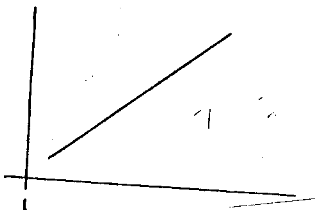
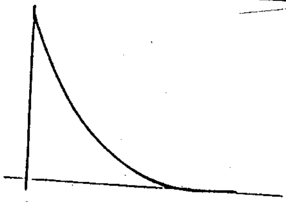
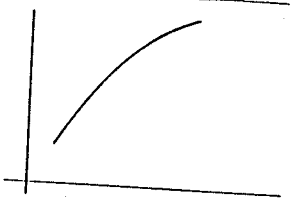
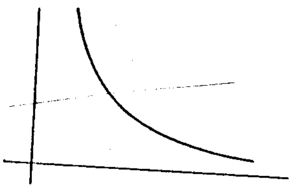
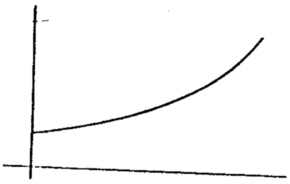
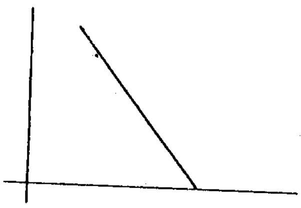
1.38. Match the figures in Part A with description in Part B.

A	B
1. 	(*a*) % of CO_2 in flue gas *vs.* % of excess air
2. 	(*b*) coefficient of friction *vs.* characteristic number $\frac{ZN}{P}$ (Z = absolute viscosity ; N = r.p.m. ; P = average pressure)
3. 	(*c*) Saturation curve on psychrometric chart
4. 	(*d*) Discharge coefficient for square-ring nozzle ($\frac{\text{Dia. of orifice}}{\text{Dia. of approach channel}}$ *vs.* coeff. of discharge)
5. 	(*e*) constant volume line on psychrometric chart
6. 	(*f*) Pressure *vs.* temperature relationship for pure hydrocarbons.

1.39. Match the two parts in connection with hydraulic turbines.

A	B
1. Air surrounds both the jet issuing from the nozzle and the runner.	(*a*) bulb
2. ________ type is of relatively high speed, suitable for low heads	(*b*) runaway speed

3. The common basis of comparison between turbine runners of different types and between runners of the same type but different designs and characteristics	(*c*) axial flow
4. In axial flow ________ type turbine, the generator is enclosed in a streamlined, watertight housing located in the water passage way, on either the upstream or the downstream side of the runner.	(*d*) propeller
5. __________ turbines use the propeller type runner and these can be installed for use with tidal power.	(*e*) reversible pump/turbines
6. __________ permits the turbine to be set above tailwater level, without loss of head, to facilitate inspection and maintenance.	(*f*) elbow
7. Pumped storage hydro plants use __________	(*g*) tube
8. __________ type of draft tube is used with most turbine installations.	(*h*) impulse pipe
9. If a turbine runner is allowed to revolve freely without load and with the wicket gates wide open.	(*i*) draft tube
10. __________ type axial flow turbine has the generator located outside the water passages.	(*j*) specific speed

1.40. Match parts A and B pertaining to pumps :

A	B
1. These pumps are characterised by their close running clearances and the absence of suction and discharge valves.	(*a*) diffusion vanes
2. For pressures above 1000 kg/cm^2 (100 MN/m^2), crank-driven pumps are impractical because of the large size, high torque, low speed (for high packing life), and side thrust on cross heads. Best suited pumps for such applications are ______	(*b*) stuffing boxes
3. To take up irregularities and induce a uniform flow, pulsation damperers in the form of __________ are often used	(*c*) NPSH
4. The major portion of the velocity energy in centrifugal pumps is converted in pressure energy by means of a set of stationary _______ surrounding the impeller/periphery.	(*d*) diaphragm/ bladder
5. ______ provide an easy and economically renewable leakage joint between the impeller and casing.	(*e*) rotary pumps
6. ________ have the primary function of protecting the pump against leakage at the point where the shaft passes out through the pump casing.	(*f*) specific speed
7. While not dimensionless, ________ is generally expressed simply as a number since its practical application is such that units are of no consequence except for their influence on the absolute magnitude of the number itself.	(*g*) injector

8. ______ required is a function of both pump speed and the pump capacity.	(*h*) pump
9. In the matter of ______ maintenance, a generally accepted cardinal rule is that as long as operation continues normal, the unit should be left alone.	(*i*) intensifier
10. A kind of pistonless pump.	(*j*) wearing rings

1.41. Match parts A and B in connection with fans :

A	B
1. A great deal of the energy transferred to the air in ______ fans is in kinetic form.	(*a*) fan
2. A considerable portion of the energy transferred to the air in a ______ fan may be in potential form due to centrifugal action.	(*b*) opposite
3. The product of fan capacity and fan total pressure and compressibility factor.	(*c*) stable
4. Ten times the logarithm (base 10) of the ratio of the actual sound power in watts to 10^{-12} watts.	(*d*) axial flow
5. Fans in ______ must all develop sufficient pressure to overcome the losses in any individual ductwork.	(*e*) surge point
6. To ensure stable operation the slopes of the pressure capacity curves for the fan and system should be of ______ sign.	(*f*) fan sound power level
7. Unsteady flow condition occurs only when the operating point is to the left of the maximum pressure on the fan curve, this peak is frequently referred to as ______	(*g*) right
8. Pulsation can be prevented by rating the fan to the ______ of the surge point.	(*h*) radial flow
9. If the fluctuations occasioned by a temporary disturbance are quickly damped out, the fan system may be described as having a ______ operating characteristic.	(*i*) parallel
10. Any device which produces a current of air.	(*j*) fan power output

1.42. Match parts A and B in connection with mechanics of solids.

A	B
1. Two particles attract each other with a force proportional to their masses and inversely proportional to the square of the distance between them.	(*a*) Statistically indeterminate
2. The linear momentum of a system of bodies is unchanged if there is no resultant external force on the system.	(*b*) law of mutual gravitation
3. The product of the magnitude of one of the forces and the perpendicular distance between the lines of action of the forces.	(*c*) Polar moment of inertia

4. When the conditions are not sufficient for the determination of the supports or other forces ; and the unknown forces have to be determined from considerations involving the deformation of the material.	(*d*) Centre of percussion
5. The study of the motion of bodies without reference to the forces causing that motion or the mass of the bodies.	(*e*) Law of the conservation of momentum
6. The point at which a suspended body may be struck without causing any pressure on the axis passing through the point of suspension.	(*f*) The angular momentum of a rigid body in plane motion
7. The ratio of the velocity of separation to the velocity of approach in case of collision.	(*g*) axis of suspension
8. The vector sum of the angular momentum about the reference axis and the moment of the linear momentum of the centre of gravity about the reference axis.	(*h*) Moment of a couple
9. The length of an equivalent simple pendulum is the distance from the centre of percussion of body to the __________	(*i*) Coefficient of restitution
10. The sum of the moments of inertia about any two axes at right angles to each other in the plane of the area and intersecting at the pole.	(*j*) kinematics

1.43. Match parts A and B in connection with friction.

A	B
1. When the rubbing surfaces are separated from each other by a very thin film of lubricant.	(*a*) viscous lubrication
2. Silver sulphate, tungsten disulphide, graphite, molybdenum disulphide, lead oxide.	(*b*) friction circle
3. Used to resist the end thrust of the shafts.	(*c*) boundary lubrication
4. When the two solid surfaces sliding over each other are free from contaminating fluid or film, the resistance encountered is called.	(*d*) 0.07 to 0.15
5. For design of ordinary machinery, value of journal friction can be taken as	(*e*) kinetic friction
6. For very low velocities of rotation, high loads, and with good lubrication (pull-out coefficient of friction on starting the journal) can be taken as __________	(*f*) Incomplete lubrication
7. When the lubrication is arranged so that rubbing surfaces are separated by a fluid film, and the load on the surfaces is carried entirely by the hydrostatic or hydrodynamic pressure in the film	(*g*) 0.008 to 0.02
8. When the load on the rubbing surfaces is carried partly by a fluid viscous film and partly by areas of boundary lubrication	(*h*) dry friction

9. When effect of friction is negligible, the force is transmitted by the link from driver to the driven link through the centre line of the pins connecting the link. With friction, the line of action shifts and is tangent to ________	(*i*) step bearings
10. If one surface slides over the other, being pressed together by a normal force *N*, a frictional force *F* resisting the motion must be overcome. The ratio F/N is called ________	(*j*) solid lubricants.

1.44. Match parts A and B in regard to properties of materials.

A	B
1. Tendency to break under an impact of load	(*a*) elasticity
2. The slow stretching or continuous plastic extension under steady stress	(*b*) proof stress
3. Ability to be stretched before fracture	(*c*) stiffness
4. Property to return to its original size and shape on removal of load	(*d*) creep
5. Resistance to penetration/abrasion	(*e*) toughness
6. Just sufficient stress to cause a specified permanent deformation	(*f*) tenacity
7. Property to sustain shock load without permanent deformation	(*g*) brittleness
8. Ability of a material to resist deformation	(*h*) resilience
9. Property to resist a tensile force without giving way	(*i*) hardness
10. Resistant to fracture by bending	(*j*) ductility

1.45. Match parts A and B in regard to mechanical properties of materials.

A	B
1. In tensile testing of materials, separation failures occur in	(*a*) fatigue limit
2. If a specimen is first plastically strained in tension, its yield stress in compression is reduced and vice versa.	(*b*) Mohs scale
3. A value of stress which will not produce failure, regardless of the number of applied reversals of loading	(*c*) brittle materials
4. A diamond-tipped hammer is dropped on the surface and the rebound is taken as an index of hardness	(*d*) creep
5. Scratch hardness is measured by	(*e*) distortion energy theory
6. A shower of steel balls is dropped from a predetermined height to dull the surface of a hardended part in proportion to its softness and thus reveal defective areas.	(*f*) structural grade steels
7. Plastic deformation caused by slip occurring along a crystallographic directions in the individual crystals, together with some flow of the grain-boundary material	(*g*) scleroscope

8. Prediction of the conditions under which plastic yielding will occur under combined stresses can be made by the ________	(*h*) Bauschinger effect
9. The transition-temperature approach is often used to ensure fracture-safe design in ________	(*i*) brittle fracture
10. Structural grade steels exhibit a characteristic temperature, known as the ductile brittle transition (DBT) temperature, below which they are susceptible to ________	(*j*) Herbert cloud burst test

1.46. Match parts A and B regarding strength to materials.

A	B
1. The area around the centre of gravity of a cross section within which any load applied will produce stress of only one sign throughout the entire cross section	(*a*) Maximum stress theory
2. In the case of curved beam, when loaded by vertical force, the neutral surface shifts towards the ________	(*b*) kern
3. The deflection of a curved beam is proportional to cube of ________	(*c*) holography
4. Isoclinics can be obtained with a beam polariscope. Isoclinics refer to ________	(*d*) zero
5. A recently developed technique for strain analysis using laser source, beam splitters, reflecting surface, filters and the recording plate	(*e*) centre of curvature
6. These are much thinner and can be applied easily to curved surfaces, have lower transverse sensitivity, exhibit negligible hysteresis under cycling load, creep little under sustained loads.	(*f*) thickness
7. For brittle materials, the theory of failure applicable is ________	(*g*) radius of curvature
8. For ductile materials the theory of failure applicable is ________	(*h*) maximum shear theory
9. The maximum deflection in case of flat plates is inversely proportional to cube of ________	(*i*) foil gauges
10. In the case of square and rectangular sections subjected to torsion, the shear stress at the corners is ________	(*j*) direction of the principal planes.

1.47. Match parts A and B in relation to Mechanics of Materials.

A	B
1. Potential energy stored up in a deformed body.	(*a*) Bulk modulus of elasticity
2. Ratio of normal stress applied to all six faces of a cube, to the change of volume	(*b*) load
3. The ratio of moment of inertia of cross section, and the distance to the fibre carrying the greatest stress	(*c*) one-half
4. Curve taken by the neutral axis	(*d*) resilience

5. The stiffness (inverse deflection) of various beams varies inversely as __________ — (*e*) uniform strength beam
6. If depth is constant, a beam of double span will attain a given deflection with only __________ — (*f*) section modulus
7. If a bean is cut in halves horizontally, the two halves laid side by side will carry __________ as much as the original beam — (*g*) elastic curve
8. A beam resting upon several supports which may or may not be in the same horizontal plane. — (*h*) one-quarter the stress
9. Beams varying in section such that the unit stress remains constant. — (*i*) principle of least work.
10. The deformation of any structure takes place in such a manner that the work of deformation is a minimum. — (*j*) continuous beam

1.48. Match parts A and B regarding stress-strain diagrams.

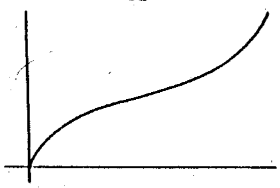
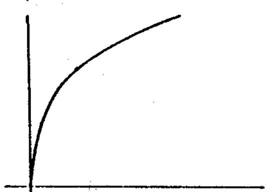
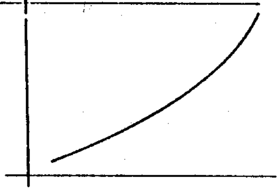
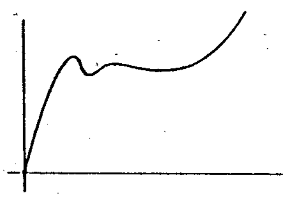
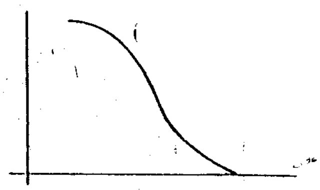
1. The engineering tensile stress-strain curve is obtained by __________ — (*a*) yield point
2. The slope of stress-strain curve in the initial linear elastic region is __________ — (*b*) ultimate tensile strength
3. The point where the stress-strain curve starts to deviate from straight line relationship is called __________ — (*c*) elastic limit
4. The point on the stress-strain curve beyond which plastic deformation is present after release of the load is called __________ — (*d*) 4.5 : 1
5. At high temperatures, a small amount of time-dependent reversible strain may be detectable, indicative of __________ — (*e*) Young's modulus
6. The maximum load sustained by the specimen divided by the original specimen cross sectional area is __________ — (*f*) 6 : 1
7. For flat and round cross section specimen, the ratio $\frac{\text{Gauge length}}{\sqrt{\text{Cross-sectional area}}}$ is taken as __________ — (*g*) proportional elastic limit
8. Flat tensile specimens of ductile metals often show shear failures (which may terminate in a chisel edge) if the ratio of width to thickness is greater than __________ — (*h*) anelastic behaviour
9. Anneal or hot rolled mild steels generally exhibit a __________ — (*i*) plastic deformation
10. The concept of true strain is useful for accurately describing large amounts of __________ — (*j*) static loading

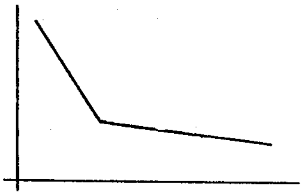
1.49. Match parts A and B in connection with columns and struts.

A	B
1. Ratio of moment of intertia to the length of the column	(*a*) stanchions

2. Same area of cross section of column has the greatest radius of gyration	(*b*) strut
3. The ratio $\sqrt{\dfrac{\text{Moment of inertia}}{\text{Cross sectional area}}}$	(*c*) columns
4. Columns generally carrying heavy loads	(*d*) pedestal
5. The ratio $\dfrac{\text{effective length}}{\text{least radius of gyration}}$	(*e*) effective length
6. The smaller vertical or inclined compression member	(*f*) most economical section of column
7. An upright compression member whose height does not exceed three times its least lateral dimension	(*g*) strength of a column
8. Generally fail by buckling	(*h*) radius of gyration
9. Function of slenderness ratio and the method by which the ends are fixed	(*i*) slenderness ratio
10. __________ is affected by end fixing of column	(*j*) measure of stiffness

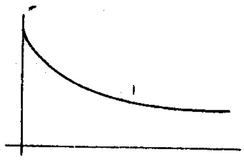
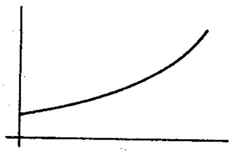
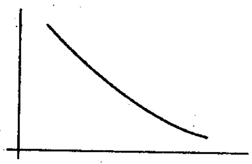
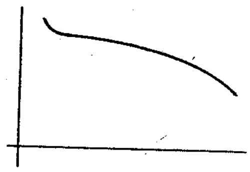
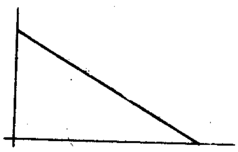
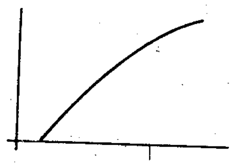
1.50. Match various curves in part A with description in regard to mechanical properties of materials given in part B.

A	B
1. 	(*a*) stress strain curve for annealed steel
2. 	(*b*) Stress *vs.* cycles to failure (Fatigue)
3. 	(*c*) Energy for brittle fracture *vs.* temperature
4. 	(*d*) True-stress strain curve
5. 	(*e*) Typical creep curve

6. 

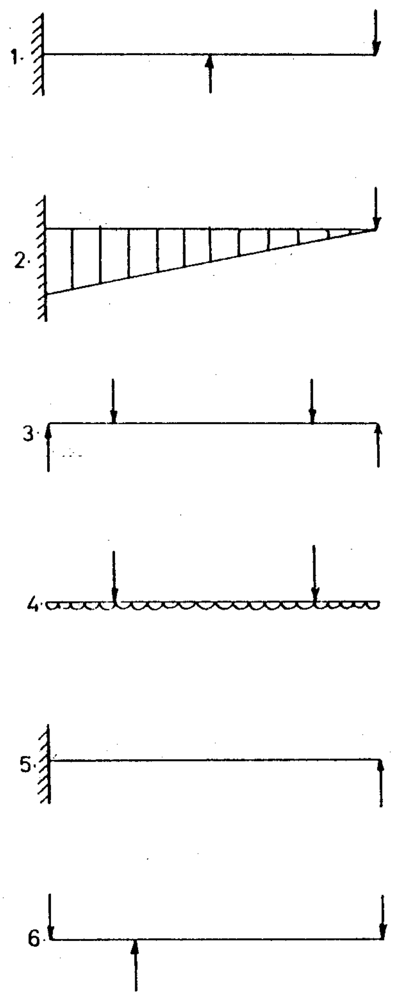
(*f*) Vickers hardness *vs.* Brinnel number

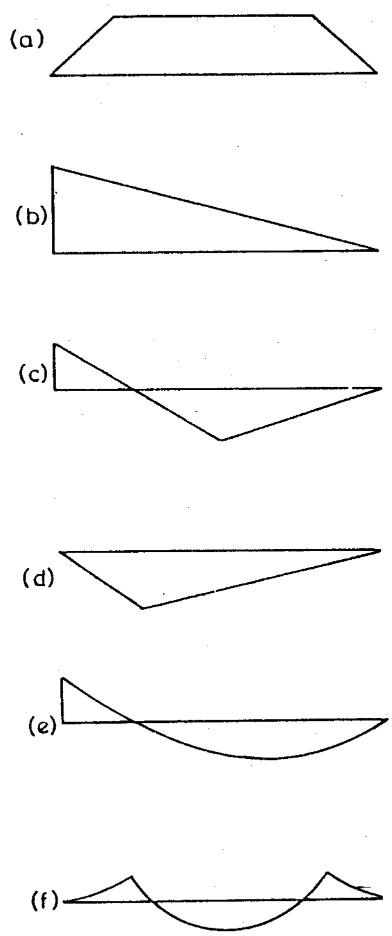
1.51. Match the figures in part A with description in Part B :

A		B
1.		(*a*) creep rate *vs.* stress
2.		(*b*) effect of mean stress on the variable stress for failure
3.		(*c*) heat absorpitivity *vs.* temperature of polished aluminium
4.		(*d*) Heat loss per area per °C temperature difference per hour *vs.* diameter of pipe
5.		(*e*) Emissivity of water vapour
6.		(*f*) Heat absorptivity *vs.* temperature for aluminium paint.

