15.782.** (*d*) **15.783.** (*a*) **15.784.** (*d*) **15.785.** (*a*) **15.786.** (*d*)
15.787. (*d*) **15.788.** (*b*) **15.789.** (*a*) **15.790.** (*a*) **15.791.** (*a*) **15.792.** (*e*)
15.793. (*c*) **15.794.** (*b*) **15.795.** (*d*) **15.796.** (*c*) **15.797.** (*a*) **15.798.** (*b*)
15.799. (*b*) **15.800.** (*a*) **15.801.** (*d*) **15.802.** (*b*) **15.803.** (*c*) **15.804.** (*e*)
15.805. (*d*) **15.806.** (*a*) **15.807.** (*b*) **15.808.** (*c*) **15.809.** (*d*) **15.810.** (*d*)
15.811. (*b*) **15.812.** (*a*) **15.813.** (*b*) **15.814.** (*b*) **15.815.** (*b*) **15.816.** (*a*)
15.817. (*a*) **15.818.** (*a*) **15.819.** (*d*) **15.820.** (*c*) **15.821.** (*c*) **15.822.** (*d*)
15.823. (*d*) **15.824.** (*d*) **15.825.** (*b*) **15.826.** (*b*) **15.827.** (*a*) **15.828.** (*a*)
15.829. (*b*) **15.830.** (*e*) **15.831.** (*a*) **15.832.** (*a*) **15.833.** (*d*) **15.834.** (*b*)
15.835. (*c*) **15.836.** (*e*) **15.837.** (*c*) **15.838.** (*c*) **15.839.** (*d*) **15.840.** (*e*)
15.841. (*d*) **15.842.** (*b*) **15.843.** (*d*) **15.844.** (*e*) **15.845.** (*c*) **15.846.** (*e*)
15.847. (*d*) **15.848.** (*a*) **15.849.** (*e*) **15.850.** (*b*) **15.851.** (*c*) **15.852.** (*a*)
15.853. (*d*) **15.854.** (*b*) **15.855.** (*d*) **15.856.** (*b*) **15.857.** (*b*) **15.858.** (*e*)
15.859. (*c*) **15.860.** (*b*) **15.861.** (*c*) **15.862.** (*b*) **15.863.** (*d*) **15.864.** (*a*)
15.865. (*e*) **15.866.** (*d*) **15.867.** (*b*) **15.868.** (*d*) **15.869.** (*e*) **15.870.** (*c*)
15.871. (*b*) **15.872.** (*c*) **15.873.** (*c*) **15.874.** (*b*) **15.875.** (*e*) **15.876.** (*b*)
15.877. (*e*) **15.878.** (*c*) **15.879.** (*b*) **15.880.** (*b*) **15.881.** (*e*) **15.882.** (*b*)
15.883. (*a*) **15.884.** (*e*) **15.885.** (*c*) **15.886.** (*e*) **15.887.** (*a*) **15.888.** (*c*)
15.889. (*e*) **15.890.** (*b*) **15.891.** (*a*) **15.892.** (*b*) **15.893.** (*c*) **15.894.** (*d*)
15.895. (*d*) **15.896.** (*d*) **15.897.** (*c*) **15.898.** (*b*) **15.899.** (*c*) **15.900.** (*b*)
15.901. (*d*) **15.902.** (*b*) **15.903.** (*a*) **15.904.** (*e*) **15.905.** (*b*) **15.906.** (*c*)
15.907. (*b*) **15.908.** (*c*) **15.909.** (*c*) **15.910.** (*a*) **15.911.** (*d*) **15.912.** (*c*)
15.913. (*d*) **15.914.** (*a*) **15.915.** (*b*) **15.916.** (*e*) **15.917.** (*a*) **15.918.** (*b*)
15.919. (*c*) **15.920.** (*b*) **15.921.** (*b*) **15.922.** (*c*) **15.923.** (*b*) **15.924.** (*d*)
15.925. (*d*) **15.926.** (*c*) **15.927.** (*c*) **15.928.** (*a*) **15.929.** (*d*) **15.930.** (*a*)
15.931. (*c*) **15.932.** (*a*) **15.933.** (*c*) **15.934.** (*c*) **15.935.** (*a*) **15.936.** (*c*)
15.937. (*c*) **15.938.** (*b*) **15.939.** (*a*) **15.940.** (*a*) **15.941.** (*c*) **15.942.** (*c*)
15.943. (*d*) **15.944.** (*a*) **15.945.** (*a*) **15.946.** (*a*) **15.947.** (*a*) **15.948.** (*d*)

15.949. (*c*) **15.950.** (*e*) **15.951.** (*d*) **15.952.** (*a*) **15.953.** (*d*) **15.954.** (*e*)
15.955. (*d*) **15.956.** (*d*) **15.957.** (*d*) **15.958.** (*d*) **15.959.** (*d*) **15.960.** (*e*)
15.961. (*d*) **15.962.** (*d*) **15.963.** (*b*) **15.964.** (*a*) **15.965.** (*b*) **15.966.** (*a*)
15.967. (*b*) **15.968.** (*e*) **15.969.** (*b*) **15.970.** (*d*) **15.971.** (*c*) **15.972.** (*a*)
15.973. (*b*) **15.974.** (*d*) **15.975.** (*e*) **15.976.** (*a*) **15.977.** (*d*) **15.978.** (*b*)
15.979. (*d*) **15.980.** (*b*) **15.981.** (*b*) **15.982.** (*b*) **15.983.** (*b*) **15.984.** (*d*)
15.985. (*d*) **15.986.** (*a*) **15.987.** (*a*) **15.988.** (*d*) **15.989.** (*c*) **15.990.** (*c*)
15.991. (*e*) **15.992.** (*b*) **15.993.** (*b*) **15.994.** (*c*) **15.995.** (*c*) **15.996.** (*d*)
15.997. (*c*) **15.998.** (*d*) **15.999.** (*a*) **15.1000.** (*c*) **15.1001.** (*c*) **15.1002.** (*b*)
15.1003. (*e*) **15.1004.** (*a*) **15.1005.** (*e*) **15.1006.** (*c*) **15.1007.** (*a*) **15.1008.** (*b*)
15.1009. (*d*) **15.1010.** (*a*) **15.1011.** (*c*) **15.1012.** (*c*) **15.1013.** (*a*) **15.1014.** (*c*)
15.1015. (*b*) **15.1016.** (*d*) **15.1017.** (*e*) **15.1018.** (*e*) **15.1019.** (*a*) **15.1020.** (*d*)
15.1021. (*e*) **15.1022.** (*e*) **15.1023.** (*c*) **15.1024.** (*d*) **15.1025.** (*c*) **15.1026.** (*a*)
15.1027. (*d*) **15.1028.** (*b*) **15.1029.** (*a*) **15.1030.** (*c*) **15.1031.** (*c*) **15.1032.** (*d*)
15.1033. (*a*) **15.1034.** (*c*) **15.1035.** (*d*) **15.1036.** (*a*) **15.1037.** (*b*) **15.1038.** (*d*)
15.1039. (*b*) **15.1040.** (*d*) **15.1041.** (*d*) **15.1042.** (*c*) **15.1043.** (*a*) **15.1044.** (*a*)
15.1045. (*a*) **15.1046.** (*b*) **15.1047.** (*b*) **15.1048.** (*a*) **15.1049.** (*a*) **15.1050.** (*d*)
15.1051. (*d*) **15.1052.** (*d*) **15.1053.** (*d*) **15.1054.** (*d*) **15.1055.** (*c*) **15.1056.** (*d*)
15.1057. (*a*) **15.1058.** (*a*) **15.1059.** (*b*) **15.1060.** (*a*) **15.1061.** (*d*) **15.1062.** (*c*)
15.1063. (*b*) **15.1064.** (*a*) **15.1065.** (*d*) **15.1066.** (*b*) **15.1067.** (*b*) **15.1068.** (*c*)
15.1069. (*d*) **15.1070.** (*e*) **15.1071.** (*a*) **15.1072.** (*a*) **15.1073.** (*d*) **15.1074.** (*e*)
15.1075. (*d*) **15.1076.** (*e*) **15.1077.** (*a*) **15.1078.** (*e*) **15.1079.** (*d*) **15.1080.** (*d*)
15.1081. (*a*) **15.1082.** (*b*) **15.1083.** (*d*)