1.52. Match the figures in Part A with the figures in Part B regarding bending moments for various loadings :

A	**B**
Bending Moment diagram	Loading diagram





1.53. Match parts A and B regarding lubrication.

A	B
1. The single most important property of a lubricant.	(*a*) pour point
2. The temperature at which the lubricant oil will just flow under prescribed conditions.	(*b*) dispersants

3. __________ is used to determine the percentage of fatty oil or fat in a compounded petroleum lubricant.	(*c*) foam inhibitors
4. The temperature at which the grease changes from a semi-solid to a liquid state.	(*d*) extreme pressure agents
5. The pressures developed in a converging fluid film are sufficient to support the bearing load.	(*e*) corrosion inhibitors
6. To reduce surface tension and allow air bubbles to separate more readily.	(*f*) dropping point
7. To keep insoluble materials suspended.	(*g*) viscosity
8. To neutralise acid materials and form protective films on metal surfaces.	(*h*) solid lubricant
9. To form film of lower shear strength than the base metals to reduce friction and prevent welding and seizure if and when the oil film is ruptured.	(*i*) saponfication number
10. A thin film composed of a single solid or a combination of solids introduced between two rubbing surfaces for the purposes of modifying friction and wear.	(*j*) hydro dynamic lubrication

1.54. Match parts A and B relating to ball and roller bearings.

A	B
1. This bearing provides for heavy radial and light thrust loads without increasing the outside diameter of the bearing.	(*a*) needle bearings
2. These bearings are designed to support combined radial and thrust loads.	(*b*) rated life
3. These bearings have rollers with length to diameter ratio of more than four. These are most useful where space is consideration.	(*c*) tapered roller bearings
4. The number of revolutions or hours at a given constant speed that 90% of an apparently identical group of bearings will complete or exceed before the first evidence of fatigue failure.	(*d*) fatigue
5. The radial load that a ball bearing can withstand for one million revolutions of the inner ring.	(*e*) rolling contact bearings
6. These bearings are used for heavy radial and thrust loads. These permit rolling motion.	(*f*) double row bearing
7. Used to space the rolling elements from each other.	(*g*) spherical roller bearings
8. Designed to support and locate rotating shafts or parts in machines.	(*h*) basic load rating
9. These bearings are excellent for heavy radial loads and moderate thrust.	(*i*) angular contact bearings
10. The only cause of failure of a bearing if it is property lubricated.	(*j*) cages

1.55. Match the two parts relating to types of gears.

A	B
1. Gears used for parallel shaft arrangement.	(*a*) mitre gears

2. Gears used for intersecting shaft arrangement.	(*b*) face gears
3. Gears used for skew shaft arrangement.	(*c*) angular bevel gears
4. Bevel gears used for connecting intersecting shafts at 90° and having speed ratio of 1 : 1.	(*d*) worm gearing
5. Tapered involute gears which can couple intersecting shafts, skew shafts, and parallel shafts.	(*e*) helical, worm, or hypoid gears
6. Gears having teeth cut on the rotating face plane of the gear and mate with standard involute spur gears. Used to connect intersecting or non-parallel non-intersecting shafts.	(*f*) Gleason bevel gears
7. Used for obtaining large speed reduction between nonintersecting shafts making an angle of 90° with each other.	(*g*) skew bevel gears
8. Bevels connecting shafts other than 90°.	(*h*) bevel gears
9. Bevels connecting non-intersecting shafts.	(*i*) beveloid gears
10. Bevel gears with basic pressure angle of 20° with long and short addendums for ratios other than 1 : 1 to avoid undercut pinions and to increase strength.	(*j*) spur gears on helical gears.

1.56. Match the two parts relating to bevel gears.

A	B
1. The mathematical form of the bevel tooth profile. Closely resembles a spherical involute but is fundamentally different.	(*a*) pitch angle
2. The angle formed between an element of the pitch cone and the bevel gear axis.	(*b*) generating mounting surface
3. The angle between the tooth trace and an element of the pitch cone, corresponding to helix angle in helical gears.	(*c*) shaft angle.
4. The diameter and/or plane of rotation surface or shaft centre which is used for locating the gear blank during fabrication of the gear teeth.	(*d*) dedendum angle
5. The sharp corner forming the outside diameter.	(*e*) octoid
6. The angle between elements of the face cone and pitch cone.	(*f*) face width
7. The angle between mating bevel gear axes ; also, the sum of the two pitch angles.	(*g*) back cone
8. The length of teeth along the cone distance.	(*h*) spiral angle
9. The angle of a cone whose elements are tangent to a sphere containing a trace of the pitch circle.	(*i*) addendum angle
10. The angle between elements of the root cone and pitch cone.	(*j*) crown

1.57. Match the two parts in relation to gearing.

A	B
1. Radial distance between the pitch circle and the top of the tooth.	(*a*) cycloid

2. The circle from which an involute curve is generated.	(*b*) roll angle
3. Length of the arc of the pitch circle between the centres or other corresponding points of adjacent teeth.	(*c*) bottom land
4. The curve formed by the point on a circle as it rolls along a straight line.	(*d*) addendum
5. That surface of the tooth which is between the pitch circle and the top of the tooth.	(*e*) circular pitch.
6. The distance between similar, equally spaced tooth surfaces, in a given direction and along a given curve or line.	(*f*) pressure angle.
7. The angle between a tooth profile and a radial line at its pitch point.	(*g*) base circle
8. The angle subtended at the centre of a base circle from the origin of an involute to the point of tangency of the generatix from any point on the same involute.	(*h*) base helix angle
9. Surface of the gear between the fillets of adjacent teeth.	(*i*) pitch
10. The angle, at the base cylinder of an involute gear, that the tooth makes with the gear axis.	(*j*) face of tooth.

1.58. Match the two parts relating to general formulae for standard spur gears.

A	B
1. Pitch diameter × cos (pressure angle)	(*a*) circular pitch
2. $\dfrac{3.1416 \times \text{pitch diameter}}{\text{No. of teeth}}$	(*b*) no. of teeth
3. $\dfrac{\text{No. of teeth in pinion (gear ratio} + 1)}{2 \times \text{diametral pitch}}$	(*c*) whole depth
4. $\dfrac{\text{No. of teeth in pinion (gear ratio} + 1)}{2 \times \text{central distance}}$	(*d*) root diameter
5. Diameteral pitch × pitch diameter	(*e*) working depth
6. $\dfrac{\text{No. of teeth} + 2}{\text{diametral pitch}}$	(*f*) diameteral pitch
7. addendum + dendentum	(*g*) gear ratio
8. addendum of gear + addendum of pinion	(*h*) base circle diameter
9. $\dfrac{\text{No. of teeth in gear}}{\text{No. of teeth in pinion}}$	(*i*) outside diameter
10. Pitch diameter - 2x dedendum	(*j*) centre distance

1.59. Match parts A and B for vibrations.

A	B
1. The amount of damping present in an oscillatory system can be judged by ________	(*a*) accelerometers

2. For free vibrations, the period of vibrations is proportional to square root of __________	(*b*) small
3. For free vibrations, the natural frequency of vibration is proportional to square root of __________	(*c*) zero
4. When the disturbing force has a very low frequency as compared with the natural frequency of the system, the magnification factor (with phase approaching zero), approaches __________	(*d*) 1/3
5. When the disturbing force has a very high frequency, the magnification factor (with phase angle tending to 180°), approaches __________	(*e*) $\sqrt{2}$
6. For an isolator to perform its function, the natural frequency of the supported structure in comparison to frequency of the disturbing forces must be __________	(*f*) static deflection
7. The transmissibility ratio is less then 1 if ω/ω_n is greater than __________	(*g*) unity
8. For more accurate estimate of the natural frequency of system, the __________ of the weight of spring must be added to the end weight	(*h*) logarithmic decrement
9. Velocity and displacement for harmonic motion can be obtained from __________	(*i*) length
10. For uniform beam vibrating in flexure, the natural frequency is inversely proportional to square of __________	(*j*) spring constant

1.60. Match parts A and B regarding screw fastenings.

A	B
1. A common standardisation of screw threads adopted by the screw thread standardisation committees of Canara, U.K. & U.S.A.	(*a*) Coarse thread series
2. Thread-series for general use, especially where rapid assembly is required and for gray iron, soft metals and plastics	(*b*) Acme threads
3. Thread-series for applications requiring greater strength or where the length of engagement is limited	(*c*) Whitworth screw thread
4. Thread-series for highly stressed parts and where internal threads are required in thin-walled fasteners	(*d*) Metric screw thread
5. Power transmission screw threads	(*e*) Unified thread standard
6. Used for fastening collars, sheaves, gears, etc.	(*f*) Oval head
7. Included angle of thread = 60°	(*g*) British Association screw
8. Included angle of thread = 55°	(*h*) Fine thread series
9. Included angle of thread = $47\frac{1}{2}°$	(*i*) setscrews
10. Screw having a rounded surface or top of the head and a countersink angle of 82°. Standard for machine screws and wood screws.	(*j*) Extra fine thread series

1.61. Match the two parts relating to pipes and pipe fittings.

A	B
1. Pipe fabricated from a heated billet using a piercing mandrel	(*a*) Vitrified pipe
2. End joints prepared by tightly tamping in hemp or jute at the bottom of the recess with yarning iron and then pouring in molten lead.	(*b*) insulation
3. ________ is provided in piping system by changes of direction in the piping through the use of bends or loops	(*c*) seamless pipe
4. A cast iron pipe with hub-and-spigot ends, the contact surfaces of which are machined on a taper, giving an iron-to-iron joint. The joint provides for flexibility and remains tight also.	(*d*) bell-and-spigot
5. Materials like 85% magnesia, foam glass, calcium silicate, and various forms of diatomaceous earths are used for ________	(*e*) inside diameter
6. For heavy lines in which expansion movements are great, it is advisable to use ________ hanger.	(*f*) ERW pipe (electric resistance welded)
7. Commercial sizes of wrought-iron and steel pipes are known by their nominal ________ from 0.3 to 30 cm diameter.	(*g*) constant support
8. Used extensively for drains and sewerage systems.	(*h*) flexibility
9. Most popular pipe ends for underground work. It possesses greater flexibility and provides for expansion and contraction.	(*i*) universal pipe
10. A pipe fabricated from a flat plate (skelp), with the help of copper disk electrodes.	(*j*) Spigot end joints.

1.62. Match the two parts for machine elements.

A	B
1. A device used to maintain belt tightness with minimum initial tension	(*a*) diameter
2. The speeds given by cone pulleys should increase in a ________	(*b*) standard hoisting rope
3. To avoid the necessity of taking up the slack in belts, a belt tightner is used. It is placed on ________	(*c*) RPM
4. When wires and strands are laid in the same direction, the rope is known as ________	(*d*) inverted tooth
5. A rope made of 6 strands, each of 19 wires, the strands being laid around a fibre core.	(*e*) geometrical ratio
6. A rope constructed of 6 strands of 7 wires each, land lay, laid around a fibre core, and covered with an outer layer composed of 12 strands, 7 wires, regular lay.	(*f*) lang-lay rope

7. A rope made of 6 strands of 37 wires each and a fibre core.	(*g*) slack side of belt nearer to driving pulley
8. Flywheel weight is universely proportional to square of ______	(*h*) Non-spinning hoisting rope
9. Silent chain drives use ______	(*i*) extra-pliable hoisting rope
10. The nominal torsional stress and bending stress in a shaft are inversely proportional to cube of ______	(*j*) pivoted motor drive

1.63. Match the two parts in relation to machine elements.

A	B
1. Keys made to facilitate removal of pulleys from shafts.	(*a*) coupling
2. Keys used to prevent parts from turning on a shaft while allowing them to move in a lengthwise direction.	(*b*) eddy current
3. A device to make a semipermanent connection between two shafts.	(*c*) clutches
4. A coupling used to connect shafts having only lateral misalignment.	(*d*) cotter pins
5. A coupling made with two grooved steel hubs keyed to their respective shafts and connection between the two halves being secured by a specially tempered alloy-steel member called the grid.	(*e*) Hooke's type joint.
6. A coupling in which there is no mechanical connection between the two shafts.	(*f*) Woodruff
7. Couplings which permit the disengagement of the coupled shafts during rotation.	(*g*) Steelflex
8. Brakes used with flywheels where quick braking is essential and large kinetic energy does not permit use of block brakes due to excessive heating.	(*h*) hydraulic torque converter
9. Shafts with misalignment upto 30° can be connected with ______	(*i*) Oldham
10. Used to secure or lock nuts, clevises, etc.	(*j*) feather.

1.64. Match parts A and B pertaining to material conveying techniques.

A	B
1. Used for moving granular, lumpy, or pulverised materials along a horizontal path or on an incline less than 40°.	(*a*) hydraulic
2. A heavy duty conveyor available for transporting large tonnages over paths beyond the range of any other type of mechanical conveyor	(*b*) tripper
3. For long belt conveyors, to take care of expansion and contraction of belt with temperature changes and to take care of occasional cutting and resplicing, a ______ is used	(*c*) automatic feeder

4. When material is drawn from a hopper or a bin to a conveyor, ________ should be used to ensure that material is fed on conveyor in a constant and controlled rate. — (*d*) magnetic

5. __________ conveyors are used for handling boiler plant ash or slag from an ash hopper or slag tank located under the furnace. — (*e*) dynamic

6. __________ conveyor transports dry, free-flowing, granular material in suspension within a pipe or duct by means of a high velocity air-stream or by the energy of expanding compressed air within a comparatively dense column of fluidised or aerated material — (*f*) flight conveyor

7. __________ pulleys are frequently used as head pulleys on belt conveyors to remove tramp iron. — (*g*) weighted gravity take up

8. In the case of heavy duty belt conveyor drives, __________ clutch is used to ensure that the drive torque is built up slowly. — (*h*) ribbon

9. __________ screw conveyors are used for wet and sticky materials, such as molasses, hot tar, and asphalt. — (*i*) belt

10. The load may be removed from the belt by __________, which snubs the belt backwards. — (*j*) pneumatic

1.65. Match the two parts in relation to equipment used for lifting.

A	B
1. For chains with low to medium hardness (less than 400 Brinell), the failure is typically due to __________	(*a*) tension due to bending
2. For chains with higher hardness, the typical mode of failure is due to __________	(*b*) air
3. Haulage ropes and suspension ropes are of __________ type.	(*c*) regenerative
4. Lang-lay ropes are difficult to __________	(*d*) shear
5. Where there is side draft on the rope, movable __________ are provided to align the rope and groove.	(*e*) track
6. Sheaves should be ________ to fit the rope as closely as possible in order to prevent the rope from assuming an oval or elliptical shape under heavy load.	(*f*) lang-lay
7. In __________ braking, the motor, when overhauled, acts as a generator to pump current back into the line	(*g*) grooved
8. __________ are portable lifting devices suspended from a hook and operated by a hand chain.	(*h*) splice
9. __________ jacks are rack-and-lever jacks which may be tripped to release the load.	(*i*) idlers

10. __________ hoists provide infinitely variable speed. (j) hand chain hoists.

1.66. Match the two parts pertaining to carrying lifting device for material handling.

A	B
1. The proper packaging of material to assist in handling can significantly minimise the handling cost and can also have a marked influence on the type of handling equipment employed.	(a) cable ways
2. To facilitate the use of fork lift trucks, the load is generally placed on a __________	(b) derricks
3. The use of __________ is advantageous for movement of materials where batches or unit quantities of materials of varying amounts have to be moved on variable schedules and destinations.	(c) containerisation.
4. The movement of large quantities of bulk materials, earth, gravel in mining, construction, quarrying, and land clearing may be handled by __________ such as crawler wheel tractors, crawler/ wheel bulldozers etc.	(d) cable tramways
5. Off-highway vehicles are mounted on _______ if the heavy pulling and pushing are required on poor or steep terrain.	(e) gantry
6. __________ cranes are modifications of travelling cranes and are generally used outdoors where it is not convenient to erect an overhead runway.	(f) power showels.
7. __________ are aerial hoisting and conveying devices using suspended steel cable for their tracks, the loads being suspended from carriages and moved by gravity or power.	(g) crawler tracks
8. __________ stand upon the bottom of pit being dug and dig above this level	(h) lift trucks
9. Aerial conveying devices using suspended cables, carriages, and buckets for transporting material over level or mountaineous country or across rivers, valleys, or hills.	(i) pallet
10. __________ are devices to lift loads, housed outdoors and built so that they can be easily moved.	(j) off-highway vehicles.

1.67. Match parts A and B regarding iron and steel.

A	B
1. Product of blast furnace and made by the reduction of iron ore	(a) ingot iron
2. An alloy of iron containing so much carbon that, as cast, it is not appreciably malleable at any temperature	(b) wrought iron
3. Contains carbon in the combined form. The presence of cementite makes it hard and brittle	(c) steel

4. As cast, it has combined carbon not in excess of a eutectoid % age.	(*d*) white cast iron
5. Open-hearth iron very low in carbon, manganese and other impurities.	(*e*) malleable cast iron
6. A malleable alloy of iron and carbon, usually containing substantial quantities of manganese	(*f*) carbon steel
7. A ferrous material aggregated from a solidifying mass of pasty particles of highly refined metallic iron containing uniformly distributed quantity of slag.	(*g*) carbon steel
8. An alloy in which all the combined carbon in a special white cast iron has been changed to free or temper carbon by suitable heat treatment	(*h*) grey cast iron
9. Produced by adding alloys of magnesium or cerium to molten iron. The additions cause graphite to form into small modules	(*i*) pig iron
10. Steel that owes its distinctive properties chiefly to the carbon contained in it.	(*j*) ductile cast iron

1.68. Match parts A and B regarding steels.

A	B
1. Sheets for deep drawing must be dead soft and have fine grains. Large grain size will cause a rough finish.	(*a*) structural carbon steel
2. The sharp yield point characteristic of low carbon steel must be eliminated to prevent sudden local elongations in steel during forming, otherwise these result in strain marks called ________	(*b*) % nickel steel
3. An important phenomenon in temper-rolled low carbon steels is the return of the sharp yield point after a period of time. This phenomenon is called ________	(*c*) Maraging steels.
4. Bridges and buildings are constructed with ________	(*d*) H. steel
5. Age hardenable martensitic steels containing normally about 12 to 18% nickel	(*e*) aging treatment
6. Carbon-free iron-nickel martensite is relatively soft and ductile. It can thus be fabricated easily and later strengthened by a simple ________	(*f*) Luders lines or stretcher strains
7. The best suited steel for cryogenic services	(*g*) boron
8. Free cutting steels used for high speed screw machine stock and other machining purpose contain high content of ________	(*h*) aging in steel
9. Addition of 0.0005% of ________ in steel increases hardenability and strength. It decreases susceptibility to flaking, results in formation of less adherent scale and offers greater softness in the unhardened condition, and better machinability.	(*i*) Orange peel effect

10. An important variety of machinery steel is ________ (*j*) Sulphur

1.69. Match parts A and B regarding special steels.

A	B
1. For small helical springs, previously treated steel wire is used which has been given a special heat treatment (patenting) and then cold drawn to develop a high yield strength	(*a*) Invar
2. Electrical sheet steels.	(*b*) Perminvar
3. Used extensively in electrical industry owing to their exceptional magnetic properties.	(*c*) anstenitic
4. An iron nickel alloy containing 36% nickel and having exceedingly low coefficient of expansion.	(*d*) music wire
5. A 42% nickel alloy covered with copper to prevent gassing at the seal, is used to replace platinum as the seal, in wire in incandescent lamps and vacuum tubes	(*e*) Hadfield's manganese steel
6. A nonmagnetic alloy containing 12% Mn and 1% C. It is relatively soft but work-hardens on surface when subjected to severe abrasion. Accordingly used for crushing machinery, for rail road crossing, tractor shoes, etc.	(*f*) cobalt
7. An iron nickel alloy containing 45% Ni and 25% Co has a constant permeability over a range of flux densities	(*g*) iron-silicon alloys.
8. Iron-__________ alloys have magnetic saturation values higher than that of pure iron.	(*h*) ferritic
9. stainless steel with 18% Cr and 8% Ni	(*i*) dumet wire
10. Stainless steels with very low carbon, non-hardenable alloys containing upto 27% Cr.	(*j*) iron-nickel alloys.

1.70. Match parts A and B in connection with terms used for steel ingots.

A	B
1. Steel in which no gas evolution occurs on solidification	(*a*) scabs
2. When the steel cools in the mould, shrinkage of the steel on solidifying causes __________	(*b*) capped steel
3. Steel not fully deoxidised to reduce the cost of hot tops wasted due to piping, but permitting blow-holes to be distributed which weld together during rolling, is called _________	(*c*) segregation
4. If steel is partly deoxidised in ladle, then oxygen and carbon form carbon mono-oxide which results in clean and low carbon outer skin of ingot. If reaction is complete then steel is called ___________	(*d*) piping

5. In (4) above, if reaction is stopped after a short while by mechanical means, the steel is called ________	(*e*) lap
6. Concentration of impurities in steels upon solidification	(*f*) semi killed steel
7. Cracks or cavities developed in mould due to presence of impurities, get elongated in the direction of rolling.	(*g*) seams
8. Improper pouring conditions (splashing of steel) in the mould forms ________	(*h*) rimmed steel
9. Surface defects like seams, laps, scabs, laps etc. can be removed by ________	(*i*) killed steel
10. A thin and wide fin when folded over while steel passes through subsequent set of rolls.	(*j*) chipping, or scarfing, or pickling.

1.71. Match A and B regarding constitution and structure of steel.

A	B
1. Pure iron having body-centred cubic arrangement of atoms.	(*a*) delta iron
2. Pure iron at 910°C having face-centered arrangement of atoms.	(*b*) cementile
3. Pure iron at 1390°C having body centered cubic structure.	(*c*) ferrite
4. Alpha iron containing carbon or any other element in solid solution.	(*d*) martensite
5. Gamma iron containing elements in solid solution.	(*e*) alpha iron
6. When not in solution in iron, the carbon forms a compound Fe_3C which is extremely hard and brittle.	(*f*) hyper-eutectoid
7. A microstructure of alternate plates or lamellae of ferrite and cementite which are rejected simultaneously on slow cooling through the critical temperature of eutectoid composition.	(*g*) critical points
8. When carbon does not have sufficient time to separate out in the form of carbide, the austenite transforms to a highly stressed structure supersaturated with carbon.	(*h*) austenite
9. Temperatures at which the phase changes occur.	(*i*) gamma iron
10. The steel which when slowly cooled will have areas of pearlite surrounded by a thin carbide network.	(*j*) pearlite

1.72. Match parts A and B regarding iron and steel castings.

A	B
1. ________ has a powerful softening effect. Its presence in cast iron reduces the ability of iron to retain carbon in chemical combination.	(*a*) dead soft

2. The elastic limit of ________ is close to its ultimate breaking strength	(*b*) magnesium and cerium
3. A thermosetting sand and resin mixture applied mechanically to a hot pattern plate for a controlled time to form a plastic layer adjacent to the pattern.	(*c*) graphite mould process
4. Horizontal spindle machine for the casting of tubular castings	(*d*) silicon
5. A process for the manufacture of permanent moulds for casting steel car wheels.	(*e*) tensile strength
6. ________ are employed when service requirements include dynamic loading and impact and fatigue-stress conditions	(*f*) cast iron
7. The primary difference between the production of steel for castings and for ingots is that steel for castings must be ________	(*g*) shell moulding
8. Gray iron castings are classified according to ________	(*h*) malleable iron
9. Nodular iron is a cast iron produced by adding ________	(*i*) steel castings
10. Castings having sections over 5 cm do not lend themselves to production in ________	(*j*) true centrifugal casting.

1.73. Match parts A and B regarding mechanical treatment of steel.

A	B
1. Mechanical treatment at temperatures above the thermal critical range of steel.	(*a*) rolling
2. Elongation of inclusions in one direction, giving the steel excellent properties in samples taken parallel to that direction.	(*b*) bloom
3. Working can be done in more than one direction thus eliminating directional properties to the steel.	(*c*) hot working
4. Used for slow application of pressure to work the interior of a large forging more effectively.	(*d*) billet
5. 150 mm square or larger sections obtained by reduction of ingot in several passes.	(*e*) cold working
6. The bloom is further reduced to sections between 30 and 150 mm square.	(*f*) forging press
7. If the width of rolled section far exceeds the thickness of the rectangular section, it is called ________	(*g*) extrusion
8. Shaping of metal into the desired form by forcing it through a die under pressure.	(*h*) glass
9. Increases greatly the yield strength and reduces the ductility.	(*i*) hammer forging
10. The lubricant used in hot extension process is ________	(*j*) slab

1.74. Match parts A and B regarding heat treatment.

A	B
1. Rapid cooling by immersion in liquids or gases or by contact with metal.	(*a*) heat treatment
2. Heating and quenching iron base alloys from within or above the critical range.	(*b*) process annealing
3. A heating and slow cooling process to remove stresses, induce softness, alter ductility/toughness, refine the crystalline structure, remove gases, to produce a definite microstructure.	(*c*) normalising
4. Heating iron-base alloys above the critical temperature range, holding for 1 hour or more followed by slow cooling in furnace or medium to prolong time of cooling.	(*d*) spheroidising
5. Heating iron-base alloys to a temperature below or close to lower limit of the critical temperature followed by cooling as desired.	(*e*) quenching
6. Heating iron-base alloys to approx. 40°C above the critical temperature range in still air at ordinary temperature.	(*f*) full annealing
7. Process of heating and cooling steel to produce rounded or globular form carbide.	(*g*) hardening
8. Reheating hardened steel to some temperature below the lower critical temperature, followed by any desired rate of cooling.	(*h*) patenting
9. Heating iron-base alloys above the critical temperature range followed by cooling below that range in air, in molten lead or a molten mixture of nitrates or nitrites.	(*i*) annealing
10. An operation involving the heating and cooling of a metal alloy in the solid state, for the purpose of obtaining certain desirable properties.	(*j*) tempering

1.75. Match parts A and B regarding non-ferrous metals.

A	B
1. Deoxidised copper is usually made by adding phosphorous, but this decreases the __________	(*a*) spelter
2. Two or more elements are combined in proper proportion so as to have a minimum and specific melting temperature.	(*b*) tungsten
3. Alloys of 12 to 25% tin and balance load, applied to steel by hot dipping	(*c*) corrosion resistance
4. __________ alloys have strength comparable with alloy steels, while the weight is only 60% that of steel.	(*d*) nickel
5. The common form of availability of zinc in the market in the form of slabs.	(*e*) magnesium

6. Aluminium is added to brass to improve ________	(*f*) season cracking
7. The highest melting point among all the metals.	(*g*) terne-plate
8. The lightest metal of structural importance	(*h*) eutectic type alloy
9. The majority of the world's production of ________ comes from the sulphide deposits in Ontario.	(*i*) conductivity
10. High zinc brasses are prone to ________	(*j*) titanium

1.76. Match parts A and B relating to corrosion.

A	B
1. The tendency of a metal to dissolve in water.	(*a*) chromium
2. __ is brittle fracture of a normally ductile material.	(*b*) nickel
3. Most of the phenomena involving corrosion of metals containing or submerged in water or atmospheric corrosion by films of moisture, are ________ in nature.	(*c*) dis-similar metals
4. Alloys of commercially pure iron with cobalt, nickel on copper in small amounts are resistant to atmospheric corrosion because they form protective. ________	(*d*) solution pressure
5. Stainless steels depend on the presence of ____ for their resistance to corrosion.	(*e*) rough
6. ________ cast iron has a high corrosion resistance toward many chemicals and to dilute acids and has the advantage of superior strength and toughness.	(*f*) rust coatings.
7. ________ surfaces are more prone to corrosion.	(*g*) stress corrosion
8. A process used to minimise corrosion by applying a coating of protective metal.	(*h*) aluminium
9. For very severe marine conditions the only coatings that give permanent protection are those of ________	(*i*) sherardising process.
10. Pipes are often destroyed by the action of ________ to which they are connected.	(*j*) electro-chemical

1.77. Match parts A and B in regard to non destructive testing methods.

A	B
1. Test to detect discontinuities at or near the surface in ferromagnetic materials. Relatively fast and low cost, portable, and extremely sensitive for locating small tight cracks.	(*a*) acoustic signature analysis
2. Used to locate defects open to the surface of non-porous materials. Indication can be further examined visually and results easily interpreted.	(*b*) holography
3. Tests based upon correlation between electro-magnetic properties and physical or structural properties of a test object. Permanent-record capability for symmetrical parts	(*c*) acoustic emission

4. This test involves the analysis of sound energy emitted from an object to determine characteristics of the object.	(*d*) Radiometry
5. Utilise electro-magnetic energy to determine characteristics of non metallic substances by analysis of reflected or transmitted energy.	(*e*) eddy current methods
6. Used for three dimensional imaging. It involves no special surface preparation or coatings. No physical contact with test specimen. Vibration-free environment is required.	(*f*) magnetic particle
7. Measures coating thickness, physical properties and detects P-N junctions in semi conductors. Requires access to one surface.	(*g*) infrared (radio meter)
8. Used to measure wall thickness, plating thickness, variations in density/composition etc. Fully automatic, fast, extremely accurate and for in-line process control.	(*h*) microwave test
9. Used to detect lack of bond, hot spots, isotherms, etc. Remote sensing, permanent record, sensitive to 1°C variation in temperature.	(*i*) liquid penetrant
10. Where strain produces bursts of energy in an object which are detected by ultrasonic transducer coupled to the object. Used to detect crack initiation and growth rate, cavitation, friction or wear, phase transformations.	(*j*) thermo electric

1.78. Match the two parts regarding foundry practice.

A	B
1. Pattern having the cope and drag portions of the pattern mounted on opposite sides of a wooden or metal plate, and designed to speed up the moulding process	(*a*) skeleton
2. __________ are used to support irregularly shaped patterns which require an irregular parting line between cope and drag	(*b*) match plate patterns
3. __________ moulding machines produce greatest densities next to the parting line and softest near the top of the flask.	(*c*) large iron cores.
4. _________ consist of power driven drum in which the castings are tumbled in contact with hard iron stars or balls and their impact removes the sand and scale.	(*d*) mullers
5. Sand is prepared in __________, which serve to mix the sand, bonding agent, and water.	(*e*) mould washes
6. Dry sand cores are made from silica sand and _________ which hardens under the action of heat.	(*f*) follow boards
7. Coal tar pitch flows with heat and freezes around the grains on cooling. Due to its low moisture-absorption rates, it is used extensively for __________	(*g*) grain size

8. ________ are coatings applied to the mould or core surface to improve the surface finish of the casting.	(*h*) oil
9. The ________ should be approximately uniform when maximum permeability is desired.	(*i*) tumbling barrels
10. For extremely large castings, ________ patterns may be used.	(*j*) jolt

1.79. Match parts A and B regarding plastic working techniques.

A	B
1. Rolling of a number of sheets together provides means of retaining enough heat to hot-roll thin sheets, as for high-silicon electric sheets	(*a*) ironing
2. ________ operations are distinguished by the relatively rapid and continuous application of working pressure along a limited line of contact	(*b*) hydraulic
3. Operations like blanking, piercing, perforating, shaving, broaching, trimming, slitting, and parting, fall under the category of ________	(*c*) clearance
4. ________ between the punch and die is required for a clean cut and durability	(*d*) swaging
5. A sheared edge may be squared up roughly by ________	(*e*) pack rolling
6. When the clearance between punch and die is less than the metal thickness, then some ________ occurs.	(*f*) sintering
7. ________ involves squeezing of the blanks to an appreciably different shape.	(*g*) double action.
8. ________ presses have no crank-shaft, clutch, or flywheel	(*h*) shaving
9. ________ presses combine the functions of blank holding with drawing.	(*i*) rolling
10. _____ of metal powder compacts at temperatures below the melting point provides the time and electron activity needed to establish bonded strength between particles.	(*j*) shearing

.80. Match the two parts pertaining to welding.

A	B
1. ________ serves to exclude oxygen and nitrogen of the air from the arc and metal, thus eliminating the formation of oxide and nitrides.	(*a*) anode
2. In a bare electrode d.c. arc, more heat is liberated at the ________	(*b*) oxyhydrogen
3. In d.c. arc welding (straight polarity), the welding electrode is made ________	(*c*) flash
4. ________ welding employs the heat of an arc between a mechanically fed bare-metal electrode and the work.	(*d*) forehand

5. Tungsten electrodes used in the gas-shielded tungsten arc welding process are __________ metal electrodes.	(*e*) cathode
6. __________ flame is used in welding metals that have low melting points.	(*f*) flux
7. In __________ welding, the torch flame is pointed ahead in the direction of welding, and the welding rod precedes the flame.	(*g*) braze
8. In __________ welding, coalescense is produced by heating above 427°C and by using a non-ferrous filler metal having a melting point below that of base metals.	(*h*) submerged arc
9. Oxyacetlyne welding of steel is performed without any __________	(*i*) non-filler
10. In __________ welding, the parts are brought together lightly, with current flowing, and then separated slightly.	(*j*) shielding

1.81. Match two parts regarding metal cutting.

A	B
1. Chips obtained in cutting ductile materials at high speeds.	(*a*) machinability
2. Chips obtained in the machining of brittle materials at very low speed.	(*b*) ceramic
3. The wear on the flank or relief side of the tool is the most dependable guide for __________	(*c*) continuous
4. __________ is best defined in terms of tool life, power requirement, and surface integrity.	(*d*) discontinuous
5. The major factors influencing __________ are the outline of the cutting tool, fragments of built-up-edge left on working, and vibration	(*e*) cutting ratio
6. __________ tool tips consist primarily of fine aluminium oxide grains which have been bonded together	(*f*) chatter
7. The ratio of depth of cut and chip thickness	(*g*) in-homogeneous
8. __________ controls the thickness of the chip in metal cutting.	(*h*) tool wear
9. ________ chips are normally produced when machining titanium alloys.	(*i*) shear angle
10. Tools with large nose radius increase the possibility of __________	(*j*) surface finish

1.82. Match the two parts for machine tools.

A	B
1. A method of controlling the motions of machine components by numbers.	(*a*) reamer
2. When turret lathes are set up for bar-stock, they are often called __________ machines.	(*b*) honing

3. A __________ machine has a single-spindle sliding head mounted over a table adjustable longitudinally and transversely by lead screws which roughly locate the work under the spindle.	(*c*) planetary
4. The _____ angles of the flutes vary from 10 to 45°.	(*d*) milling
5. __________ is a multiple cutting edge tool used to enlarge or finish holes.	(*e*) grinding ratio
6. ________ machines use cutters with multiple teeth.	(*f*) planers
7. In __________ milling machines the work is stationary on the bed or clamped to the tail-stock while the cutter rotates.	(*g*) numerical control
8. ____ are used to rough and finish large flat surface.	(*h*) helix
9. Ratio of the volume of material removed to the volume of wheel wear.	(*i*) screw
10. A superfinishing process.	(*j*) jib boring

1.83. Match two parts regarding industrial economics and management :

A	B
1. A ______ organisation comprises the individuals, groups, and supervising employees concerned directly with the productive operation of the business.	(*a*) process analysis
2. A _______ organisation involves personnel, departments, or activities and assists the line supervisors in any advisory, service, coordinating or control capacity.	(*b*) break even
3. A procedure for studying all productive and non-productive operations for the purpose of optimising cost, production output, or quality.	(*c*) present value
4. In _______ layout, the machinery is located so that the flow from one operation to the next is minimised for any product class.	(*d*) linear programming
5. Scheduling of production, the despatching of materials, tools, and supplies at the required time so that the schedule can be realised.	(*e*) line
6. The point at which the company neither makes a profit nor suffers a loss.	(*f*) job evaluation
7. A mathematical technique which permits determination of the best use which can be made of available resources.	(*g*) cost accounting
8. ______ means that a rupee received a year hence is not the equivalent of a rupee received today, because the use of money has a value.	(*h*) staff
9. An integral part of the management process, furnishes the costs of production, operation or functions and compares actual costs and expenses with predetermined budgets and standards.	(*i*) production control
10. A formal system for ranking jobs in classes.	(*j*) product