Chapter 16
PRODUCTION MANAGEMENT AND INDUSTRIAL ENGINEERING

16.1. (*c*) **16.2.** (*c*) **16.3.** (*a*) **16.4.** (*a*) **16.5.** (*c*) **16.6.** (*c*)
16.7. (*b*) **16.8.** (*a*) **16.9.** (*e*) **16.10.** (*a*) **16.11.** (*d*) **16.12.** (*a*)
16.13. (*b*) **16.14.** (*c*) **16.15.** (*c*) **16.16.** (*d*) **16.17.** (*a*) **16.18.** (*a*)
16.19. (*a*) **16.20.** (*a*) **16.21.** (*d*) **16.22.** (*e*) **16.23.** (*a*) **16.24.** (*c*)
16.25. (*d*) **16.26.** (*a*) **16.27.** (*c*) **16.28.** (*a*) **16.29.** (*b*) **16.30.** (*a*)
16.31. (*a*) **16.32.** (*a*) **16.33.** (*a*) **16.34.** (*b*) **16.35.** (*a*) **16.36.** (*c*)
16.37. (*a*) **16.38.** (*b*) **16.39.** (*b*) **16.40.** (*e*) **16.41.** (*c*) **16.42.** (*d*)
16.43. (*a*) **16.44.** (*d*) **16.45.** (*b*) **16.46.** (*b*) **16.47.** (*a*) **16.48.** (*c*)
16.49. (*a*) **16.50.** (*a*) **16.51.** (*d*) **16.52.** (*e*) **16.53.** (*c*) **16.54.** (*e*)
16.55. (*a*) **16.56.** (*a*) **16.57.** (*d*) **16.58.** (*a*) **16.59.** (*b*) **16.60.** (*a*)
16.61. (*b*) **16.62.** (*d*) **16.63.** (*d*) **16.64.** (*d*) **16.65.** (*a*) **16.66.** (*a*)
16.67. (*b*) **16.68.** (*d*) **16.69.** (*b*) **16.70.** (*c*) **16.71.** (*a*) **16.72.** (*c*)
16.73. (*c*) **16.74.** (*d*) **16.75.** (*e*) **16.76.** (*c*) **16.77.** (*e*) **16.78.** (*c*)
16.79. (*c*) **16.80.** (*a*) **16.81.** (*a*) **16.82.** (*b*) **16.83.** (*d*) **16.84.** (*d*)
16.85. (*a*) **16.86.** (*a*) **16.87.** (*a*) **16.88.** (*b*) **16.89.** (*b*) **16.90.** (*a*)
16.91. (*d*) **16.92.** (*e*) **16.93.** (*d*) **16.94.** (*a*) **16.95.** (*d*) **16.96.** (*a*)
16.97. (*b*) **16.98.** (*d*) **16.99.** (*c*) **16.100.** (*b*) **16.101.** (*a*) **16.102.** (*b*)
16.103. (*c*) **16.104.** (*c*) **16.105.** (*a*) **16.106.** (*a*) **16.107.** (*b*) **16.108.** (*b*)

16.109. (*e*) **16.110.** (*a*) **16.111.** (*a*) **16.112.** (*c*) **16.113.** (*b*) **16.114.** (*c*)
16.115. (*d*) **16.116.** (*c*) **16.117.** (*c*) **16.118.** (*d*) **16.119.** (*e*) **16.120.** (*b*)
16.121. (*b*) **16.122.** (*a*) **16.123.** (*d*) **16.124.** (*c*) **16.125.** (*b*) **16.126.** (*c*)
16.127. (*e*) **16.128.** (*c*) **16.129.** (*a*) **16.130.** (*e*) **16.131.** (*e*) **16.132.** (*d*)
16.133. (*d*) **16.134.** (*d*) **16.135.** (*b*) **16.136.** (*e*) **16.137.** (*e*) **16.138.** (*c*)
16.139. (*d*) **16.140.** (*a*) **16.141.** (*a*) **16.142.** (*b*) **16.143.** (*d*) **16.144.** (*a*)
16.145. (*d*) **16.146.** (*d*) **16.147.** (*c*) **16.148.** (*d*) **16.149.** (*a*) **16.150.** (*a*)
16.151. (*e*) **16.152.** (*a*) **16.153.** (*a*) **16.154.** (*e*) **16.155.** (*e*) **16.156.** (*e*)
16.157. (*a*) **16.158.** (*a*) **16.159.** (*d*) **16.160.** (*c*) **16.161.** (*c*) **16.162.** (*d*)
16.163. (*e*) **16.164.** (*d*) **16.165.** (*e*) **16.166.** (*b*) **16.167.** (*c*) **16.168.** (*e*)
16.169. (*d*) **16.170.** (*c*) **16.171.** (*c*) **16.172.** (*a*) **16.173.** (*e*) **16.174.** (*c*)
16.175. (*d*) **16.176.** (*e*) **16.177.** (*b*) **16.178.** (*b*) **16.179.** (*e*) **16.180.** (*c*)
16.181. (*e*) **16.182.** (*e*) **16.183.** (*e*) **16.184.** (*e*) **16.185.** (*d*) **16.186.** (*e*)
16.187. (*a*) **16.188.** (*b*) **16.189.** (*c*) **16.190.** (*c*) **16.191.** (*b*) **16.192.** (*c*)
16.193. (*c*) **16.194.** (*d*) **16.195.** (*e*) **16.196.** (*b*) **16.197.** (*a*) **16.198.** (*a*)
16.199. (*a*) **16.200.** (*c*) **16.201.** (*a*) **16.202.** (*a*) **16.203.** (*d*) **16.204.** (*a*)
16.205. (*c*) **16.206.** (*a*) **16.207.** (*b*) **16.208.** (*c*) **16.209.** (*a*) **16.210.** (*a*)
16.211. (*e*) **16.212.** (*d*) **16.213.** (*d*) **16.214.** (*c*) **16.215.** (*c*) **16.216.** (*a*)
16.217. (*c*) **16.218.** (*c*) **16.219.** (*a*) **16.220.** (*b*) **16.221.** (*e*) **16.222.** (*b*)
16.223. (*c*) **16.224.** (*a*) **16.225.** (*a*) **16.226.** (*e*) **16.227.** (*d*) **16.228.** (*d*)
16.229. (*c*) **16.230.** (*c*) **16.231.** (*c*) **16.232.** (*d*) **16.233.** (*b*) **16.234.** (*e*)
16.235. (*a*) **16.236.** (*e*) **16.237.** (*e*) **16.238.** (*b*) **16.239.** (*e*) **16.240.** (*d*)
16.241. (*d*).