ANSWERS

Ans. 1.1.	**1.** (*b*)	**2.** (*f*)	**3.** (*i*)	**4.** (*a*)	**5.** (*d*)
	6. (*j*)	**7.** (*c*)	**8.** (*e*)	**9.** (*g*)	**10.** (*h*)
Ans. 1.2.	**1.** (*i*)	**2.** (*f*)	**3.** (*e*)	**4.** (*a*)	**5.** (*c*)
	6. (*b*)	**7.** (*d*)	**8.** (*j*)	**9.** (*g*)	**10.** (*h*)
Ans. 1.3.	**1.** (*c*)	**2.** (*f*)	**3.** (*a*)	**4.** (*e*)	**5.** (*b*)
	6. (*d*)				
Ans. 1.4.	**1.** (*h*)	**2.** (*j*)	**3.** (*a*)	**4.** (*c*)	**5.** (*i*)
	6. (*b*)	**7.** (*d*)	**8.** (*f*)	**9.** (*e*)	**10.** (*g*)
Ans. 1.5.	**1.** (*c*)	**2.** (*h*)	**3.** (*a*)	**4.** (*j*)	**5.** (*g*)
	6. (*i*)	**7.** (*d*)	**8.** (*e*)	**9.** (*f*)	**10.** (*b*)
Ans. 1.6.	**1.** (*e*)	**2.** (*j*)	**3.** (*g*)	**4.** (*i*)	**5.** (*h*)
	6. (*d*)	**7.** (*b*)	**8.** (*f*)	**9.** (*c*)	**10.** (*a*)
Ans. 1.7.	**1.** (*h*)	**2.** (*f*)	**3.** (*a*)	**4.** (*c*)	**5.** (*g*)
	6. (*j*)	**7.** (*d*)	**8.** (*b*)	**9.** (*e*)	**10.** (*i*)
Ans. 1.8.	**1.** (*f*)	**2.** (*c*)	**3.** (*i*)	**4.** (*h*)	**5.** (*a*)
	6. (*j*)	**7.** (*d*)	**8.** (*e*)	**9.** (*g*)	**10.** (*b*)
Ans. 1.9.	**1.** (*c*)	**2.** (*f*)	**3.** (*j*)	**4.** (*a*)	**5.** (*h*)
	6. (*d*)	**7.** (*b*)	**8.** (*e*)	**9.** (*g*)	**10.** (*i*)
Ans. 1.10.	**1.** (*e*)	**2.** (*c*)	**3.** (*a*)	**4.** (*b*)	**5.** (*f*)
	6. (*d*)				
Ans. 1.11.	**1.** (*e*)	**2.** (*d*)	**3.** (*a*)	**4.** (*f*)	**5.** (*b*)
	6. (*c*)				
Ans. 1.12.	**1.** (*j*)	**2.** (*d*)	**3.** (*g*)	**4.** (*i*)	**5.** (*h*)
	6. (*a*)	**7.** (*e*)	**8.** (*b*)	**9.** (*f*)	**10.** (*c*)
Ans. 1.13.	**1.** (*g*)	**2.** (*j*)	**3.** (*a*)	**4.** (*h*)	**5.** (*i*)
	6. (*e*)	**7.** (*c*)	**8.** (*d*)	**9.** (*f*)	**10.** (*b*)
Ans. 1.14.	**1.** (*d*)	**2.** (*g*)	**3.** (*j*)	**4.** (*a*)	**5.** (*i*)
	6. (*c*)	**7.** (*b*)	**8.** (*e*)	**9.** (*f*)	**10.** (*h*)
Ans. 1.15.	**1.** (*d*)	**2.** (*f*)	**3.** (*a*)	**4.** (*i*)	**5.** (*c*)
	6. (*j*)	**7.** (*h*)	**8.** (*e*)	**9.** (*g*)	**10.** (*b*)
Ans. 1.16.	**1.** (*d*)	**2.** (*g*)	**3.** (*j*)	**4.** (*a*)	**5.** (*i*)
	6. (*j*)	**7.** (*e*)	**8.** (*b*)	**9.** (*f*)	**10.** (*h*)
Ans. 1.17.	**1.** (*h*)	**2.** (*c*)	**3.** (*f*)	**4.** (*j*)	**5.** (*a*)
	6. (*i*)	**7.** (*b*)	**8.** (*g*)	**9.** (*d*)	**10.** (*e*)
Ans. 1.18.	**1.** (*f*)	**2.** (*j*)	**3.** (*g*)	**4.** (*d*)	**5.** (*i*)
	6. (*b*)	**7.** (*c*)	**8.** (*d*)	**9.** (*h*)	**10.** (*e*)
Ans. 1.19.	**1.** (*h*)	**2.** (*d*)	**3.** (*e*)	**4.** (*j*)	**5.** (*g*)
	6. (*a*)	**7.** (*c*)	**8.** (*b*)	**9.** (*f*)	**10.** (*i*)
Ans. 1.20.	**1.** (*f*)	**2.** (*d*)	**3.** (*a*)	**4.** (*b*)	**5.** (*c*)
	6. (*e*)				

Ans. 1.21.	**1.** (*b*)	**2.** (*e*)	**3.** (*a*)	**4.** (*c*)	**5.** (*f*)
	6. (*d*)				
Ans. 1.22.	**1.** (*c*)	**2.** (*e*)	**3.** (*a*)	**4.** (*g*)	**5.** (*h*)
	6. (*b*)	**7.** (*d*)	**8.** (*j*)	**9.** (*f*)	**10.** (*i*)
Ans. 1.23.	**1.** (*f*)	**2.** (*i*)	**3.** (*e*)	**4.** (*j*)	**5.** (*g*)
	6. (*a*)	**7.** (*d*)	**8.** (*b*)	**9.** (*h*)	**10.** (*c*)
Ans. 1.24.	**1.** (*i*)	**2.** (*f*)	**3.** (*h*)	**4.** (*j*)	**5.** (*a*)
	6. (*d*)	**7.** (*b*)	**8.** (*g*)	**9.** (*e*)	**10.** (*c*)
Ans. 1.25.	**1.** (*e*)	**2.** (*a*)	**3.** (*g*)	**4.** (*j*)	**5.** (*h*)
	6. (*c*)	**7.** (*b*)	**8.** (*d*)	**9.** (*f*)	**10.** (*i*)
Ans. 1.26.	**1.** (*d*)	**2.** (*j*)	**3.** (*a*)	**4.** (*i*)	**5.** (*c*)
	6. (*b*)	**7.** (*h*)	**8.** (*f*)	**9.** (*g*)	**10.** (*e*)
Ans. 1.27.	**1.** (*f*)	**2.** (*i*)	**3.** (*h*)	**4.** (*a*)	**5.** (*c*)
	6. (*j*)	**7.** (*d*)	**8.** (*b*)	**9.** (*e*)	**10.** (*g*)
Ans. 1.28.	**1.** (*b*)	**2.** (*g*)	**3.** (*i*)	**4.** (*e*)	**5.** (*h*)
	6. (*j*)	**7.** (*f*)	**8.** (*c*)	**9.** (*d*)	**10.** (*a*)
Ans. 1.29.	**1.** (*i*)	**2.** (*d*)	**3.** (*a*)	**4.** (*g*)	**5.** (*b*)
	6. (*j*)	**7.** (*c*)	**8.** (*f*)	**9.** (*e*)	**10.** (*h*)
Ans. 1.30.	**1.** (*g*)	**2.** (*a*)	**3.** (*i*)	**4.** (*j*)	**5.** (*b*)
	6. (*h*)	**7.** (*d*)	**8.** (*f*)	**9.** (*c*)	**10.** (*e*)
Ans. 1.31.	**1.** (*f*)	**2.** (*d*)	**3.** (*a*)	**4.** (*i*)	**5.** (*h*)
	6. (*b*)	**7.** (*c*)	**8.** (*j*)	**9.** (*g*)	**10.** (*e*)
Ans. 1.32.	**1.** (*d*)	**2.** (*f*)	**3.** (*a*)	**4.** (*j*)	**5.** (*b*)
	6. (*e*)	**7.** (*i*)	**8.** (*c*)	**9.** (*h*)	**10.** (*g*)
Ans. 1.33	**1.** (*f*)	**2.** (*c*)	**3.** (*b*)	**4.** (*e*)	**5.** (*d*)
	6. (*a*)				
Ans. 1.34.	**1.** (*c*)	**2.** (*j*)	**3.** (*a*)	**4.** (*e*)	**5.** (*g*)
	6. (*i*)	**7.** (*b*)	**8.** (*d*)	**9.** (*h*)	**10.** (*f*)
Ans. 1.35.	**1.** (*j*)	**2.** (*a*)	**3.** (*g*)	**4.** (*b*)	**5.** (*c*)
	6. (*i*)	**7.** (*d*)	**8.** (*f*)	**9.** (*e*)	**10.** (*h*)
Ans. 1.36.	**1.** (*f*)	**2.** (*c*)	**3.** (*a*)	**4.** (*h*)	**5.** (*b*)
	6. (*g*)	**7.** (*e*)	**8.** (*d*)		
Ans. 1.37.	**1.** (*d*)	**2.** (*f*)	**3.** (*a*)	**4.** (*e*)	**5.** (*c*)
	6. (*b*)				
Ans. 1.38.	**1.** (*b*)	**2.** (*d*)	**3.** (*f*)	**4.** (*a*)	**5.** (*c*)
	6. (*e*)				
Ans. 1.39.	**1.** (*h*)	**2.** (*d*)	**3.** (*j*)	**4.** (*a*)	**5.** (*c*)
	6. (*i*)	**7.** (*e*)	**8.** (*f*)	**9.** (*b*)	**10.** (*g*)
Ans. 1.40.	**1.** (*e*)	**2.** (*i*)	**3.** (*d*)	**4.** (*a*)	**5.** (*j*)
	6. (*b*)	**7.** (*f*)	**8.** (*c*)	**9.** (*h*)	**10.** (*g*)
Ans. 1.41.	**1.** (*d*)	**2.** (*h*)	**3.** (*j*)	**4.** (*f*)	**5.** (*i*)
	6. (*b*)	**7.** (*e*)	**8.** (*g*)	**9.** (*c*)	**10.** (*a*)
Ans. 1.42.	**1.** (*b*)	**2.** (*e*)	**3.** (*h*)	**4.** (*a*)	**5.** (*j*)
	6. (*d*)	**7.** (*i*)	**8.** (*f*)	**9.** (*g*)	**10.** (*c*)

Ans. 1.43.	**1.** (*c*)	**2.** (*j*)	**3.** (*i*)	**4.** (*h*)	**5.** (*g*)
	6. (*d*)	**7.** (*a*)	**8.** (*f*)	**9.** (*b*)	**10.** (*e*)
Ans. 1.44.	**1.** (*g*)	**2.** (*d*)	**3.** (*j*)	**4.** (*a*)	**5.** (*i*)
	6. (*b*)	**7.** (*h*)	**8.** (*c*)	**9.** (*f*)	**10.** (*e*)
Ans. 1.45.	**1.** (*c*)	**2.** (*h*)	**3.** (*a*)	**4.** (*g*)	**5.** (*b*)
	6. (*j*)	**7.** (*d*)	**8.** (*e*)	**9.** (*f*)	**10.** (*i*)
Ans. 1.46.	**1.** (*b*)	**2.** (*e*)	**3.** (*g*)	**4.** (*j*)	**5.** (*c*)
	6. (*i*)	**7.** (*a*)	**8.** (*h*)	**9.** (*f*)	**10.** (*d*)
Ans. 1.47.	**1.** (*d*)	**2.** (*a*)	**3.** (*f*)	**4.** (*g*)	**5.** (*b*)
	6. (*h*)	**7.** (*c*)	**8.** (*j*)	**9.** (*e*)	**10.** (*i*)
Ans. 1.48.	**1.** (*j*)	**2.** (*e*)	**3.** (*g*)	**4.** (*c*)	**5.** (*h*)
	6. (*b*)	**7.** (*d*)	**8.** (*f*)	**9.** (*a*)	**10.** (*i*)
Ans. 1.49.	**1.** (*j*)	**2.** (*f*)	**3.** (*h*)	**4.** (*a*)	**5.** (*i*)
	6. (*b*)	**7.** (*d*)	**8.** (*c*)	**9.** (*g*)	**10.** (*e*)
Ans. 1.50.	**1.** (*e*)	**2.** (*d*)	**3.** (*f*)	**4.** (*a*)	**5.** (*c*)
	6. (*b*)				
Ans. 1.51.	**1.** (*d*)	**2.** (*c*)	**3.** (*f*)	**4.** (*e*)	**5.** (*b*)
	6. (*a*)				
Ans. 1.52.	**1.** (*c*)	**2.** (*e*)	**3.** (*a*)	**4.** (*f*)	**5.** (*b*)
	6. (*d*)				
Ans. 1.53.	**1.** (*g*)	**2.** (*a*)	**3.** (*i*)	**4.** (*f*)	**5.** (*j*)
	6. (*c*)	**7.** (*b*)	**8.** (*e*)	**9.** (*d*)	**10.** (*h*)
Ans. 1.54	**1.** (*f*)	**2.** (*i*)	**3.** (*a*)	**4.** (*b*)	**5.** (*h*)
	6. (*c*)	**7.** (*j*)	**8.** (*e*)	**9.** (*g*)	**10.** (*d*)
Ans. 1.55.	**1.** (*j*)	**2.** (*h*)	**3.** (*e*)	**4.** (*a*)	**5.** (*i*)
	6. (*b*)	**7.** (*d*)	**8.** (*c*)	**9.** (*g*)	**10.** (*f*)
Ans. 1.56.	**1.** (*e*)	**2.** (*a*)	**3.** (*h*)	**4.** (*b*)	**5.** (*j*)
	6. (*i*)	**7.** (*c*)	**8.** (*f*)	**9.** (*g*)	**10.** (*d*)
Ans. 1.57.	**1.** (*d*)	**2.** (*g*)	**3.** (*e*)	**4.** (*a*)	**5.** (*j*)
	6. (*i*)	**7.** (*f*)	**8.** (*b*)	**9.** (*c*)	**10.** (*h*)
Ans. 1.58.	**1.** (*h*)	**2.** (*a*)	**3.** (*j*)	**4.** (*f*)	**5.** (*b*)
	6. (*i*)	**7.** (*c*)	**8.** (*e*)	**9.** (*g*)	**10.** (*d*)
Ans. 1.59.	**1.** (*h*)	**2.** (*f*)	**3.** (*j*)	**4.** (*g*)	**5.** (*c*)
	6. (*b*)	**7.** (*e*)	**8.** (*d*)	**9.** (*a*)	**10.** (*i*)
Ans. 1.60.	**1.** (*e*)	**2.** (*a*)	**3.** (*h*)	**4.** (*j*)	**5.** (*b*)
	6. (*i*)	**7.** (*d*)	**8.** (*c*)	**9.** (*g*)	**10.** (*f*)
Ans. 1.61.	**1.** (*c*)	**2.** (*j*)	**3.** (*h*)	**4.** (*i*)	**5.** (*b*)
	6. (*g*)	**7.** (*e*)	**8.** (*a*)	**9.** (*d*)	**10.** (*f*)
Ans. 1.62.	**1.** (*j*)	**2.** (*e*)	**3.** (*g*)	**4.** (*f*)	**5.** (*b*)
	6. (*h*)	**7.** (*i*)	**8.** (*c*)	**9.** (*d*)	**10.** (*a*)
Ans. 1.63.	**1.** (*f*)	**2.** (*j*)	**3.** (*a*)	**4.** (*i*)	**5.** (*g*)
	6. (*h*)	**7.** (*c*)	**8.** (*b*)	**9.** (*e*)	**10.** (*d*)
Ans. 1.64.	**1.** (*f*)	**2.** (*i*)	**3.** (*g*)	**4.** (*c*)	**5.** (*a*)
	6. (*j*)	**7.** (*d*)	**8.** (*e*)	**9.** (*h*)	**10.** (*b*)

Ans. 1.65.	**1.** (*d*)	**2.** (*a*)	**3.** (*f*)	**4.** (*h*)	**5.** (*i*)
	6. (*g*)	**7.** (*c*)	**8.** (*j*)	**9.** (*e*)	**10.** (*b*)
Ans. 1.66.	**1.** (*c*)	**2.** (*i*)	**3.** (*h*)	**4.** (*j*)	**5.** (*g*)
	6. (*e*)	**7.** (*a*)	**8.** (*f*)	**9.** (*d*)	**10.** (*b*)
Ans. 1.67.	**1.** (*i*)	**2.** (*f*)	**3.** (*d*)	**4.** (*h*)	**5.** (*a*)
	6. (*c*)	**7.** (*b*)	**8.** (*e*)	**9.** (*j*)	**10.** (*g*)
Ans. 1.68.	**1.** (*i*)	**2.** (*f*)	**3.** (*h*)	**4.** (*a*)	**5.** (*c*)
	6. (*e*)	**7.** (*b*)	**8.** (*j*)	**9.** (*g*)	**10.** (*d*)
Ans. 1.69.	**1.** (*d*)	**2.** (*g*)	**3.** (*j*)	**4.** (*a*)	**5.** (*i*)
	6. (*e*)	**7.** (*b*)	**8.** (*f*)	**9.** (*c*)	**10.** (*h*)
Ans. 1.70.	**1.** (*i*)	**2.** (*d*)	**3.** (*f*)	**4.** (*h*)	**5.** (*b*)
	6. (*c*)	**7.** (*g*)	**8.** (*a*)	**9.** (*j*)	**10.** (*e*)
Ans. 1.71	**1.** (*e*)	**2.** (*i*)	**3.** (*a*)	**4.** (*c*)	**5.** (*h*)
	6. (*b*)	**7.** (*j*)	**8.** (*d*)	**9.** (*g*)	**10.** (*f*)
Ans. 1.72.	**1.** (*d*)	**2.** (*f*)	**3.** (*g*)	**4.** (*j*)	**5.** (*c*)
	6. (*i*)	**7.** (*a*)	**8.** (*e*)	**9.** (*b*)	**10.** (*h*)
Ans. 1.73.	**1.** (*c*)	**2.** (*a*)	**3.** (*i*)	**4.** (*f*)	**5.** (*b*)
	6. (*d*)	**7.** (*j*)	**8.** (*g*)	**9.** (*e*)	**10.** (*h*)
Ans. 1.74.	**1.** (*e*)	**2.** (*g*)	**3.** (*i*)	**4.** (*f*)	**5.** (*b*)
	6. (*c*)	**7.** (*d*)	**8.** (*j*)	**9.** (*h*)	**10.** (*a*)
Ans. 1.75.	**1.** (*i*)	**2.** (*h*)	**3.** (*g*)	**4.** (*j*)	**5.** (*a*)
	6. (*c*)	**7.** (*b*)	**8.** (*e*)	**9.** (*d*)	**10.** (*f*)
Ans. 1.76.	**1.** (*d*)	**2.** (*g*)	**3.** (*j*)	**4.** (*f*)	**5.** (*a*)
	6. (*b*)	**7.** (*e*)	**8.** (*i*)	**9.** (*h*)	**10.** (*c*)
Ans. 1.77.	**1.** (*f*)	**2.** (*i*)	**3.** (*e*)	**4.** (*a*)	**5.** (*h*)
	6. (*b*)	**7.** (*j*)	**8.** (*d*)	**9.** (*g*)	**10.** (*c*)
Ans. 1.78.	**1.** (*b*)	**2.** (*f*)	**3.** (*j*)	**4.** (*i*)	**5.** (*d*)
	6. (*h*)	**7.** (*c*)	**8.** (*e*)	**9.** (*g*)	**10.** (*a*)
Ans. 1.79.	**1.** (*e*)	**2.** (*i*)	**3.** (*j*)	**4.** (*c*)	**5.** (*h*)
	6. (*a*)	**7.** (*d*)	**8.** (*b*)	**9.** (*g*)	**10.** (*f*)
Ans. 1.80.	**1.** (*j*)	**2.** (*a*)	**3.** (*e*)	**4.** (*h*)	**5.** (*i*)
	6. (*b*)	**7.** (*d*)	**8.** (*g*)	**9.** (*f*)	**10.** (*c*)
Ans. 1.81.	**1.** (*c*)	**2.** (*d*)	**3.** (*h*)	**4.** (*a*)	**5.** (*j*)
	6. (*b*)	**7.** (*e*)	**8.** (*i*)	**9.** (*g*)	**10.** (*f*).
Ans. 1.82.	**1.** (*g*)	**2.** (*i*)	**3.** (*j*)	**4.** (*h*)	**5.** (*a*)
	6. (*d*)	**7.** (*c*)	**8.** (*f*)	**9.** (*e*)	**10.** (*b*)
Ans. 1.83.	**1.** (*e*)	**2.** (*h*)	**3.** (*a*)	**4.** (*j*)	**5.** (*i*)
	6. (*b*)	**7.** (*d*)	**8.** (*c*)	**9.** (*g*)	**10.** (*f*)

Fill in the Blanks

Fill up the blanks, choosing the best response from three alternatives specified.