Chapter 17
GENERAL ENGINEERING

17.1. (*d*) **17.2.** (*d*) **17.3.** (*b*) **17.4.** (*c*) **17.5.** (*c*) **17.6.** (*c*)
17.7. (*c*) **17.8.** (*d*) **17.9.** (*a*) **17.10.** (*d*) **17.11.** (*c*) **17.12.** (*a*)
17.13. (*b*) **17.14.** (*b*) **17.15.** (*a*) **17.16.** (*d*) **17.17.** (*c*) **17.18.** (*d*)
17.19. (*d*) **17.20.** (*a*) **17.21.** (*d*) **17.22.** (*b*) **17.23.** (*d*) **17.24.** (*d*)
17.25. (*a*) **17.26.** (*d*) **17.27.** (*a*) **17.28.** (*d*) **17.29.** (*e*) **17.30.** (*b*)
17.31. (*d*) **17.32.** (*b*) **17.33.** (*d*) **17.34.** (*e*) **17.35.** (*d*) **17.36.** (*e*)
17.37. (*e*) **17.38.** (*c*) **17.39.** (*b*) **17.40.** (*d*) **17.41.** (*d*) **17.42.** (*b*)
17.43. (*e*) **17.44.** (*b*) **17.45.** (*b*) **17.46.** (*e*) **17.47.** (*a*) **17.48.** (*c*)
17.49. (*d*) **17.50.** (*d*) **17.51.** (*a*) **17.52.** (*d*) **17.53.** (*c*) **17.54.** (*a*)
17.55. (*a*) **17.56.** (*b*) **17.57.** (*b*) **17.58.** (*a*) **17.59.** (*e*) **17.60.** (*c*)
17.61. (*c*) **17.62.** (*a*) **17.63.** (*b*) **17.64.** (*d*) **17.65.** (*a*) **17.66.** (*d*)
17.67. (*d*) **17.68.** (*b*) **17.69.** (*d*) **17.70.** (*b*) **17.71.** (*e*) **17.72.** (*a*)
17.73. (*a*) **17.74.** (*c*) **17.75.** (*e*) **17.76.** (*d*) **17.77.** (*d*) **17.78.** (*a*)
17.79. (*e*) **17.80.** (*d*) **17.81.** (*d*) **17.82.** (*a*) **17.83.** (*a*) **17.84.** (*d*)
17.85. (*b*) **17.86.** (*d*) **17.87.** (*d*) **17.88.** (*c*) **17.89.** (*a*) **17.90.** (*b*)
17.91. (*d*) **17.92.** (*c*) **17.93.** (*a*) **17.94.** (*a*) **17.95.** (*c*) **17.96.** (*a*)
17.97. (*a*) **17.98.** (*e*) **17.99.** (*c*) **17.100.** (*c*) **17.101.** (*b*) **17.102.** (*d*)
17.103. (*c*) **17.104.** (*b*) **17.105.** (*c*) **17.106.** (*a*) **17.107.** (*a*) **17.108.** (*c*)

17.109. (*d*)	**17.110.** (*d*)	**17.111.** (*c*)	**17.112.** (*c*)	**17.113.** (*c*)	**17.114.** (*a*)
17.115. (*a*)	**17.116.** (*a*)	**17.117.** (*c*)	**17.118.** (*c*)	**17.119.** (*c*)	**17.120.** (*d*)
17.121. (*a*)	**17.122.** (*a*)	**17.123.** (*b*)	**17.124.** (*d*)	**17.125.** (*a*)	**17.126.** (*d*)
17.127. (*c*)	**17.128.** (*b*)	**17.129.** (*c*)	**17.130.** (*c*)	**17.131.** (*c*)	**17.132.** (*b*)
17.133. (*c*)	**17.134.** (*c*)	**17.135.** (*c*)	**17.136.** (*c*)	**17.137.** (*c*)	**17.138.** (*d*)
17.139. (*e*)	**17.140.** (*c*)	**17.141.** (*a*)	**17.142.** (*a*)	**17.143.** (*c*)	**17.144.** (*c*)
17.145. (*b*)	**17.146.** (*a*)	**17.147.** (*d*)	**17.148.** (*d*)	**17.149.** (*d*)	**17.150.** (*a*)
17.151. (*c*)	**17.152.** (*b*)	**17.153.** (*a*)	**17.154.** (*c*)	**17.155.** (*c*)	**17.156.** (*d*)
17.157. (*e*)	**17.158.** (*a*)	**17.159.** (*c*)	**17.160.** (*c*)	**17.161.** (*d*)	**17.162.** (*c*)
17.163. (*b*)	**17.164.** (*c*)	**17.165.** (*b*)	**17.166.** (*a*)	**17.167.** (*e*)	**17.168.** (*b*)
17.169. (*b*)	**17.170.** (*b*)	**17.171.** (*b*)	**17.172.** (*d*)	**17.173.** (*c*)	**17.174.** (*b*)
17.175. (*b*)	**17.176.** (*b*)	**17.177.** (*b*)	**17.178.** (*d*)	**17.179.** (*c*)	**17.180.** (*e*)
17.181. (*c*)	**17.182.** (*e*)	**17.183.** (*d*)	**17.184.** (*b*)	**17.185.** (*a*)	**17.186.** (*c*)
17.187. (*d*)	**17.188.** (*e*)	**17.189.** (*c*)	**17.190.** (*a*)	**17.191.** (*d*)	**17.192.** (*c*)
17.193. (*c*)	**17.194.** (*e*)	**17.195.** (*d*)	**17.196.** (*d*)	**17.197.** (*a*)	**17.198.** (*a*)
17.199. (*c*)	**17.200.** (*a*)	**17.201.** (*a*)	**17.202.** (*a*)		

CHAPTER 18
ENGINEERING METROLOGY

18.1. (*d*)	**18.2.** (*a*)	**18.3.** (*b*)	**18.4.** (*d*)	**18.5.** (*a*)	**18.6.** (*b*)
18.7. (*c*)	**18.8.** (*c*)	**18.9.** (*b*)	**18.10.** (*a*)	**18.11.** (*d*)	**18.12.** (*e*)
18.13. (*d*)	**18.14.** (*d*)	**18.15.** (*a*)	**18.16.** (*b*)	**18.17.** (*d*)	**18.18.** (*c*)
18.19. (*a*)	**18.20.** (*c*)	**18.21.** (*c*)	**18.22.** (*d*)	**18.23.** (*a*)	**18.24.** (*e*)
18.25. (*b*)	**18.26.** (*d*)	**18.27.** (*e*)	**18.28.** (*b*)	**18.29.** (*c*)	**18.30.** (*a*)
18.31. (*a*)	**18.32.** (*d*)	**18.33.** (*c*)	**18.34.** (*a*)	**18.35.** (*a*)	**18.36.** (*b*)
18.37. (*b*)	**18.38.** (*c*)	**18.39.** (*c*)	**18.40.** (*e*)	**18.41.** (*a*)	**18.42.** (*c*)
18.43. (*a*)	**18.44.** (*e*)	**18.45.** (*c*)	**18.46.** (*c*)	**18.47.** (*c*)	**18.48.** (*a*)
18.49. (*d*)	**18.50.** (*e*)	**18.51.** (*b*)	**18.52.** (*e*)	**18.53.** (*e*)	**18.54.** (*d*)
18.55. (*a*)	**18.56.** (*c*)	**18.57.** (*e*)	**18.58.** (*c*)	**18.59.** (*c*)	**18.60.** (*c*)
18.61. (*e*)	**18.62.** (*a*)	**18.63.** (*a*)	**18.64.** (*d*)	**18.65.** (*d*)	**18.66.** (*e*)
18.67. (*e*)	**18.68.** (*e*)	**18.69.** (*d*)	**18.70.** (*e*)	**18.71.** (*e*)	**18.72.** (*e*)
18.73. (*a*)	**18.74.** (*d*)	**18.75.** (*c*)	**18.76.** (*d*)	**18.77.** (*e*)	**18.78.** (*a*)
18.79. (*b*)	**18.80.** (*e*)	**18.81.** (*c*)	**18.82.** (*c*)	**18.83.** (*b*)	**18.84.** (*d*)
18.85. (*a*)	**18.86.** (*e*)	**18.87.** (*d*)	**18.88.** (*b*)	**18.89.** (*b*)	**18.90.** (*a*)
18.91. (*a*)	**18.92.** (*e*)	**18.93.** (*b*)	**18.94.** (*d*)	**18.95.** (*b*)	**18.96.** (*e*)
18.97. (*a*)	**18.98.** (*b*)	**18.99.** (*e*)	**18.100.** (*b*)	**18.101.** (*a*)	**18.102.** (*c*)
18.103. (*a*)	**18.104.** (*e*)	**18.105.** (*d*)	**18.106.** (*c*)	**18.107.** (*d*)	**18.108.** (*c*)
18.109. (*b*)	**18.110.** (*e*)	**18.111.** (*b*)	**18.112.** (*d*)	**18.113.** (*c*)	**18.114.** (*c*)
18.115. (*a*)	**18.116.** (*a*)	**18.117.** (*c*)	**18.118.** (*d*)	**18.119.** (*e*)	**18.120.** (*d*)
18.121. (*a*)	**18.122.** (*d*)	**18.123.** (*b*)	**18.124.** (*a*)	**18.125.** (*c*)	**18.126.** (*d*)
18.127. (*c*)	**18.128.** (*a*)	**18.129.** (*b*)	**18.130.** (*d*)	**18.131.** (*d*)	**18.132.** (*a*)
18.133. (*e*)	**18.134.** (*c*)	**18.135.** (*b*)	**18.136.** (*a*)	**18.137.** (*a*)	**18.138.** (*e*)
18.139. (*a*)	**18.140.** (*b*)	**18.141.** (*d*)	**18.142.** (*b*)	**18.143.** (*d*)	**18.144.** (*b*)
18.145. (*e*)	**18.146.** (*a*)	**18.147.** (*a*)	**18.148.** (*c*)	**18.149.** (*c*)	**18.150.** (*d*)

18.151. (*b*) **18.152.** (*d*) **18.153.** (*a*) **18.154.** (*d*) **18.155.** (*a*) **18.156.** (*e*)
18.157. (*a*) **18.158.** (*b*) **18.159.** (*a*) **18.160.** (*c*) **18.161.** (*b*) **18.162.** (*d*)
18.163. (*e*) **18.164.** (*a*) **18.165.** (*b*) **18.166.** (*a*) **18.167.** (*c*) **18.168.** (*a*)
18.169. (*e*) **18.170.** (*d*) **18.171.** (*d*) **18.172.** (*c*) **18.173.** (*d*) **18.174.** (*e*)
18.175. (*c*) **18.176.** (*a*) **18.177.** (*a*) **18.178.** (*a*) **18.179.** (*c*) **18.180.** (*e*)
18.181. (*d*) **18.182.** (*b*) **18.183.** (*a*) **18.184.** (*c*) **18.185.** (*b*) **18.186.** (*a*)
18.187. (*e*) **18.188.** (*e*) **18.189.** (*a*) **18.190.** (*d*) **18.191.** (*d*) **18.192.** (*b*)
18.193. (*c*) **18.194.** (*a*) **18.195.** (*a*) **18.196.** (*b*) **18.197.** (*c*) **18.198.** (*b*)
18.199. (*b*) **18.200.** (*a*) **18.201.** (*c*) **18.202.** (*a*) **18.203.** (*b*) **18.204.** (*b*)
18.205. (*a*) **18.206.** (*e*) **18.207.** (*c*) **18.208.** (*c*) **18.209.** (*c*) **18.210.** (*d*)
18.211. (*e*) **18.212.** (*d*) **18.213.** (*a*) **18.214.** (*c*) **18.215.** (*b*) **18.216.** (*a*)
18.217. (*b*) **18.218.** (*e*) **18.219.** (*a*) **18.220.** (*c*) **18.221.** (*c*) **18.222.** (*a*)
18.223. (*a*) **18.224.** (*e*) **18.225.** (*a*) **18.226.** (*d*) **18.227.** (*b*) **18.228.** (*c*)
18.229. (*d*) **18.230.** (*d*) **18.231.** (*a*) **18.232.** (*e*) **18.233.** (*a*) **18.234.** (*a*)
18.235. (*c*) **18.236.** (*c*) **18.237.** (*e*) **18.238.** (*e*) **18.239.** (*e*) **18.240.** (*a*)
18.241. (*a*) **18.242.** (*b*) **18.243.** (*c*) **18.244.** (*a*) **18.245.** (*b*) **18.246.** (*e*)
18.247. (*a*) **18.248.** (*c*) **18.249.** (*c*) **18.250.** (*d*) **18.251.** (*d*) **18.252.** (*e*)
18.253. (*e*) **18.254.** (*b*) **18.255.** (*b*) **18.256.** (*d*) **18.257.** (*d*) **18.258.** (*b*)
18.259. (*a*) **18.260.** (*c*) **18.261.** (*c*) **18.262.** (*a*) **18.263.** (*c*) **18.264.** (*a*)
18.265. (*e*) **18.266.** (*d*).