1. The heating value of a fuel containing hydrogen, when all the water vapour of combustion has condensed, thus giving up its latent heat of evaporation is called __________ (Calorific value, higher heating value, lower heating)
2. The lower heating value of a hydrogenous fuel is obtained when sufficient excess air is used to __________ (prevent any condensation of water vapour, allow complete condensation of water vapour)
3. The lower heating value of a fuel at constant value is __________ than that at constant pressure (less, more, less/more)
4. To heat a room most effectively, hot air must be blown near the __________ (floor, ceiling, middle of room)
5. To heat a room effectively, the steam radiators must be painted __________ (black, with aluminium paint, red)
6. While the heat which produces a rise of temperature is called __________ heat, the heat which produces a change of state is called __________ heat (sensible, latent, transparent) (specific, sensible, latent)
7. The solid substance remaining after the partial burning of coal in an oven or after distillation in a retort is known as __________ (distillate, coke, semi bituminous)
8. High temperatures may be approximated by the experienced eye. The clear cherry and red heat corresponds to __________ °C temperature. (525, 1000, 1400)
9. __________ substance in ashes causes clinker. (oxide of iron, silicon, lime)
10. Substances that distill at low temperature and are released when the coal is heated are called __________ (distillate, smoke, volatile matter)
11. The smoke density is graded by comparing with __________ (% of volatile matter, Ringlemann chart, amount of CO_2 in gases)
12. The coals which clinker least under high temperature are judged by colour of ash being __________ (grayish, black, pure white)
13. The amount of heat that water will absorb at the boiling point without a change in temperature is called __________ heat. (sensible, internal latent, external latent)
14. When vaporisation takes place, the amount of heat required because of the work in pushing back the atmosphere to make room for the steam is called __________ heat. (sensible, internal latent, external latent)
15. __________ is a hinged or pivoted movable auxiliary surface of an airplane, usually part of the trailing edge of the wing, the primary purpose of which is to impress a rolling movement on the airplane. (ailerons, elevators, rudder)
16. The __________ is a movable auxiliary airfoil, the function of which is to impress a pitching movement on the airplane (ailerons, elevators, rudder)
17. The purpose of __________ is to impress a yawing moment on the airplane in normal flight. (ailerons, elevators, rudder)

18. An acceptable comfort range for the human body is 22 to 27°C at ________ % relative humidity.
(10 - 20%, 45 - 50%, 80 - 90%)

19. The relative humidity ________ as the temperature is increased
(decreases, increases, remains unaffected)

20. High relative humidity ________ the evaporative process.
(increases, decreases, has no effect on)

21. An increase in air movement ________ the evaporation, convection, and radiation processes.
(increases, decreases, has no effect on)

22. The boiling point of a liquid can be raised by ________ its pressure
(increasing, decreasing, releasing)

23. When liquid changes to a vapour, it can ________ large quantities of heat.
(absorb, release, transfer)

24. The compressor in a refrigeration cycle maintains ________ conditions in the cooling coil and creates high pressure condition in the condenser. (high pressure, low pressure, uniform pressure)

25. The condenser removes heat from the refrigerant and changes it into a ________
(vapour, liquid, solid)

26. The basic absorption-refrigeration cycle uses ________ moving part.
(piston as, fan as, no)

27. In absorption systems, ________ is used as the refrigerant, and ________ is used as the adsorbent. (ammonia, freon, hydrogen) (Salt solution, lithium bromide, acidic solution)

28. The action of the ________ in absorption-refrigeration cycle is sometimes considered to be similar to the work done by the compressor.
(generator and absorber, evaporator and condenser, absorber and condenser)

29. Heat in an absorption cycle is applied at ________ (absorber, generator, evaporator)

30. In ammonia-water system ________ is the adsorbent (ammonia, water, both ammonia and water)

31. In a lithium-bromide absorption system, ________ is used as the refrigerant
(water, lithium bromide, ammonia)

32. In psychrometric chart, horizontal lines represent ________ (dew point, grains of moisture, both of them)

33. In psychrometric chart, vertical lines represent ________
(dry bulb temperature, wet bulb temperature, relative humidity)

34. A wet bulb thermometer registers a lower temperature than a dry bulb thermometer except at ________ % relative humidity
(0, 50, 100)

35. The wet bulb temperature is ________ in wet air than it is in dry air at the same temperature (higher, lower, same)

36. In process *A-B*, the relative humidity (Refer Fig. F-1) ________
(increases, decreases, remains same)

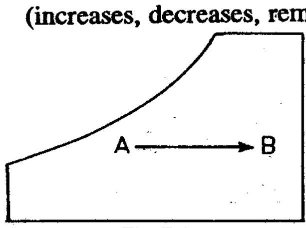


Fig. F-1

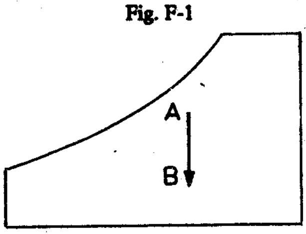


Fig. F-2

37. Process *A-B* represents ________ latent heat (Refer Fig. F-2)
(adding, removing, keeping same)

38. In air conditioning, the increase in moisture content ________ the latent heat.
(increases, decreases, makes no change in)

39. A ________ process is shown as a diagonal line beginning at the lower left and moving to the upper right of the psychrometric chart
(heating and humidifying, cooling and dehumidifying, heating and dehumidifying)

40. The simultaneous addition of sensible heat and latent heat represents as heating and __________ process.
(humidifying, dehumidifying, evaporation)

41. A typical residence may have a sensible heat factor of __________ (0.4, 0.6, 0.8)

42. A sensible factor of 0.8 means that 80% of total heat changes is due to __________
(sensible heat, latent heat, combination of both)

43. When sensible heat is added to the air, the relative humidity __________ an dew point __________
(increases, decreases, does not change)
(increases, decreases, does not change)

44. The simultaneous addition of sensible heat and latent heat represents a heating and __________ process.
(humidifying, dehumidifying, evaporative cooling)

45. The evaporative cooling process __________ sensible heat and __________ latent heat
(adds, removes, neither adds nor removes)
(adds, removes, neither adds nor removes)

46. The combined process of cooling and humidifying is also known as __________ process (evaporative cooling, spray cooling, dehumidifying)

47. In the cooling and humidifying process, the spray water __________ the dry bulb temperature and __________ the dew point temperature
(raises, lowers, neither raises nor lowers)
(raises, lowers, neither raises nor lowers)

48. In the cooling and dehumidifying process, the chilled spray water lowers the __________
(dry-bulb temperature, dry-bulb and wet bulb temperatures, dry-bulb, wet bulb, and dew-point temperatures)

49. In calculation of air conditioning load, ventilation air is a source of __________
(heat, cooling, neither heat nor cooling)

50. Percentage of pearlite is maximum in steel when the percentage of carbon is ________%
(0.2, 0.8, 1.2)

51. The elongation in tensile test for a carbon steel is maximum when the carbon content is __________ % (0, 0.2, 0.8)

52. With 0.8% carbon, the microstructure of steel is completely pearlistic and the maximum tensile strength of __________ N/mm^2 is attained
(250, 540, 850)

53. When austenite is very slowly cooled, the __________ microstructure is obtained
(pearlite, spheroidite, Widmanstatten structure)

54. If martensite is tempered in case of plain steels between temperatures of 205–395°C, the __________ is formed
(sorbite, troostite, spheriodite)

55. The presence of __________ in steel lowers the toughness and transverse ductility. It imparts brittleness to chips removed in machining operations
(sulphur, lead, phosphorous)

56. Which of the following elements provide corrosion resistance
(Vanadium and Aluminium, Manganese and Silicon, Chromium and Nickel)

57. __________ is used as a control-rod material for pressurised water cooled reactors
(Zirconium, Beryllium, Halnium)

58. A brass is an alloy of cooper and __________ and a bronze is an alloy of copper and __________
(zinc, tin, lead)
(zinc, tin, lead)

59. Music wire finds use in __________
(musical instruments, electrical appliances, small helical springs)

60. __________ is a pure iron with a body-centered cubic lattice structure
(α-iron, austenite, pearlite)

61. When austenite is oil cooled, it produces __________
(martensite, very fine pearlite, coarse pearlite)

62. Martensite on reheating upto around 300°C will produce __________
(troostite, sorbite, spheroidite)

63. Martensite on reheating upto around 700°C will result in production of __________
(sorbite, spheroidite, troostite)

64. In order that steel responds to a hardening treatment, it must at least have __________ % of carbon (0.0, 0.1%, 0.2%)

65. Nitriding is accomplished by heating the component at a temperature of 500°C in an atmosphere of __________ (nitrogen, ammonia, alkali solution)

66. A steel article having coarse austenite grain size will have __________ hardenability. (lower, higher, medium)

67. At arrest points, the temperature __________ (remains constant for a period, changes very fast, changes direction)

68. Sand in natural form in more or less moist state is called __________ (loam sand, facing sand, green sand)

69. Green sand requires __________ as binder. (CO_2, molasses, water)

70. Core sand is silica sand mixed with __________ (linseed oil, CO_2, Bentonite)

71. With increase in water content in the moulding sand, its permeability __________ (increases, decreases, increases upto a limit and then decreases)

72. The ability of sand particles to stick together is termed __________ (cohesiveness, adhesiveness, plasticity)

73. Green strength of sand is more for __________ particles. (coarse, fine, medium)

74. If a flask is made in three parts, the middle one is called _______ (drag, cope, cheek)

75. High dry strength of moulding sand would result in introduction of defect like __________ (scab, blow hole, hot tears)

76. During solidification of molten metal in a mould, the equiaxed crystals are produced near the __________ of the mould. (wall, middle, centre)

77. If V is the volume of a casting and A the cross-sectional area of the mould-metal interface, then solidification time in sand casting is proportional to __________ (V/A), $(V/A)^2$, $(A/V)^2$

78. If P is the partial pressure of gases above the metal in a mould, then the concentration of dissolved gas is proportional to __________ (P, $\sqrt{P}$, P^2)

79. Minimum thickness of cast parts for ease of metal flow in case of very small castings of grey iron should be of the order of __________ mm. (3, 6, 12)

80. In order to ensure that metal in feeder solidifies last, the value of $\left(\frac{\text{Volume }(v)}{\text{Surface Area }(s)}\right)^2$ for feeder in comparison to $\left(\frac{V}{5}\right)^2$ for casting should be __________ (greater, smaller, equal)

81. Skim bob in casting refers to __________ (casting tool, part of pouring system, sand tester)

82. Depending on the metal being cast, the volume of riser is kept between __________ % of the casting. (5–10, 15–20, 25–55)

83. Provision of __________ helps in trapping both heavier and lighter impurities flowing towards the casting. (skim bob, pouring basin, sqrue)

84. The term honey-combing refers to __________ (casting method, metal pouring technique, casting defect)

85. Defect caused by two streams of metals that are too cold to fuse properly is referred to as __________ (cold shot, hot tear, pour short)

86. Very uniform ramming throughout the mould is obtained by __________ (jolting, squeezing, sand slinger)

87. Slush casting employs __________ to produce hollow castings. (cores, no cores, dies)

88. A hot short material is one which is more or less __________ when heated. (ductile, brittle, fusible)

89. The object of compounding in a steam turbine is to __________ speed of turbine. (reduce, increase, attain uniform)

90. A compressor having a vane rotor or its equivalent mounted eccentrically in a stationary casing is called __________ compressor.
(centrifugal, axial/radial type, rotary)

91. __________ is a work hardening method for strengthening steel tubes (usually carried out on gun barrels) (austenising, artificial ageing, autofrettage)

92. __________ is a term used for a specific type of annealing. In this process the steel is treated in such a manner that the carbides are converted into spheroids.
(spheroidising, balling, carborising)

93. In __________ process, steel surface is given an adherent oxide, formed by means of controlled oxidation by heating the matèrial inside a closed box so that free oxidising conditions are not present, (black annealing, barffing, black anodising)

94. __________ is a form of joining process where the two metals or components do not themselves fuse but the joining material is melted and acts as a form of metallic glue
(brass plating, bonderising, brazing)

95. __________ is a form of metal finishing, where the surface is treated mechanically in such a manner that no appreciable metal is removed but the surface is smoothed.
(buttering, burnishing, honing)

96. __________ is a form of aluminising process which coats the surface of steel with aluminium oxide, giving increased corrosion and oxidation resistance at temperature upto 700°C. (Calorising, electroplating, cladding)

97. __________ is an inspection process used to identify hard spots on soft material or soft spots on hard materials. (cloud-bursting, sankey test, strain gauging)

98. __________ is a form of ductility test, which is applied only to sheet metal.
(macroetch, metascope testing, cupping)

99. __________ is a method of joining similar, or specifically different, metals, generally using pressure. (diffusion bonding, cladding, inertia welding)

100. Drop test is a quality-control operation, usually applied to __________
(finished component, raw material, electronic items)

101. Durometer test is a hardness testing technique used for __________
(ductile material, brittle materials, materials like rubber and plastic)

102. __________ is an inspection technique to show microporosity in metallic or non-metallic coatings.
(electrography, air pressure test, sieve test)

103. Fire Gilt process is a method of producing a coating of __________ on a metallic substrate. (abrasive, gold, plastic)

104. __________ is a form of bend test which is applied to tube.
(flattening test, flex test, spread test)

105. __________ is type of metal finishing where a fine matt finish is produced.
(porcelain enamelling, gilding, frosting)

106. __________ test is performed to rapidly assess corrosion resistance.
(Holiday, Huey, Ferrite)

107. Jominy test is a quality control test to give a measure of __________
(penetration, permanent set, hardenability)

108. __________ is a work hardening technique which can be applied during the manufacturig cycle when the material, generally is sheet form, will be subjected to a limited amount of cold work.
(planishing, malomising, burnishing)

109. Sweating is an alternative name for the process of __________
(electroplating, soldering, lost wax casting)

110. Wohler test is a destructive test carried out on prepared specimens to find the __________ strength.
(endurance, fatigue, creep)

111. The efficiency of a screw jack is maximum (if μ is coefficient of friction), when angle of helix is equal to __________
$\left(45° - \frac{\mu}{2}, 45° + \frac{\mu}{2}, 45° - \mu\right)$

112. If μ is the Poisson's ratio, then volumetric strain is proportional to __________

$$\left[(1-\mu), (1-2\mu), \left(1-\frac{\mu}{2}\right)\right]$$

113. If the stress due to a gradually applied load be doubled, then modulus of resistance will increase __________ time. (2, 4, 8)

114. The maximum shear stress developed in a beam of rectangular cross section is __________ times the average shear stress.
(1.5, 2, 2.5)

115. Circular cross-section beams are always __________ than rectangular cross section beams.
(stronger, weaker, stronger/weaker)

116. The ratio of maximum shear stress developed in a rectangular section and circular section of same area of cross section is __________

$$\left(\frac{8}{9}, \frac{9}{8}, \frac{5}{4}\right)$$

117. If L is the length of a cantilever beam, then slope at free end is proportional to __________ (L, L^2, L^3)

118. An elevator weighing 1000 kg attains an upward velocity of 3.924 m/s in 4 sec. with uniform acceleration. The tension in the supporting cable will be __________ N.
(10000 N, 9810 N, 10791 N, 9219 N)

119. A body weighing 500 kg falls 100 mm and strikes a 200 kg/mm spring. The deformation of spring is equal to __________
(25 mm, 20 mm, 50 mm, 12.5 mm)

120. The three masses of 10 kg. 20 kg and 30 kg are supported in the position as shown in Fig. F-3. If masses are released simultaneously then the tight cord will be __________
(A, B, C, A and B, B and C)

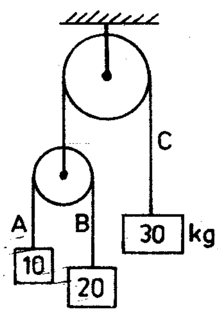


Fig. F-3

121. A 13 m long ladder stands on a rough horizontal floor and leans against a vertical, smooth wall, the foot of the ladder being 5 m away from the wall. Half way of the ladder is a person weighing 80 kg. The frictional force at bottom of ladder to avoid slipping should at least be equal to __________ kg.
(16.67, 20, 25, 40, 50)

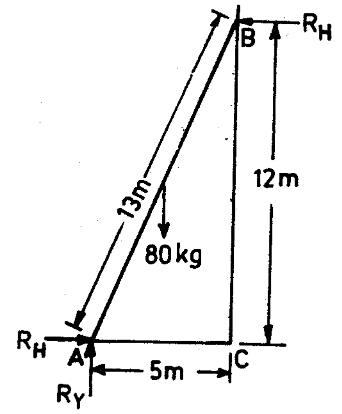


Fig. F-4

122. An automobile tyre in inflated to 2 kg/cm^2 gauge pressure at 27°C. After being driven, the temperature rises to 37°C. The final gauge pressure will be __________ kg/cm^2 gauge.
(2, 2.075, 2.05, 2.1, 2.75)

123. Planes of maximum shear are always located at __________ from planes of principal stress.

$$\left(45°, 90°, 22\tfrac{1}{2}°\right)$$

124. A principal plane is a plane of __________ shear. (minimum, maximum, zero)

125. In a Mohr's circle an angle of θ corresponds to an angle of __________ on the element.

$$\left(\theta, \frac{\theta}{2}, 2\theta\right)$$

126. A material in which the stress is a function not only of the strains, but of the time rates of change of stress and strain as well as is called __________
(linearly elastic, plastically deformed solid, viscoelastic solid)

127. Engineering stress is the load divided by original area, but true stress is load divided by actual area at a given point of time. True stress = engineering stress x __________
(unity, engineering strain ε_0, $1+\varepsilon_0$, $1-\varepsilon_0$)

128. Slope of the linearly elastic portion of stress –strain diagram is referred to as __________ (modulus of elasticity, modulus of resilience, modulus of toughness)

129. Area under a stress-strain curve upto the proportional limit is referred to __________ (modulus of elasticity, modulus of toughness, modulus of resilience)

130. Entire area under a stress-strain curve is referred to as __________ (modulus of elasticity, modulus of resilience, modulus of toughness)

131. The change in volume per unit volume is referred to as __________ (dilatation, shear modulus, bulk modulus of elasticity)