CHAPTER 19
MEASUREMENT AND INSTRUMENTATION

19.1. (*d*) **19.2.** (*b*) **19.3.** (*a*) **19.4.** (*b*) **19.5.** (*b*) **19.6.** (*a*)
19.7. (*b*) **19.8.** (*c*) **19.9.** (*e*) **19.10.** (*a*) **19.11.** (*d*) **19.12.** (*a*)
19.13. (*d*) **19.14.** (*e*) **19.15.** (*a*) **19.16.** (*b*) **19.17.** (*a*) **19.18.** (*d*)
19.19. (*a*) **19.20.** (*a*) **19.21.** (*d*) **19.22.** (*c*) **19.23.** (*a*) **19.24.** (*d*)
19.25. (*e*) **19.26.** (*a*) **19.27.** (*a*) **19.28.** (*b*) **19.29.** (*c*) **19.30.** (*e*)
19.31. (*b*) **19.32.** (*b*) **19.33.** (*d*) **19.34.** (*d*) **19.35.** (*c*) **19.36.** (*b*)
19.37. (*d*) **19.38.** (*e*) **19.39.** (*c*) **19.40.** (*d*) **19.41.** (*a*) **19.42.** (*b*)
19.43. (*a*) **19.44.** (*d*) **19.45.** (*d*) **19.46.** (*a*) **19.47.** (*c*) **19.48.** (*b*)
19.49. (*c*) **19.50.** (*d*) **19.51.** (*c*) **19.52.** (*e*) **19.53.** (*b*) **19.54.** (*d*)
19.55. (*c*) **19.56.** (*d*) **19.57.** (*d*) **19.58.** (*a*) **19.59.** (*a*) **19.60.** (*b*)
19.61. (*e*) **19.62.** (*b*) **19.63.** (*c*) **19.64.** (*d*) **19.65.** (*c*) **19.66.** (*a*)
19.67. (*d*) **19.68.** (*b*) **19.69.** (*d*) **19.70.** (*a*) **19.71.** (*b*) **19.72.** (*e*)
19.73. (*e*) **19.74.** (*c*) **19.75.** (*b*) **19.76.** (*a*) **19.77.** (*b*) **19.78.** (*b*)
19.79. (*d*) **19.80.** (*d*) **19.81.** (*a*) **19.82.** (*b*) **19.83.** (*e*) **19.84.** (*d*)
19.85. (*a*) **19.86.** (*d*) **19.87.** (*a*) **19.88.** (*c*) **19.89.** (*d*) **19.90.** (*b*)
19.91. (*a*) **19.92.** (*b*) **19.93.** (*b*) **19.94.** (*c*) **19.95.** (*d*) **19.96.** (*a*)
19.97. (*c*) **19.98.** (*b*) **19.99.** (*c*) **19.100.** (*a*) **19.101.** (*e*) **19.102.** (*a*)
19.103. (*b*) **19.104.** (*e*) **19.105.** (*a*) **19.106.** (*e*) **19.107.** (*d*) **19.108.** (*d*)
19.109. (*a*) **19.110.** (*a*) **19.111.** (*b*) **19.112.** (*d*) **19.113.** (*c*) **19.114.** (*a*)
19.115. (*a*) **19.116.** (*c*) **19.117.** (*b*) **19.118.** (*a*) **19.119.** (*a*)

MODEL TEST PAPER–1

1. (e)	2. (c)	3. (d)	4. (d)	5. (d)	6. (e)
7. (b)	8. (b)	9. (e)	10. (b)	11. (d)	12. (c)
13. (a)	14. (a)	15. (a)	16. (b)	17. (b)	18. (a)
19. (a)	20. (c)	21. (e)	22. (d)	23. (b)	24. (b)
25. (a)	26. (b)	27. (c)	28. (a)	29. (d)	30. (e)
31. (b)	32. (b)	33. (a)	34. (d)	35. (c)	36. (c)
37. (c)	38. (d)	39. (c)	40. (d)	41. (c)	42. (c)
43. (e)	44. (b)	45. (c)	46. (a)	47. (b)	48. (d)
49. (d)	50. (b)	51. (c)	52. (b)	53. (e)	54. (b)
55. (a)	56. (b)	57. (c)	58. (a)	59. (e)	60. (b)
61. (d)	62. (a)	63. (d)	64. (e)	65. (d)	66. (a)
67. (d)	68. (b)	69. (d)	70. (b)	71. (a)	72. (c)
73. (b)	74. (d)	75. (e)			

MODEL TEST PAPER–2

1. (b)	2. (c)	3. (b)	4. (e)	5. (a)	6. (a)
7. (c)	8. (e)	9. (c)	10. (c)	11. (b)	12. (a)
13. (a)	14. (a)	15. (b)	16. (d)	17. (a)	18. (c)
19. (d)	20. (e)	21. (d)	22. (d)	23. (a)	24. (c)
25. (c)	26. (b)	27. (d)	28. (a)	29. (d)	30. (a)
31. (d)	32. (d)	33. (c)	34. (e)	35. (b)	36. (a)
37. (a)	38. (b)	39. (c)	40. (d)	41. (e)	42. (a)
43. (d)	44. (c)	45. (a)	46. (a)	47. (b)	48. (c)
49. (a)	50. (a)	51. (d)	52. (b)	53. (d)	54. (a)
55. (b)	56. (a)	57. (b)	58. (a)	59. (b)	60. (c)
61. (e)	62. (c)	63. (a)	64. (d)	65. (e)	66. (d)
67. (b)	68. (b)	69. (d)	70. (d)	71. (e)	72. (d)
73. (e)	74. (a)	75. (b)	76. (d)	77. (e)	78. (d)
79. (c)	80. (d)	81. (b)	82. (d)	83. (a)	84. (c)
85. (a)	86. (b)	87. (d)	88. (b)	89. (d)	90. (c)
91. (b)	92. (c)	93. (c)	94. (d)	95. (e)	96. (c)
97. (a)	98. (e)	99. (d)	100. (d)	101. (a)	102. (b)
103. (a)	104. (d)	105. (a)	106. (c)	107. (e)	108. (a)
109. (b)	110. (a)	111. (e)	112. (e)	113. (a)	114. (a)
115. (b)	116. (d)	117. (b)	118. (d)	119. (a)	120. (d)
121. (d)	122. (a)	123. (c)	124. (d)	125. (d)	126. (c)
127. (d)	128. (a)	129. (b)	130. (e)	131. (d)	132. (b)
133. (a)	134. (b)	135. (e)	136. (b)	137. (d)	138. (b)
139. (a)	140. (a)	141. (b)	142. (a)	143. (d)	144. (c)
145. (c)	146. (d)	147. (a)	148. (a)	149. (a)	150. (e)
151. (c)	152. (b)	153. (a)	154. (a)	155. (c)	156. (a)
157. (c)	158. (c)	159. (e)	160. (d)	161. (e)	162. (d)
163. (a)	164. (d)	165. (e)	166. (c)	167. (a)	168. (a)