132. Constantan, an alloy composed of 60% copper and 40% nickel, produces wire or foil gauges with a gauge factor of approximately __________ (2, 5, 10)

133. In the case of two spherical surfaces in contact because of force P and contact pressure distributed over a small circle of radius r, the maximum contact pressure is equal to __________ $\times \frac{r}{\pi r^2}$ (1.5, 2, 2.5)

134. Strain rates of the order of __________ are regarded as static loading. (10^{-3} sec^{-1}, 10^{-4} sec^{-1}, 10^{-5} sec^{-1})

135. If prior to fracture, the material can suffer only small yielding the material is classified as __________ (brittle, ductile, tough)

136. Experience shows that for steel, the __________ relations are the most reliable for predicting fatigue failure. (Soderberg, Gerber, SAE)

137. Beams of uniform strength so vary in section that the unit shear stress remains constant, and $\frac{I}{c}$ varies as __________ (load, deflection, moment)

138. In case of a beam of uniform strength, if the width of beam is constant, then depth should vary as __________ (parabola, triangular, elliptical)

139. In case of beam of uniform strength, if the depth is to remain constant, then its width should vary as __________ (parabola, triangular, elliptical)

140. In simple cases, where the mass can be considered to be concentrated at a single point, the critical speed is proportional to __________, if δ is the static deflection ($\delta^{1/2}$, $\delta^{-1/2}$, $\delta^{-3/2}$)

141. If a perfectly flexible and infinitely thin sheet of uniform material and thickness is stretched uniformly in all directions in its plane by a tension 's' and if A is the area of membrane and w the weight per unit area, then frequency of fundamental mode of vibration of membrane is proportional to __________ $\left(\sqrt{\frac{As}{wg}}, \sqrt{\frac{gA}{ws}}, \sqrt{\frac{gs}{wA}}\right)$

142. A valve push rod for an overhead valve engine has diameter 'd' and its length is 'l'. The critical load when the rod is considered as a column with round ends is equal to __________ $\left(\frac{\pi^3 E d^4}{64 l^2}, \frac{\pi^3 E d^4}{32 l^2}, \frac{\pi^3 E d^4}{16 l^2}\right)$

143. Deflection of a multileaf cantilever spring is proportional to __________ (length, lenght^2, lenght^3) and the diameter of a shaft is proportional to __________ $\left(\frac{\text{Torque}}{\text{shear stress}}, \sqrt{\frac{\text{Torque}}{\text{shear stress}}}, \sqrt[3]{\frac{\text{Torque}}{\text{shear stress}}}\right)$

144. Shearing stress in a key of width 'w' and length 'l' subjected to tangential force F is equal to __________ $\left(\frac{F}{wl}, \frac{F}{w^2 l^2}, \frac{F}{w^3 l^3}\right)$

145. If T_1 and T_2 be the tensions in tight side and slack side of a belt, then power transmitted is proportional to __________ $\left(\frac{T_1 + T_2}{2}, T_1 - T_2, \frac{T_1}{T_2}\right)$

146. When the belt speed v is more than 900 m/min, the effect of centrifugal tension needs to be considered. The centrifugal tension is proportional to __________ (v, v^2, $\sqrt{v}$)

147. When belt speed is 3000 m/mt, then percentage of rated horse power lost will be of the order of __________ (60%, 76%, 95%)

148. If D is the diameter of a flywheel and N the RPM, then weight of flywheel is proportional to $\left(\frac{1}{DN}, \frac{1}{\sqrt{DN}}, \frac{1}{D^2N^2}\right)$

149. If weight, radius of gyration, and angular speed of a flywheel be W, R and ω, then energy stored in the rim of flywheel is proporitonal to ____ $\left(WR^2\omega^2, W^2R^2\omega^2, \frac{W}{R^2\omega^2}\right)$

150. If I_s be the moment of inertia of a rotor spinning at ω_S rad/sec and if it is processed at

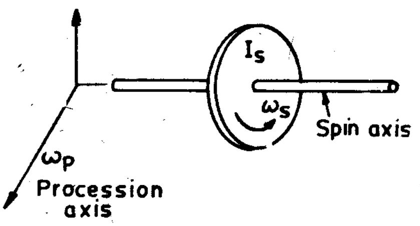


Fig. F-5

ω_P rad/sec as shown in Fig. F-5 then gyroscopic torque T developed is equal to __________ $\left(I_s\,\omega_P\,\omega_s, I_S\,\omega_P{}^2\omega_s{}^2, \frac{I_s}{\omega_P{}^2\omega_s{}^2}\right)$

151. The value of $\frac{T_1}{T_2}\left(\frac{\text{tight side tension}}{\text{slack side tension}}\right)$ in case of V belt with decrease in angle of contact __________ (increases, decreases, remains same)

152. The form of pitch surface in case of hypoid gears is ________ (cylindrical, conical, approximately conical)

153. The angle made by the line of action of the tooth with a line tangent to both the pitch circles where these come together is called __________ (pressure angle, involute angle, angle of contact)

154. The most commonly used pressure angle for involute gears is _____ (14.5°, 16°, 20°)

155. If two shafts are connected by spur gears of pitch radii 100 mm and 500 mm, then torque multiplication factor is equal to __________ $(5, \sqrt{5}, 25)$

156. The mechanism shown in Fig. F-6 is __________

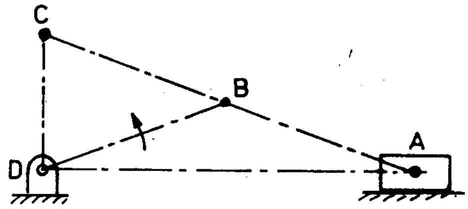


Fig. F-6

Link AC is twice as long a link DB. (Watt straight line mechanism, Scott Russel Mechanism, Pantograph)

157. The mechanism shown in Fig. F-7 _______ converts rotary motion to __________.

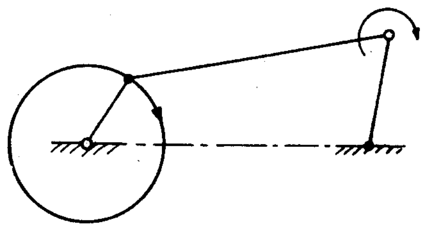


Fig. F-7

(straight line harmonic, rotary rocking, slow advance and quick return)

158. Fig. F-8 __________ below provides pantograph mechanism (A, B, C)

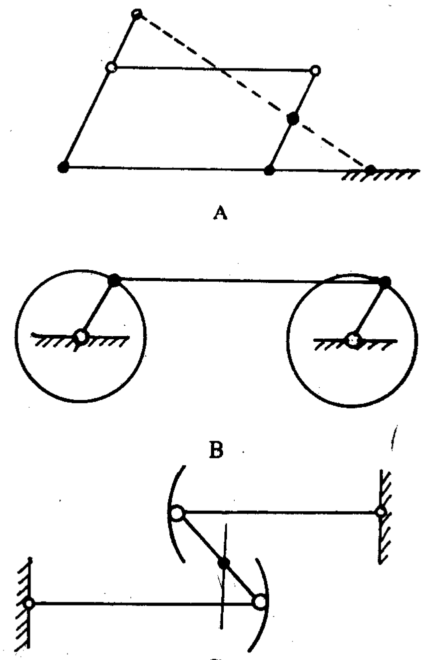


Fig. F-8

159. The ratio of inertia force to gravity force is called __________ number.
(Froude, Cauchy, Weber)

160. The ratio of inertia force to surface tension force is called __________ number
(Euler, Cauchy, Froude)

161. The ratio of inertia force to elastic force is called __________ number.
(Cauchy, Reynold, Euler)

162. The Prandtl, Grashof and Enckert numbers are important in the study of __________
(heat exchange, cavitation, vortex shedding from an immersed body)

163. In case of laminar flow, the friction factor 'f' is independent of the relative roughness and is only a function of the Reynold number R_e, 'f' is given by the expression $f=$ __________
$\left(\frac{16}{R_e}, \frac{32}{R_e}, \frac{64}{R_e}\right)$

164. The dimensions of surface tension are __________ (MT, MT^{-1}, MT^{-2})

165. In SI system, surface tension is expressed as __________ (N/m, N/m^2, N/m^3)

166. The ratio $\frac{\text{surface tension}}{\text{density}}$ is called __________
(kinematic capillarity, dynamic capillarity, static capillarity)

167. The unit of bulk modulus or modulus of elasticity is __________ (N/m^2, N/m, N/m^3)

168. Kinematic elasticity is the ratio of bulk modulus to density and its unit is __________
(m^2/s, m^2/s^2, m^2/s^3)

169. The modulus of elasticity of sea water is on average about __________ % higher than plain water. (2, 4, 9)

170. In order to increase the density of water by about 1%, an increase of about __________ atmospheres is required. (20, 100, 200)

171. The coefficient of __________ viscosity is the parameter that represents the existence of tangential forces in liquids in movement.
(dynamic, static, kinematic)

172. The coefficient of __________ viscosity is the ratio of the coefficient of dynamic viscosity to the fluid density.
(static, kinematic, flow)

173. The unit of dynamic viscosity is __________
(poise, stoke, Saybolt),
and the unit of kinematic viscosity is__________
(poise, stoke, Saybolt)

174. 1 Poise is equal to __________ N s/m^2
(0.1, 1, 10)

175. 1 stoke is equal to __________ m^2/s
$(10^{-2}, 10^{-3}, 10^{-4})$

176. For water at 20°C, the coefficient of kinematic viscosity is equal to __________ m^2/s
$(10^{-6}, 10^{-5}, 10^{-4})$

177. For water at 20°C, the coefficient of dynamic viscosity is equal to __________ Ns/m^2.
$(1, 10^{-2}, 10^{-3})$

178. Time taken to lower the water level from h_1 to h_2 in a vessel of cylindrical shape through an orifice or short pipe is proportional to __________
$\left(\sqrt{h_1} - \sqrt{h_2}, \sqrt{h_1 - h_2}, \frac{h_1 - h_2}{2}\right)$

179. For a hemispherical tank of radius r at full level, the time to empty it completely is proportional to __________ $(\sqrt{r}, r^{3/2}, r^{5/2})$

180. A hydrant outlet is located ym above ground and jet of water strikes distance xm away as shown in Fig. F-9.

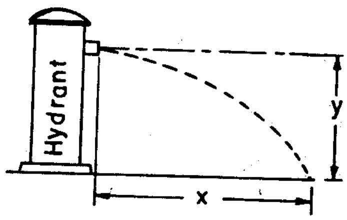


Fig. F-9

The velocity of jet is proportional to __________
$\left(\frac{x}{\sqrt{y}}, \frac{x^2}{y}, \sqrt{\frac{x}{y}}\right)$

181. For measuring the flow of liquid containing solids in suspension, the best device would be __________
(concentric orifice, flow nozzle, venturi)

182. For same flow conditions, the ratio of friction head losses of two pipes of diameters d_1 and d_2 are proportional to ________ $\left[\frac{d_1}{d_2}, \left(\frac{d_1}{d_2}\right)^2, \left(\frac{d_1}{d_2}\right)^{4.8}\right]$

183. For pipe flows, at constant head, capacity is proportional to ________ $(d^2, d^{2.5}, d^3)$

184. For pipe flows, at constant capacity, head is proportional to ________ $\left(\frac{1}{d^3}, \frac{1}{d^4}, \frac{1}{d^5}\right)$

185. For pipe flows, at constant diameter, head is proportional to ________ $(\text{flow}, \text{flow}^2, \text{flow}^3)$

186. For pipe flows, at constant diameter, capacity is proportional to ________ (friction head, $\sqrt{\text{friction head}}$ (friction head)^2)

187. In case of V-notch weir, the head is proportional to ________ (flow, $\sqrt{\text{flow}}$, $(\text{flow})^{1/2.5}$)

188. A throttling pressure is one which occurs at constant ________ (enthalpy, entropy, internal energy)

189. If ratio of specific heats be n, then velocity of sound in a gas is proportional to ________ $\left(n, \frac{1}{n}, \sqrt{n}\right)$

190. If absolute temperature be T, then velocity of sound in a gas is proportional to ________ $(T, \sqrt{T}, T^{3/2})$

191. The velocity of sound in a gas varies as proportional to ________ (Specific weight, $\sqrt{\text{sp. wt.}}$, $\frac{1}{\sqrt{\text{sp. wt.}}}$)

192. Streamlines is the name given to the lines that are ________, at any point and moment, to the fluid velocity vector (radials, perpendiculars, tangents)

193. In turbulent flow, the particles undergo distorted transverse motion that tends to make the velocities ________ (uniform, non uniform, irregular)

194. Stokes formula can be used to determine the ________ of the fluid. (specific density, viscosity, surface tension)

195. If L is the length of a pipe and D diameter, then head loss due to friction in a steady, fully developed flow is proportional to ________ $\left(\frac{L}{D^2}, \frac{L^2}{D}, \frac{L}{D}\right)$

196. If V is the mean velocity of flow and 'h' the head, then Froude number for free surface flows is ________ $\left(\frac{V}{\sqrt{gh}}, \frac{V^2}{2gh}, \frac{Vg}{h^2}\right)$

197. Whether the flow is critical, super critical or subcritical is decided by ________ number. (Reynold, Prandtl, Froude)

198. For the same area, the discharge will be maximum when the hydraulic radius is ________ (maximum, minimum, optimum)

199. For the same area, the discharge will be maximum when the wetted perimeter is ________ (maximum, minimum, optimum)

200. If R is the radius of a circular pipe, then the hydraulic radius is eaqual to ________ $(R, 2R, R/2)$

201. Flow through a rectangular spillway is proportional to length of spillway, and proportional to head H and gravitational acceleration 'g' as ________ $(Hg\,;\, H^{1/2}g^{1/2}, H^{3/2}g^{1/2})$

202. A square plane surface with a side of 0.20 m is placed on the wall of a reservoir with a slope of 45°. The depth of the centroid is 1.5 m. The centre of pressure is located at ________ m. (1.5, 1.501, 1.51)

203. If ρ is the density of a fluid, then the velocity of propagation of the pressure wave is proportional to ________ $\left(\sqrt{\rho}, \frac{1}{\sqrt{\rho}}, \rho^{-3/2}\right)$

204. If l is the length of pipe and v the velocity of elastic wave in fluid, then there will be a rapid closure if the time of annulment of the discharge is less than ________ $\left(\frac{l}{v}, \frac{2l}{v}, \frac{4l}{v}\right)$

205. The sounding rod is a portable scale that gives the ________ (depth of water level, flow, pressure)

206. A piezometer is a __________ whose lower part is connected to the pressure part and upper part is freely open to atmosphere.
(scale, rotating element, tube)

207. A pitot-static tube used for measurement of velocity consists basically of __________ tubes. (one, two, three)

208. A current meter consists essentially of a __________, used to measure the local velocity of flow.
(venturi, tube, rotating element)

209. In the case of a rectangular orifice of large dimensions located at bottom of a reservoir, (Refer Fig. F-10), the flow is proportional to __________

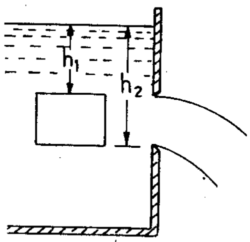


Fig. F-10

$[(h_2 - h_1), (\sqrt{h_2} - \sqrt{h_1}), h_2^{3/2} - h_1^{3/2})]$

210. The coefficient of velocity represents the influence of __________
(friction and viscosity, vena contracta, edge conditions of orifice)

211. Cipolletti weir is a trapezoidal notched sharp-crested weir, with sides sloping with inclination of __________
(1 H : 2 V, 1 H : 3 V, 1 H : 4 V)

212. In case of circular weir of diameter 'd', the discharge is proportional to __________
$(d^{1/2}, d^{3/2}, d^{5/2})$

213. If specific speed of a pump is 75, it means pump is __________
(single suction radial flow type, mixed flow type, axial-flow type)

214. The specific speed is the parameter, which together with the __________ is the best guide to check the suitability of a pump chosen from the point of view of suction.
(speed, friction losses, net positive suction head)

215. In radial pumps the power is __________ for zero discharge and in axial pumps the power is __________ for zero discharge.
(minimal, maximum, average)
(minimal, maximum, average)

216. Radial pump is started with its discharge valve __________ and axial pump with its valve __________
(closed, open, in middle position)
(closed, open, in middle position)

217. If a centrifugal pump is not primed, it would result in __________ on starting of pump.
(no discharge, low discharge, low pressure)

218. In a centrifugal (radial flow pump), the fluid enters __________ through the centre and leaves radially by the periphery.
(axially, radially, at angle)

219. Axial flow type of pump is well adapted to __________ pumping heads.
(high, low, medium)

220. In order to determine the sense of rotation of a horizontal-axis pump it is necessary to look at the pump from the side of the motor that drives it. If the axis turns from left to right (clockwise) the pump is an __________ pump, otherwise it is __________ pump.
(inverse-sense, direct-sense, normal)
(inverse-sense, direct-sense, special)

221. In a centrifugal pump, discharge is proportional to speed, head is proportional to speed^2, power absorbed is proportional speed^3 and efficiency is proportional to __________
$[(\text{speed})^{\circ}, (\text{speed})^{3/2}), (\text{speed}^{2/3})]$

222. In a centrifugal pump, if the head is doubled, new power required will increase in the ratio of__________ $[(2)^2, (2)^3, (2)^{3/2}]$

223. For determining the specific speed of a double-suction pump, the discharge must be divided by 2, or its specific speed divided by __________ $(\sqrt{2}, 2^{3/2}, 2^2)$

224. Axial flow pumps have __________ specific speed in comparison to radial flow pumps.
(higher, lower, same)

225. A pump of low specific speed will operate more effectively with __________ pumping capacities. (large, small, any)

226. With low suction heads or with positive suction heads, speed must be __________ and a cheaper pump can be used.
(decreased, increased, regulated)

227. Fig. F-11 shows the pump and system characteristics. In these curves, for higher

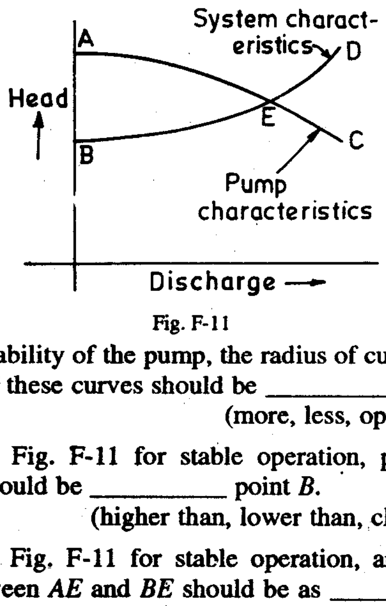


Fig. F-11

stability of the pump, the radius of curvature of these curves should be __________
(more, less, optimum)

228. In Fig. F-11 for stable operation, point *A* should be __________ point *B*.
(higher than, lower than, close to)

229. In Fig. F-11 for stable operation, area between *AE* and *BE* should be as __________ as possible (large, small, optimum)

230. Fig. F-12 shows the characteristics of pump and system which intersect at two points

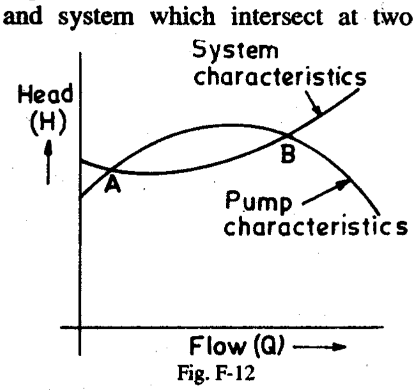


Fig. F-12

A and *B*. Pump operation is stable at point __________ (*A*, *B*, in between *A* and *B*)

231. In Fig. F-12 the performance of pumps will be unstable if the points *A* and *B* are ______
(close together, far apart, in straight line)

232. Fig. F-13 shows a typical characteristic diagram known as Hill diagram for a centrifugal

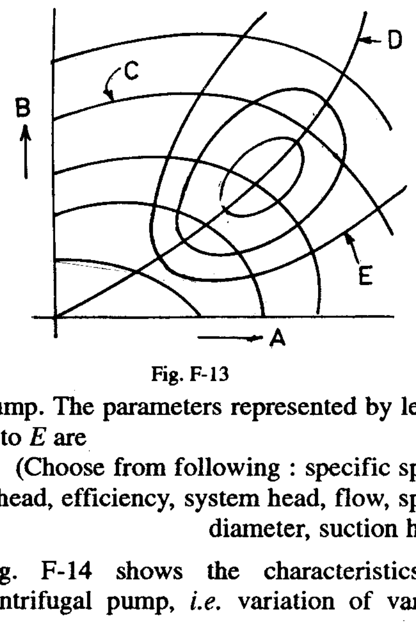


Fig. F-13

pump. The parameters represented by letters *A* to *E* are
(Choose from following : specific speed, head, efficiency, system head, flow, speed, diameter, suction head)

233. Fig. F-14 shows the characteristics of centrifugal pump, *i.e.* variation of various

Fig. F-14

parameters *vs.* discharge, Parameters *A* to *E* are: (Choose from following : efficiency, total head loss, total head, speed, static head plus other losses, absorbed power)

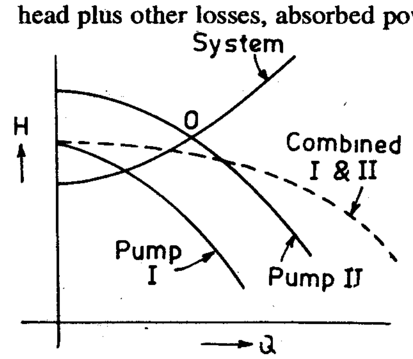


Fig. F-15

234. Fig. F-15 shows the characteristics of pumps I and II individually, in parallel, and of the system.
The case shown is operating under ________ conditions. (poor, good, average)

235. If the diameter or speed of an ampeller of centrifugal pump are reduced by 10%, then the flow, head, and power will increase by ________, and ________ % respectively.
Choose from following : (10%, 11%, 16%, 21%, 30%, 31%, 33.1%, 50%)

236. A centrifugal pump takes its suction from a storage heater tank in which pressure is maintained by admitting steam at high pressure. Can the available NPSH be increased by increasing steam pressure. (Yes/No)

237. A centrifugal pump handling the hydrocarbons requires ________ NPSH than when it handles water. (less/more)

238. The fact that a pump is cavitating manifests itself by ________
(noise, vibration, drop in the head-capacity and efficiency curves, damage to impeller by pitting and erosion after some time)

239. ________ material is chosen for condenser tubes where cooling water is salt water.
(stainless steel, copper, titanium)

240. Aluminium brass contains ________ % of aluminium. (2%, 25%, 50%)

241. The thermal conductivities of four commonly used condenser tube materials in descending order are ________
(*a*) stainless steel (*b*) admirality brass
(*c*) titanium (*d*) aluminium brass
(*a, c, d, b ; b, d, a, c ; b, d, c, a*)

242. It is of paramount importance in high pressure and high temperature boilers that copper pick up be eliminated since it results in acceleration of ________ generation
(methane, atomic hydrogen, ammonia)

243. Hydrogen embrittlement failure is caused by the high intergranular pressure of ________, which results in voids, fissures and intergranular disintegration (CO_2, H_2, CH_4)

244. The pressure loss across an orifice in a pipeline is measured by a differential gauge of relative density 0.75 as the gauge liquid. The density of liquid flowing is 1.5. The change in pressure between *A* and *B* = ________
(1.25 m of liquid, 1.5 m of liquid, 2.25 m of liquid)

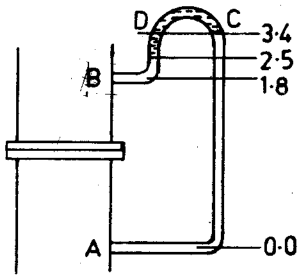


Fig. F-16

245. An oil has an absolute viscosity of 520 poises. Its viscosity in S.I. units is ________ Pa s (52, 5.2, 5200)

246. The pressure inside a raindrop 1.5 mm in diameter, at a temperature of 21°C is = ________ Pa gauge (19, 190, 1900)

247. A 2 m diameter gate *AB* in Fig. F-17 swings about a horizontal pivot *C* located 100 mm below the centre of gravity. Upto what depth *h* above *A*, the water can rise without causing an unbalanced clockwise moment about the point *C*. (1.5 m, 2 m, 2.5 m)

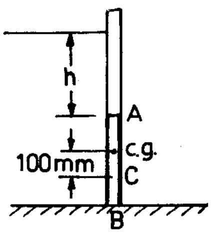


Fig. F-17

248. What fraction of the volume of a solid piece of metal of relative density 7.8 floats above the surface of a container of mercury of relative density 13.
(0.4, 0.5, 0.6)

249. Water is filled upto a depth of 3.5 m in a 4 m deep tank with base of 4 m length. At what value of linear horizontal acceleration, the water will start pouring out of the tank.
(1.2 m/s^2, 2 m/s^2, 2.45 m/s^2)

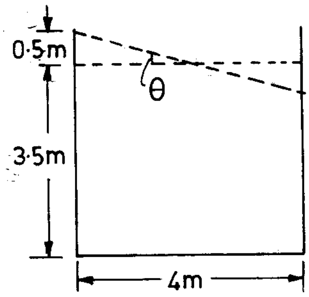


Fig. F-18

250. Cauchy number is obtained from the inertia __________ ratio.
(elasticity force, surface tension, gravity force)

251. Mach number is the square root of __________ number.
(Froude, Weber, Cauchy)

252. Interia-pressure force ratio gives the _______ number. (Euler, Reynold, Weber)

253. A 1 : 12 model of a submarine is to be tested in a towing tank. If the submarine moves at 4 m/s, the model, for dynamic similarity, should be towed at __________ m/s.
(48, 0.33, 576)

254. A ship whose hull length is 100 m is to travel at 10 m/s. For dynamic similarity, a 1 : 25 model should be towed at __________ m/s
(5, 1, 2)

255. A flow in which, at any point, the velocity of successive fluid particles is the same at successive periods of time, is called _____ flow.
(steady, uniform, laminar)

256. A flow in which the magnitude and direction of the velocity do not change from point to point in the fluid, is called __________ flow.
(one-dimensional, laminar, uniform)

257. If average velocity of flow in 0.3 m pipe is 0.64 m/s, the average velocity of flow in 0.15 m pipe will be __________
(0.16 m/s, 2.56 m/s, 1.28 m/s)

258. A turbine is rated at 450 kW. If head acting on turbine is 88 m and efficiency is 87%, the flow through turbine must be __________ m^3/s (0.6, 1.2, 0.3)

259. _______ flow is governed by the law relating shear stress to rate of angular deformation.
(laminar, turbulant, uniform)

260. If R be the hydraulic radius of a non-circular pipe, then Reynold's number = __________
$\left(\frac{VR}{\nu}, \frac{2VR}{\nu}, \frac{4VR}{\nu}\right)$

261. Velocity distribution at a cross-section will follow a parabolic law of variation for __________ flow.
(laminar, turbulant, uniform)

262. In case of laminar flow in a pipe the maximum velocity is at the centre of the pipe and is __________ the average velocity.
(twice, thrice, four times)

263. For a given velocity of flow, the head loss for laminar flow in a pipe is proportional to __________ $\left[d \text{ (diameter of pipe)}, \frac{1}{d}, \frac{1}{d^2}\right]$

264. For a given velocity, the head loss for turbulent flow in a pipe is proportional to __________ $\left(d, \frac{1}{d}, \frac{1}{d^2}\right)$

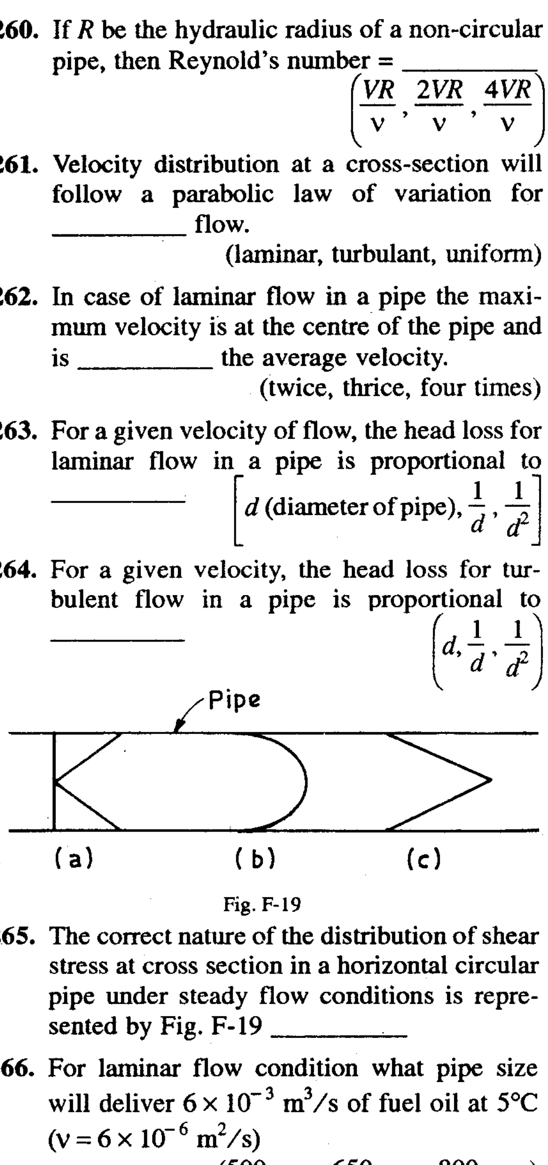


Fig. F-19

265. The correct nature of the distribution of shear stress at cross section in a horizontal circular pipe under steady flow conditions is represented by Fig. F-19 __________

266. For laminar flow condition what pipe size will deliver 6×10^{-3} m^3/s of fuel oil at 5°C ($\nu = 6 \times 10^{-6}$ m^2/s)
(500 mm, 650 mm, 800 mm)

267. If V is the velocity of flow in a pipe, then stress at the pipe wall is proportional to __________ $(V, V^2, \sqrt{V})$

268. For uniform flow in open channel, __________ remains constant from section to section.
(velocity, lost head, specific energy)

269. Critical depth for a constant flow in a rectangular channel occurs when the specific energy is a __________
(maximum, minimum, zero)

270. Vertical distribution of velocity in an open channel may be assumed as __________ for turbulant flow.
(parabolic, logarithmic, straight line)

271. If R is the hydraulic radius of an open channel, then for steady uniform flow, discharge if proportional to __________
($\sqrt{R}$, $R^{2/3}$, $R^{3/2}$)

272. A __________ open channel will discharge more water than any other shape for the same area, slope, and factor '*n*'.
(trapezoidal, rectangular, semicircular)

273. For a rectangular channel, the best depth is __________ the width.
(half, three-fourth, three-eighth)

274. __________ is the probability of a device performing its purpose adequately for the period of time intended under the operating conditions encountered.
(maintainability, operability, reliability)

275. The __________ failures in most of the engineering items are concerned with malfunctions due to poor design, poor workmanship, and poor quality. (initial, normal, aging)

276. The normal failures are associated with the __________ failures occurring during the primary operating life of the equipment.
(probability, random, cummulative)

277. The probability of failure of a system is defined as one minus the __________
(operability, reliability, availability)

278. The mean time between failure (MTBF) is defined as the average value of the time intervals between successive failures of equipment, and mean time to restore or repair (MTTR) includes the time required to locate a failure and repair it. The ratio MTBF/(MTBF + MTTR) is called
(availability, operability, maintainability)

279. __________ techniques utilise two parallel elements to reduce the probability of a failure.
(reliability, redundancy, coupling)

280. In a __________ feature, a failure in the detector itself will always leave the system operating with either the normal or redundant channel
(fail-safe, self diagnostic, fault-tolerant)

281. System __________ can be improved by providing accessible test points, built-in-test equipment, built-in diagnostic aids, training the operating personnel, and providing spare parts and euipment for incorporating repairs.
(reliability, maintenance, maintainability)

282. System __________ is basically the process of obtaining the best system result for a specified set of given condition.
(programming, optimisation, linearisation)

283. The concept of __________ programming is based on the principle of optimality and the imbedding principle.
(linear, nonlinear, dynamic)

284. __________ is defined as the difference in motion between an increasing and a decreasing output.
(stiction, hysteresis, backlash)

285. __________ is a constant frictional drag which opposes motion.
(coulomb friction, stiction, viscous friction)

286. Dynamometer is a transducer used to measure __________
(angular motion, linearity, torque)

287. A random signal generator is required to test the __________ characteristics of systems.
(reliability, statistical, dynamic)

288. A __________ is the attempt on the part of the consumer to tell the producer what he wants.
(test report, catalogue, specification)

289. The capacity of a material to absorb energy depends upon both strength and __________
(plasticity, stiffness, ductility)

290. If in a mechanical test of a material, the load is applied very rapidly so that the effect of inertia and the time element are involved, the test is called __________ test.
(dynamic, impact, long-time)

291. Fig. F-20 shows the stress-strain relations in compression. The curve A is applicable for __________ material and B for __________ material. (ductile, non-ductile, plastic)
(ductile, plastic, hard)

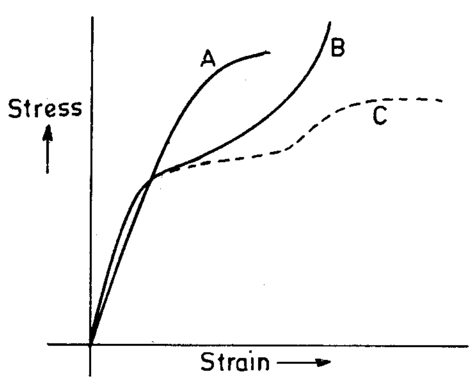


Fig. F-20

292. The term flexibility is opposite of __________. (hardness, plasticity, stiffness)

293. The resultant total system error, caused by the simultaneous presence of dynamic, random, and systematic errors is obtained by taking __________
(average of all, adding all, sequre root of sum of squares of all)

294. The term __________ refers to the field of technology which is concerned with the use of either liquid or gaseous fluids the motion to perform functions such as amplification, sensing, logic switching, computation and control.
(pneumatics, fluidics, fluid amplifiers)

295. __________ casting is best for parts that are too complicated for other casting methods.
(shell-mould, investment, die)

296. __________ involves squeezing of the blank to an appreciably different form.
(swaging, coining, extrusion)

297. Shielded metal-arc welding employs covered electrodes and can be performed with __________ power sources.
(a.c, d.c, a.c, or d.c)

298. In d.c arc welding, the term straight polarity signifies that the electrode is __________
(the positive terminal, the negative terminal, connected to earth)

299. Tungsten electrodes with small additions of __________ are used for their improvement in arc starting and stabilisation.
(copper, nickel, thoria)

300. When turret lathes are set up for bar stock, they are often called __________
(screw machines, saddle type turret lathes, ram-type turret lathes)

ANSWERS

1. Higher heating value
2. According to definition, first choice is correct.
3. If the final volume of the products of a constant-pressure combustion exceeds the original volume, part of the fuel energy has been used to push the atmosphere out of the way. If this case it is less than at constant volume. If however the final volume is less than the original volume, then constant pressure heating value is more than the constant volume value. Thus third choice is correct.
4. Since specific weight of hot air is less than that of cold air, the warm air will rise, thus setting up convection currents. Therefore first choice is correct.
5. Emissivity factor, e, is the number expressing the degree to which the source surface approaches an ideal black body, for which $e = 1$. Aluminium paint has $e = 0.3$ to 0.5. Black paint has $e \gg 0.5$. Thus, first choice is correct.