169. (*e*)	**170.** (*c*)	**171.** (*b*)	**172.** (*a*)	**173.** (*e*)	**174.** (*b*)
175. (*d*)	**176.** (*c*)	**177.** (*a*)	**178.** (*b*)	**179.** (*a*)	**180.** (*b*)

MODEL TEST PAPER–3

1. (*a*)	**2.** (*c*)	**3.** (*b*)	**4.** (*e*)	**5.** (*d*)	**6.** (*b*)
7. (*d*)	**8.** (*d*)	**9.** (*a*)	**10.** (*c*)	**11.** (*b*)	**12.** (*a*)
13. (*b*)	**14.** (*d*)	**15.** (*d*)	**16.** (*b*)	**17.** (*e*)	**18.** (*a*)
19. (*d*)	**20.** (*a*)	**21.** (*e*)	**22.** (*a*)	**23.** (*a*)	**24.** (*c*)
25. (*b*)	**26.** (*a*)	**27.** (*b*)	**28.** (*d*)	**29.** (*a*)	**30.** (*b*)
31. (*c*)	**32.** (*a*)	**33.** (*c*)	**34.** (*d*)	**35.** (*b*)	**36.** (*c*)
37. (*a*)	**38.** (*b*)	**39.** (*a*)	**40.** (*b*)	**41.** (*c*)	**42.** (*b*)
43. (*d*)	**44.** (*d*)	**45.** (*c*)	**46.** (*b*)	**47.** (*a*)	**48.** (*a*)
49. (*d*)	**50.** (*b*)	**51.** (*a*)	**52.** (*a*)	**53.** (*a*)	**54.** (*a*)
55. (*a*)	**56.** (*b*)	**57.** (*a*)	**58.** (*b*)	**59.** (*b*)	**60.** (*a*)
61. (*c*)	**62.** (*a*)	**63.** (*b*)	**64.** (*e*)	**65.** (*c*)	**66.** (*c*)
67. (*e*)	**68.** (*c*)	**69.** (*c*)	**70.** (*c*)	**71.** (*c*)	**72.** (*b*)
73. (*a*)	**74.** (*d*)	**75.** (*a*)	**76.** (*d*)	**77.** (*a*)	**78.** (*a*)
79. (*b*)	**80.** (*d*)	**81.** (*d*)	**82.** (*e*)	**83.** (*d*)	**84.** (*d*)
85. (*a*)	**86.** (*c*)	**87.** (*c*)	**88.** (*e*)	**89.** (*e*)	**90.** (*e*)
91. (*c*)	**92.** (*b*)	**93.** (*a*)	**94.** (*a*)	**95.** (*a*)	**96.** (*d*)
97. (*a*)	**98.** (*c*)	**99.** (*c*)	**100.** (*b*)	**101.** (*d*)	**102.** (*a*)
103. (*d*)	**104.** (*a*)	**105.** (*a*)	**106.** (*c*)	**107.** (*a*)	**108.** (*e*)
109. (*c*)	**110.** (*c*)	**111.** (*d*)	**112.** (*a*)	**113.** (*a*)	**114.** (*d*)
115. (*b*)	**116.** (*c*)	**117.** (*d*)	**118.** (*b*)	**119.** (*d*)	**120.** (*c*)
121. (*d*)	**122.** (*d*)	**123.** (*a*)	**124.** (*b*)	**125.** (*c*)	**126.** (*b*)
127. (*d*)	**128.** (*c*)	**129.** (*b*)	**130.** (*e*)	**131.** (*b*)	**132.** (*e*)
133. (*c*)	**134.** (*b*)	**135.** (*e*)	**136.** (*b*)	**137.** (*a*)	**138.** (*c*)
139. (*b*)	**140.** (*a*)	**141.** (*b*)	**142.** (*c*)	**143.** (*c*)	**144.** (*b*)
145. (*c*)	**146.** (*a*)	**147.** (*b*)	**148.** (*c*)	**149.** (*a*)	**150.** (*a*)
151. (*a*)	**152.** (*a*)	**153.** (*c*)	**154.** (*a*)	**155.** (*c*)	**156.** (*c*)
157. (*c*)	**158.** (*c*)	**159.** (*a*)	**160.** (*d*)	**161.** (*c*)	**162.** (*d*)
163. (*b*)	**164.** (*b*)	**165.** (*e*)	**166.** (*c*)	**167.** (*c*)	**168.** (*e*)
169. (*a*)	**170.** (*d*)	**171.** (*c*)	**172.** (*e*)	**173.** (*a*)	**174.** (*a*)
175. (*b*)	**176.** (*a*)	**177.** (*a*)	**178.** (*d*)	**179.** (*d*)	**180.** (*a*)

MODEL TEST PAPER–4

1. (*d*)	**2.** (*c*)	**3.** (*c*)	**4.** (*d*)	**5.** (*a*)	**6.** (*d*)
7. (*b*)	**8.** (*a*)	**9.** (*a*)	**10.** (*b*)	**11.** (*c*)	**12.** (*a*)
13. (*d*)	**14.** (*d*)	**15.** (*c*)	**16.** (*c*)	**17.** (*a*)	**18.** (*a*)
19. (*a*)	**20.** (*c*)	**21.** (*e*)	**22.** (*d*)	**23.** (*a*)	**24.** (*d*)
25. (*a*)	**26.** (*a*)	**27.** (*c*)	**28.** (*b*)	**29.** (*d*)	**30.** (*c*)
31. (*a*)	**32.** (*d*)	**33.** (*c*)	**34.** (*b*)	**35.** (*e*)	**36.** (*a*)
37. (*c*)	**38.** (*d*)	**39.** (*a*)	**40.** (*a*)	**41.** (*b*)	**42.** (*e*)

43. (c)	44. (a)	45. (a)	46. (c)	47. (a)	48. (a)
49. (a)	50. (a)	51. (b)	52. (b)	53. (a)	54. (b)
55. (b)	56. (d)	57. (c)	58. (d)	59. (e)	60. (b)
61. (a)	62. (a)	63. (d)	64. (c)	65. (c)	66. (d)
67. (a)	68. (c)	69. (c)	70. (c)	71. (d)	72. (b)
73. (a)	74. (a)	75. (c)	76. (e)	77. (e)	78. (e)
79. (c)	80. (a)	81. (c)	82. (b)	83. (c)	84. (d)
85. (e)	86. (d)	87. (a)	88. (c)	89. (b)	90. (b)
91. (d)	92. (c)	93. (a)	94. (c)	95. (a)	96. (d)
97. (c)	98. (c)	99. (b)	100. (c)	101. (d)	102. (b)
103. (d)	104. (a)	105. (e)	106. (a)	107. (c)	108. (c)
109. (c)	110. (a)	111. (d)	112. (d)	113. (b)	114. (d)
115. (a)	116. (a)	117. (b)	118. (d)	119. (b)	120. (d)
121. (e)	122. (d)	123. (c)	124. (d)	125. (b)	126. (e)
127. (a)	128. (c)	129. (c)	130. (a)	131. (a)	132. (a)
133. (a)	134. (a)	135. (e)	136. (d)	137. (c)	138. (c)
139. (c)	140. (e)	141. (d)	142. (b)	143. (a)	144. (d)
145. (c)	146. (b)	147. (d)	148. (a)	149. (a)	150. (c)
151. (c)	152. (d)	153. (a)	154. (a)	155. (b)	156. (e)
157. (b)	158. (d)	159. (b)	160. (d)	161. (e)	162. (b)
163. (c)	164. (d)	165. (b)	166. (a)	167. (b)	168. (a)
169. (e)	170. (e)	171. (e)	172. (c)	173. (d)	174. (a)
175. (d)	176. (d)	177. (c)	178. (a)	179. (d)	180. (b)

MODEL TEST PAPER–5

1. (a)	2. (a)	3. (e)	4. (d)	5. (c)	6. (c)
7. (e)	8. (d)	9. (a)	10. (e)	11. (e)	12. (e)
13. (d)	14. (b)	15. (e)	16. (d)	17. (a)	18. (e)
19. (d)	20. (d)	21. (a)	22. (b)	23. (e)	24. (a)
25. (b)	26. (e)	27. (a)	28. (e)	29. (b)	30. (a)
31. (c)	32. (e)	33. (b)	34. (a)	35. (e)	36. (c)
37. (a)	38. (b)	39. (b)	40. (c)	41. (e)	42. (c)
43. (a)	44. (a)	45. (b)	46. (b)	47. (b)	48. (c)
49. (b)	50. (a)	51. (e)	52. (a)	53. (b)	54. (b)
55. (a)	56. (d)	57. (d)	58. (a)	59. (e)	60. (b)
61. (a)	62. (d)	63. (d)	64. (e)	65. (c)	66. (b)
67. (c)	68. (d)	69. (b)	70. (c)	71. (d)	72. (e)
73. (d)	74. (d)	75. (e)	76. (e)	77. (c)	78. (e)
79. (d)	80. (d)	81. (d)	82. (a)	83. (b)	84. (b)
85. (b)	86. (c)	87. (a)	88. (b)	89. (b)	90. (d)
91. (e)	92. (a)	93. (a)	94. (b)	95. (d)	96. (c)
97. (d)	98. (d)	99. (c)	100. (d)	101. (a)	102. (b)
103. (b)	104. (c)	105. (a)	106. (c)	107. (e)	108. (e)
109. (d)	110. (a)	111. (a)	112. (b)	113. (d)	114. (b)

115. (a)	116. (c)	117. (b)	118. (b)	119. (a)	120. (e)
121. (a)	122. (a)	123. (d)	124. (e)	125. (d)	126. (d)
127. (c)	128. (b)	129. (b)	130. (c)	131. (e)	132. (a)
133. (c)	134. (a)	135. (d)	136. (c)	137. (c)	138. (d)
139. (b)	140. (b)	141. (b)	142. (a)	143. (a)	144. (b)
145. (a)	146. (e)	147. (c)	148. (a)	149. (d)	150. (a)
151. (c)	152. (c)	153. (b)	154. (c)	155. (d)	156. (a)
157. (a)	158. (c)	159. (d)	160. (b)	161. (d)	162. (b)
163. (b)	164. (d)	165. (a)	166. (a)	167. (e)	168. (a)
169. (a)	170. (e)	171. (a)	172. (a)	173. (a)	174. (d)
175. (a)	176. (d)	177. (d)	178. (b)	179. (d)	180. (c)

MODEL TEST PAPER–6

1. (c)	2. (d)	3. (d)	4. (d)	5. (d)	6. (e)
7. (a)	8. (d)	9. (a)	10. (e)	11. (c)	12. (d)
13. (e)	14. (b)	15. (c)	16. (a)	17. (c)	18. (d)
19. (b)	20. (a)	21. (d)	22. (b)	23. (a)	24. (c)
25. (b)	26. (d)	27. (d)	28. (c)	29. (d)	30. (d)
31. (c)	32. (b)	33. (a)	34. (e)	35. (b)	36. (b)
37. (e)	38. (d)	39. (a)	40. (b)	41. (d)	42. (a)
43. (d)	44. (b)	45. (c)	46. (c)	47. (d)	48. (c)
49. (c)	50. (a)	51. (c)	52. (b)	53. (a)	54. (c)
55. (b)	56. (b)	57. (c)	58. (c)	59. (a)	60. (c)
61. (a)	62. (d)	63. (d)	64. (a)	65. (d)	66. (a)
67. (a)	68. (d)	69. (b)	70. (a)	71. (c)	72 (e)
73. (b)	74. (d)	75. (c)	76. (c)	77. (a)	78. (b)
79. (d)	80. (a)	81. (b)	82. (e)	83. (c)	84. (d)
85. (b)	86. (c)	87. (d)	88. (d)	89. (b)	90. (a)
91. (c)	92. (d)	93. (e)	94. (c)	95. (a)	96. (c)
97. (a)	98. (b)	99. (d)	100. (c)	101. (d)	102. (d)
103. (a)	104. (d)	105. (a)	106. (b)	107. (e)	108. (d)
109. (d)	110. (a)	111. (c)	112. (a)	113. (b)	114. (a)
115. (e)	116. (d)	117. (e)	118. (d)	119. (b)	120. (b)
121. (e)	122. (e)	123. (c)	124. (a)	125. (d)	126. (e)
127. (c)	128. (d)	129. (c)	130. (d)	131. (e)	132. (d)
133. (a)	134. (a)	135. (a)	136. (e)	137. (e)	138. (a)
139. (b)	140. (d)	141. (d)	142. (a)	143. (b)	144. (c)
145. (a)	146. (a)	147. (a)	148. (e)	149. (d)	150. (e)
151. (a)	152. (b)	153. (e)	154. (b)	155. (a)	156. (c)
157. (d)	158. (d)	159. (a)	160. (d)	161. (b)	162. (c)
163. (c)	164. (b)	165. (b)	166. (c)	167. (d)	168. (e)
169. (e)	170. (b)	171. (b)	172. (d)	173. (c)	174. (c)
175. (d)	176. (a)	177. (b)	178. (d)	179. (a)	180. (e)

MODEL TEST PAPER–7

1. (*d*)	2. (*b*)	3. (*b*)	4. (*d*)	5. (*a*)	6. (*c*)
7. (*e*)	8. (*a*)	9. (*c*)	10. (*b*)	11. (*d*)	12. (*d*)
13. (*a*)	14. (*a*)	15. (*e*)	16. (*c*)	17. (*b*)	18. (*b*)
19. (*a*)	20. (*b*)	21. (*e*)	22. (*b*)	23. (*d*)	24. (*b*)
25. (*d*)	26. (*a*)	27. (*a*)	28. (*c*)	29. (*c*)	30. (*a*)
31. (*d*)	32. (*a*)	33. (*c*)	34. (*b*)	35. (*d*)	36. (*e*)
37. (*a*)	38. (*b*)	39. (*d*)	40. (*b*)	41. (*a*)	42. (*b*)
43. (*a*)	44. (*a*)	45. (*d*)	46. (*a*)	47. (*c*)	48. (*b*)
49. (*c*)	50. (*e*)	51. (*c*)	52. (*a*)	53. (*b*)	54. (*e*)
55. (*d*)	56. (*c*)	57. (*a*)	58. (*d*)	59. (*e*)	60. (*d*)
61. (*a*)	62. (*c*)	63. (*b*)	64. (*c*)	65. (*d*)	66. (*b*)
67. (*c*)	68. (*e*)	69. (*a*)	70. (*c*)	71. (*e*)	72. (*e*)
73. (*e*)	74. (*c*)	75. (*d*)	76. (*a*)	77. (*b*)	78. (*c*)
79. (*c*)	80. (*b*)	81. (*c*)	82. (*c*)	83. (*b*)	84. (*a*)
85. (*e*)	86. (*a*)	87. (*a*)	88. (*d*)	89. (*b*)	90. (*a*)
91. (*d*)	92. (*c*)	93. (*a*)	94. (*d*)	95. (*a*)	96. (*c*)
97. (*d*)	98. (*c*)	99. (*a*)	100. (*d*)	101. (*e*)	102. (*a*)
103. (*b*)	104. (*c*)	105. (*c*)	106. (*a*)	107. (*e*)	108. (*a*)
109. (*b*)	110. (*c*)	111. (*a*)	112. (*d*)	113. (*a*)	114. (*b*)
115. (*a*)	116. (*a*)	117. (*b*)	118. (*c*)	119. (*b*)	120. (*b*)
121. (*d*)	122. (*b*)	123. (*b*)	124. (*d*)	125. (*b*)	126. (*a*)
127. (*a*)	128. (*d*)	129. (*a*)	130. (*a*)	131. (*a*)	132. (*e*)
133. (*e*)	134. (*c*)	135. (*b*)	136. (*c*)	137. (*a*)	138. (*a*)
139. (*a*)	140. (*d*)	141. (*e*)	142. (*e*)	143. (*d*)	144. (*c*)
145. (*a*)	146. (*a*)	147. (*a*)	148. (*a*)	149. (*b*)	150. (*b*)
151. (*d*)	152. (*c*)	153. (*b*)	154. (*a*)	155. (*a*)	156. (*b*)
157. (*c*)	158. (*c*)	159. (*d*)	160. (*a*)	161. (*a*)	162. (*d*)
163. (*a*)	164. (*b*)	165. (*d*)	166. (*a*)	167. (*d*)	168. (*a*)
169. (*e*)	170. (*d*)	171. (*a*)	172. (*e*)	173. (*d*)	174. (*e*)
175. (*b*)	176. (*a*)	177. (*a*)	178. (*b*)	179. (*e*)	180. (*a*)

MODEL TEST PAPER–8

1. (*e*)	2. (*a*)	3. (*a*)	4. (*a*)	5. (*a*)	6. (*c*)
7. (*e*)	8. (*c*)	9. (*e*)	10. (*a*)	11. (*e*)	12. (*a*)
13. (*c*)	14. (*b*)	15. (*a*)	16. (*b*)	17. (*c*)	18. (*a*)
19. (*b*)	20. (*c*)	21. (*b*)	22. (*a*)	23. (*b*)	24. (*a*)
25. (*c*)	26. (*e*)	27. (*d*)	28. (*d*)	29. (*c*)	30. (*a*)
31. (*e*)	32. (*b*)	33. (*c*)	34. (*d*)	35. (*b*)	36. (*e*)
37. (*b*)	38. (*b*)	39. (*d*)	40. (*d*)	41. (*a*)	42. (*c*)
43. (*c*)	44. (*d*)	45. (*b*)	46. (*d*)	47. (*c*)	48. (*e*)
49. (*b*)	50. (*e*)	51. (*c*)	52. (*d*)	53. (*b*)	54. (*c*)
55. (*c*)	56. (*e*)	57. (*d*)	58. (*e*)	59. (*a*)	60. (*c*)
61. (*a*)	62. (*a*)	63. (*c*)	64. (*c*)	65. (*a*)	66. (*a*)

67. (*c*)	**68.** (*c*)	**69.** (*b*)	**70.** (*e*)	**71.** (*a*)	**72.** (*c*)
73. (*a*)	**74.** (*b*)	**75.** (*b*)	**76.** (*e*)	**77.** (*e*)	**78.** (*c*)
79. (*e*)	**80.** (*d*)	**81.** (*d*)	**82.** (*a*)	**83.** (*b*)	**84.** (*b*)
85. (*d*)	**86.** (*c*)	**87.** (*c*)	**88.** (*e*)	**89.** (*e*)	**90.** (*e*)
91. (*d*)	**92.** (*c*)	**93.** (*e*)	**94.** (*a*)	**95.** (*c*)	**96.** (*d*)
97. (*e*)	**98.** (*d*)	**99.** (*a*)	**100.** (*d*)	**101.** (*d*)	**102.** (*c*)
103. (*b*)	**104.** (*c*)	**105.** (*b*)	**106.** (*a*)	**107.** (*a*)	**108.** (*b*)
109. (*a*)	**110.** (*b*)	**111.** (*e*)	**112.** (*d*)	**113.** (*a*)	**114.** (*c*)
115. (*e*)	**116.** (*c*)	**117.** (*d*)	**118.** (*d*)	**119.** (*a*)	**120.** (*e*)
121. (*a*)	**122.** (*a*)	**123.** (*a*)	**124.** (*d*)	**125.** (*c*)	**126.** (*d*)
127. (*a*)	**128.** (*d*)	**129.** (*a*)	**130.** (*c*)	**131.** (*b*)	**132.** (*d*)
133. (*c*)	**134.** (*a*)	**135.** (*e*)	**136.** (*a*)	**137.** (*c*)	**138.** (*e*)
139. (*d*)	**140.** (*a*)	**141.** (*d*)	**142.** (*a*)	**143.** (*e*)	**144.** (*c*)
145. (*c*)	**146.** (*a*)	**147.** (*a*)	**148.** (*c*)	**149.** (*d*)	**150.** (*a*)
151. (*d*)	**152.** (*d*)	**153.** (*c*)	**154.** (*a*)	**155.** (*c*)	**156.** (*c*)
157. (*c*)	**158.** (*c*)	**159.** (*d*)	**160.** (*a*)	**161.** (*c*)	**162.** (*e*)
163. (*e*)	**164.** (*a*)	**165.** (*d*)	**166.** (*d*)	**167.** (*a*)	**168.** (*c*)
169. (*b*)	**170.** (*e*)	**171.** (*c*)	**172.** (*d*)	**173.** (*e*)	**174.** (*d*)
175. (*c*)	**176.** (*a*)	**177.** (*b*)	**178.** (*d*)	**179.** (*e*)	**180.** (*d*)