6. Sensible	**7.** Coke	**8.** 1000	**9.** Oxide of iron
10. Volatile matter	**11.** Ringlemann chart	**12.** Pure white	**13.** Internal latent
14. External latent	**15.** Ailerons	**16.** Elevators	**17.** Rudder
18. 45-50%	**19.** Decreases	**20.** Decreases	**21.** Increases
22. Increasing	**23.** Absorb	**24.** Low pressure	**25.** Liquid
26. No	**27.** Ammonia	**28.** Generator and the absorber	
29. Generator	**30.** Water	**31.** Water	**32.** Both of them
33. Dry bulb temperature		**34.** 100	**35.** Higher

36. Decreases **37.** Removing **38.** Increases
39. Heating and humidifying **40.** Humidifying **41.** 0.8
42. Sensible Heat **43.** Decreases Does Not change **44.** Humidifying
45. Removes Adds **46.** Evaporative cooling **47.** Lowers Raises
48. Dry-bulb, wet bulb and dew-point temperatures **49.** Heat **50.** 0.8
51. 0 **52.** 850 **53.** Spheroidite **54.** Troostite
55. Sulphur **56.** Chromium and Nickel **57.** Halnium **58.** Zinc, Tin
59. Small helical springs **60.** α-iron **61.** Very fine pearlite
62. Troostite **63.** Spheroidite **64.** 0.2% **65.** Ammonia
66. Higher **67.** Remains constant for a period **68.** Green sand
69. Water **70.** Linseed Oil **71.** Increases upto a limit and then decreases
72. Cohesiveness **73.** Fine **74.** Cheek **75.** Hot tears
76. Wall **77.** $\left(\frac{V}{A}\right)^2$ **78.** $\sqrt{P}$ **79.** 3
80. Greater **81.** Part of Pouring System **82.** 25-55 **83.** Skim bob
84. Casting defect **85.** Cold Shot **86.** Sand slinger **87.** No cores
88. Brittle **89.** Reduce **90.** Rotary **91.** Autofrettage
92. Balling **93.** Black annealing **94.** Brazing **95.** Burnishing
96. Calorising **97.** Strain gauging **98.** Cupping **99.** Diffusion bonding
100. Finished component **101.** Materials like rubber and plastic **102.** Electrography
103. Gold **104.** Flattening test **105.** Frosting **106.** Huey
107. Hardenability **108.** Planishing **109.** Soldering **110.** Fatigue
111. $45° - \frac{\mu}{2}$ **112.** $(1 - 2\mu)$ **113.** 4 **114.** 1.5
115. Stronger **116.** $\frac{9}{8}$ **117.** L^2
118. 10791 N

$$V = u + at \quad \text{or} \quad 3.924 = 0 + a \times 4$$

and $$a = \frac{3.924}{4} = 0.981 \text{ m/s}^2$$

Tension in cable $$= m(g + a) = 1000(9.81 + 0.981) = 10791 \text{ N}$$

119. 25 mm

Weight × distance of free fall + Weight × displacement of spring = Work of spring = average force of spring × displacement of spring squared

or $$500 \times 100 + 500 \times d_s = \frac{200}{2} \times d_s^2$$

or $$100\, d_s^2 - 500 d_s - 50000 = 0$$

or $$d_s^2 - 5d_s - 500 = 0, \text{ or } (d_s - 25)(d_s + 20) = 0$$

or $$d_s = 25 \text{ mm}$$

120. A

$$T_A = T_B \quad \text{and} \quad T_C = T_A + T_B$$

When masses are released, weight 20 kg being more than 10 kg, cord A will move up and B pull down. Then $T_A = 10 + \frac{10}{g} \times a_A$ (Cord A is tight)

$$T_B = 20 - \frac{20}{g} \times a_B \text{ (B cord is loose)}$$

Now obviously 30 kg > T_C, ∴ Cord C moves down and

$$T_C = 30 - \frac{30}{g} \times a_C \quad (C \text{ Cord is loose})$$

121. 16.67

In Fig. F-4, $AB = 13$ m, $AC = 5$ m, $BC = \sqrt{13^2 - 5^2} = 12$ m

$$R_y = 80 \text{ kg}$$

$$\Sigma M_A = 0 = 80 \times 2.5 - R_H \times 12$$

or

$$R_H = \frac{80 \times 2.5}{12} = \frac{20 \times 2.5}{3}$$

$$= \frac{50}{3} = 16.67 \text{ kg.}$$

122. 2.075

Since volume remains constant, $\frac{P_2}{P_1} = \frac{T_2}{T_1}$, or $\frac{P_2}{2+1} = \frac{273+37}{273+27}$

or $P_2 = \frac{410}{400} \times 3 = \frac{12.3}{4} = 3.075$

or $P_2 = 2.075 \text{ kg/cm}^2$ (gauge)

123. 45° **124.** Zero **125.** $\frac{\theta}{2}$

126. Viscoelastic solid **127.** $1 + \varepsilon_0$ **128.** Modulus of elasticity

129. Modulus of resilience **130.** Modulus of toughness

131. Dilatation **132.** 2 **133.** 1.5 **134.** 10^{-4} $\sec^{-1}$

135. Brittle **136.** Soderberg **137.** Moment **138.** Parabola

139. Triangular **140.** $\delta^{-1/2}$ **141.** $\sqrt{gs/wA}$ **142.** $\frac{\pi^3 E d^4}{64 l^2}$

143. $\text{Length}^2 \sqrt[3]{\frac{\text{Torque}}{\text{shear stress}}}$ **144.** $\frac{F}{wl}$ **145.** $T_1 - T_2$

146. v^2 **147.** 95% **148.** $\frac{1}{D^2 N^2}$ **149.** $WR^2\omega^2$

150. $I_s\, \omega_p\, \omega_s$ **151.** Decreases **152.** Approximately conical

153. Pressure angle **154.** 14.5° **155.** 5

156. Scott Russel **157.** Rotary rocking **158.** A **159.** Froude

160. Cauchy **161.** Cauchy **162.** Heat exchange **163.** 64/Re

164. MT^2 **165.** N/m **166.** Dynamic capillarity

167. N/m^2 **168.** m^2/s^2 **169.** 9 **170.** 200

171. Dynamic **172.** Kinematic **173.** Poise Stoke **174.** 0.1

175. 10^{-4} **176.** 10^{-6} **177.** 10^{-3} **178.** $\sqrt{h_1} - \sqrt{h_2}$

179. $r^{5/2}$ **180.** $\frac{x}{\sqrt{y}}$ **181.** Venturi **182.** $\left(\frac{d_1}{d_2}\right)^{4.8}$

183. $d^{2.5}$ **184.** $1/d^5$ **185.** flow^2 **186.** $\sqrt{\text{Friction head}}$

187. $(\text{flow})^{1/2.5}$ **188.** Enthalpy **189.** $\sqrt{n}$ **190.** $\sqrt{T}$

191. $\frac{1}{\sqrt{\text{sp. wt.}}}$ **192.** Tangents **193.** Uniform **194.** Viscosity

195. $\frac{L}{D}$ **196.** $\frac{V}{\sqrt{gh}}$ **197.** Froude **198.** Maximum

199. Minimum

200. $R/2$

$$\left(\text{Hydraulic radius} = \frac{\text{wetted area}}{\text{wetted perimeter}} = \frac{\pi R^2}{2\pi R} = \frac{R}{2}\right)$$

201. $H^{3/2} g^{1/2}$

$$[Q \alpha L \times H^{\alpha} \times g^{\beta}$$

or $$L^3 T^{-1} = L \times L^{\alpha} \times (LT^{-2})^{\beta} = L^{1+\alpha+\beta}\, T^{-2\beta}$$

$\therefore$ $$3 = 1 + \alpha + \beta \text{ ; and } -1 = -2\beta$$

$\therefore$ $$\beta = \frac{1}{2},\ \alpha = \frac{3}{2}, \qquad \therefore\ Q = CL\, H^{3/2} g^{1/2}$$

202. 1.501

$$[\text{Centre of pressure} = 1.5 + \frac{0.2^2}{12} \times \left(\frac{\sqrt{2}}{2}\right)^2 \times \frac{1}{1.5}$$
$$= 1.501 \text{ m}]$$

203. $1/\sqrt{\rho}$ **204.** $2l/v$ **205.** Depth of water level

206. Tube **207.** Two **208.** Rotating element **209.** $(h_2^{3/2} - h_1^{3/2})$

210. Friction and viscosity **211.** 1 H : 4 V **212.** $d^{5/2}$

213. Single suction radial flow type **214.** Net positive suction head

215. Minimal Maximum **216.** Closed Open **217.** No discharge

218. Axially **219.** Low **220.** Inverse-sense Direct-sense

221. (speed)° **222.** $(2)^{3/2}$ **223.** $\sqrt{2}$ **224.** Higher

225. Large **226.** Increased **227.** More **228.** Higher

229. Large

230. B

The operating condition corresponding to B is stable. At point A, if discharge increases, H also increases, which causes an increase in discharge of the system and so on, successively, until the operating point moves to B. On the other hand, if discharge of the pump falls below that corresponding to A, the pumping head becomes lower than that required by the system. This further reduces the discharge, and the pump falls to point $Q = 0$.

231. Close together

232. Flow, pressure, speed, system head, efficiency

233. Total head loss, efficiency, static head + other losses, total head, absorbed power.

234. Poor

Upto operating point, only one pump is operating and other has to idle (without discharge). This would harm the idle pump by overheating.

235. 10%, 21% and 55.1%.

The following relationship for centrifugal pumps must be remembered.

$$\frac{Q_2}{Q_1} = \frac{D_2}{D_1} = \frac{\sqrt{H_2}}{\sqrt{H_1}} = \frac{\sqrt[3]{BHP_2}}{\sqrt[3]{BHP_1}}$$

Thus $$\frac{Q_2}{Q_1} = \frac{1.1 D_1}{D_1} \text{ and } \frac{Q_2 - Q_1}{Q_1}\% = \frac{1.1 - 1}{1} \times 100\%$$
$$= 10\%$$

Similarly $$\frac{H_2 - H_1}{H_1}\% = \frac{1.21 - 1}{1} \times 100\% = 21\%$$

and $$\frac{BHP_2 - BHP_1}{BHP_1} = \frac{1.1^3 - 1}{1} \times 100\% = \frac{1.331 - 1}{1} \times 100\% = 33.1\%$$

236. No, because the increase in steam pressure increases the temperature of water. The vapour pressure thus remains equal to heater pressure. Thus increasing heater pressure by increasing steam pressure does not affect the available NPSH of pump.

237. Less. It may be remembered that cavitation in a pump occurs when the absolute pressure within an impeller falls below the vapour pressure of the liquid. And the vapour pressure of hydrocarbons compared to water is high.

238. Pump cavitation could be manifested by one or more of specified signs.

239. Titanium **240.** 2% **241.** *b, d, c, a*

242. Atomic hydrogen **243.** CH_4

244. 2.25 m of liquid

Pressure at C in Pascals, = Pressure at D in pascals

$\therefore\ P_A - (9810 \times 1.5)3.4$

$$= P_B - (9180 \times 1.5)(2.5 - 1.8) - (9810 \times 0.75)(3.4 - 2.5)$$

or $$p_A - p_B = 33100 P_a = \frac{33100}{9810 \times 1.5} = 2.25 \text{ m of liquid}$$

245. 52 **246.** 190

247. 1.5

$$y_{C_p} = \frac{I_{cg}}{g_{cg} A} = y_{cg}$$

or $$= y_{cp} - y_{cg} = 0.1 = \frac{\pi d^4/64}{\pi \frac{d^2}{4} \times y_{cg}} = \frac{\frac{\pi \times 2^4}{64}}{(h+1)\left(\frac{\pi d^2}{4}\right)}$$

or $$h = 1.5 \text{ m}$$

248. 0.4

Weight of body = Weight of displaced mercury

$$7.8 \times V = 13 \times V'$$

or $$\frac{V'}{V} = \frac{7.8}{13} = 0.6$$

$\therefore$ Fraction of volume above mercury

$$= 1 - 0.6 = 0.4$$

249. 245 m/s^2

$$\tan\theta = \frac{\text{linear acceleration}}{\text{gravitational acceleration}}$$

For water to pour out $$\tan\theta = \frac{0.5}{2} = \frac{1}{4}$$

or linear acceleration $$= \frac{1}{4} \times g$$

$$= \frac{1}{4} \times 9.81 = 2.45 \text{ m/s}^2$$

250. Elasticity force **251.** Cauchy **252.** Euler

253. 48

Reynold number should be same for prototype and model

$\therefore$ $$\frac{4 \times L}{\nu} = \frac{V \times L/12}{\nu}$$

or $$v = 48 \text{ m/s}$$

254. 2

Equate Froude number in this case

$$\frac{V}{\sqrt{gL}} = \frac{V'}{\sqrt{g'L'}} \text{ or } \frac{V}{\sqrt{L}} = \frac{V'}{\sqrt{L'}} \text{ or } \frac{V}{\sqrt{100}} = \frac{V'}{\sqrt{100/25}} \text{ or } V' = \frac{10}{10} \times 2$$
$$= 2 \text{ m/s}$$

255. Steady **256.** Uniform **257.** 2.56 m/s

258. 0.6

Rated power $= \text{extracted power} \times \eta = \rho g Q H \times \eta$

or $450 \times 1000 = 9810 \times Q \times 88 \times 0.87$

and $Q = 0.6 \text{ m}^3/\text{s}$

259. Laminar **260.** $\frac{4VR}{\nu}$ **261.** Laminar **262.** Twice

263. $\frac{1}{d^2}$ **264.** $\frac{1}{d}$ **265.** a

266. 650 mm

$$V = \frac{Q}{A} = \frac{Q}{\frac{\pi}{4} d^2} = \frac{4 \times 6 \times 10^{-3}}{\pi d^2} \text{ m/s}$$

or Reynold number $= \frac{Vd}{\nu} = 2000$ (for laminar flow)

or $\frac{4 \times 6 \times 10^{-3} \times d}{6 \times 10^{-6} \times \pi d^2} = 2000$

and $d = \frac{4 \times 10^3}{\pi \times 2000} = \frac{2}{\pi} \sim = 0.65 \text{ m}$

267. V^2 **268.** Specific energy **269.** Minimum **270.** Logarithmic

271. $R^{2/3}$ **272.** Semi-circular **273.** Half **274.** Reliability

275. Initial **276.** Random **277.** Reliability **278.** Availability

279. Redundancy **280.** Fail-safe **281.** Maintainability **282.** Optimisation

283. Dynamic **284.** Backlash **285.** Coulomb friction **286.** Torque

287. Statistical **288.** Specification **289.** Stiffness **290.** Dynamic

291. Non-ductile Ductile **292.** Stiffness

293. Square root of sum of squares of all **294.** Fluidics **295.** Investment

296. Swaging **297.** a.c. or d.c. **298.** The negative terminal

299. Thoria **300.** Screw machines.

Engineering Service Examination

MECHANICAL ENGINEERING—1993

PAPER–I

1. *This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each item.*
2. *You have to mark all your responses ONLY on the separate Answer Sheet provided. See directions in the Answer Sheet.*
3. *All items carry equal marks. Attempt all items. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet.*

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1. For a real fluid moving with uniform velocity, the pressure

(*a*) Depends upon depth and orientation

(*b*) is independent of depth but depends upon orientation

(*c*) is independent of orientation but depends upon depth

(*d*) is independent of both depth and orientation

Sol. (*d*) In case of a real fluid moving with uniform velocity, the velocity head and pressure head are dependent on each other and their total sum remains constant. The pressure is thus independent of both depth and orientation, but in case of fluids under static condition, the pressure would depend on depth.

2. The vertical component of force on a curved surface submerged in a static liquid is eqaul to the

(*a*) mass of the liquid above the curved surface

(*b*) weight of the liquid above the curved surface

(*c*) product of pressure at C.G. multiplied by the area of the curved surface

(*d*) product of pressure at C.G. multiplied by the projected area of the curved surface

Sol. (*b*) The correct choice is (*b*) since the vertical component of force on a curved surface submerged in a static liquid is the weight of the liquid above the curved surface.

3. In the situation shown in the given figure, the length BC is 3 m and M is the mid-point of BC. The hydrostatic force on BC measured per unit width (width being perpendicular to the plane of the paper) with 'g' being the acceleration due to gravity, will be

(*a*) 16500 g N/m passing through M

(*b*) 16500 g N/m passing through a point between M and C

(*c*) 14250 g N/m passing through M

(*d*) 14250 g N/m passing through a point between M and C

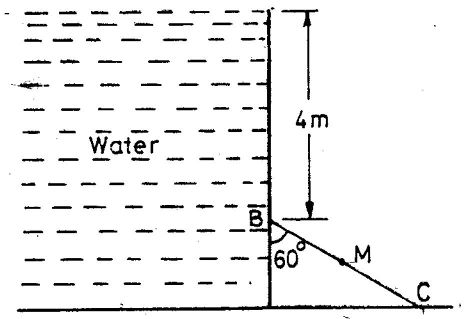

Fig. 1

Sol. The correct choice is (*d*)

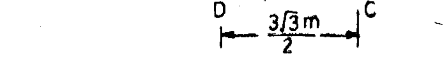

Fig. 2

The hydrostatic force on $BC = \sqrt{F_V^2 + F_H^2}$.

where F_V = vertical component

= weight over area BC

$$= \left(\frac{4+5\cdot5}{2}\right)\times\frac{3\sqrt{3}}{2}\times10^3\,\text{g (for unit width)}$$

$= 4\cdot75\times1\cdot5\times1\cdot732\times10^3\,g$

$= 12.34\times10^3\,g$ N/m

F_H = Projected area of BC, *i.e.* BD × depth upon centre of BD $\times 10^3\,g$

$= 1\cdot5\times4\cdot75\times10^3\,g$ (for unit width)

$= 7\cdot125\times10^3\,g$

Resultant $= 10^3 g\sqrt{12\cdot34^2 + 7\cdot125^2}$

$= 14250$ g N/m

This resultant acts at centre of pressure, *i.e.*, at $\frac{2}{3}$ of BD or between M and C.

4. Two pipe lines at different pressures, p_A and p_B, each carrying the same liquid of specific gravity S_1, are connected to a U-tube with a liquid of specific gravity S_2 resulting in the level differences h_1, h_2 and h_3 as shown in the figure. The difference in pressure head between points A and B in terms of head of water is

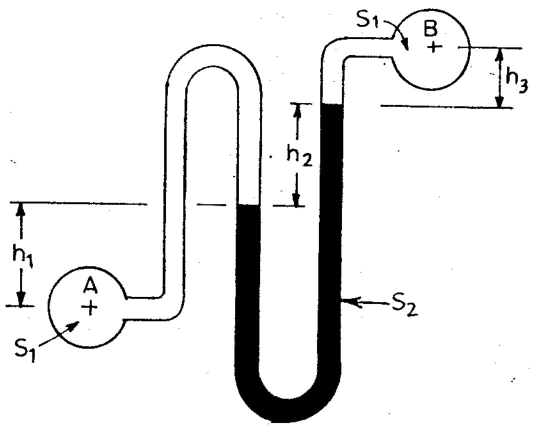

Fig. 3

(*a*) $h_1S_2 + h_2S_1 + h_3S_1$ (*b*) $h_1S_1 + h_2S_2 - h_3S_1$

(*c*) $h_1S_1 - h_2S_2 - h_3S_1$ (*d*) $h_1S_1 + h_2S_2 + h_3S_1$

Sol. **(d)** Considering the datum at XX in Fig. 4, the net pressure on left side is $p_A - h_1S_1$ (the pressure due to inverted portion being equal)

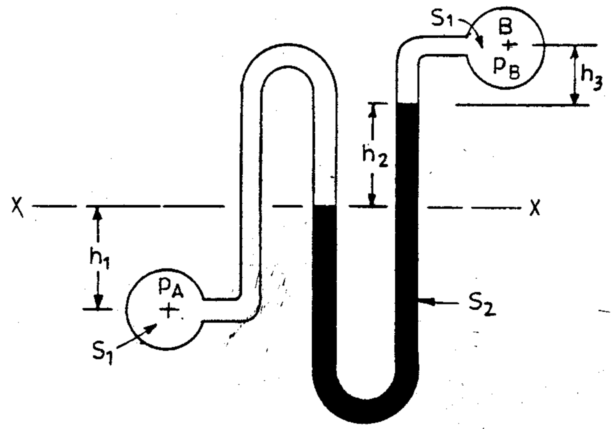

Fig. 4

and net pressure on right side = $p_B + h_3S_1 + h_2S_2$

$\therefore \quad p_A - p_B = h_1 S_1 + h_2 S_2 + h_3 S_1$

Thus choice (*d*) is correct.

5. If the governing equation for a flow field is given by $\nabla^2 \phi = 0$ and the velocity is given by $\vec{V} = \nabla\phi$, then

(*a*) $\nabla \times \vec{V} = 0$

(*b*) $\nabla \times \vec{V} = 1$

(*c*) $\nabla^2 \times \vec{V} = 1$

(*d*) $(\vec{V}.\nabla)\vec{V} = \frac{\partial \vec{V}}{\partial t}$

Sol. (*a*) Relationship $\nabla \times \vec{V} = 0$ is correct.

6. Decrease in temperature, in general, results in

(*a*) an increase in viscosities of both gases and liquids
(*b*) a decrease in the viscosities of both liquids and gases
(*c*) an increase in the viscosity of liquids and a decrease in that of gases
(*d*) a decrease in the viscosity of liquids and an increase in that of gases

Sol. The viscosity of water with increase in temperature decreases and that of air increases

For water, $\mu_t = \left[\frac{0 \cdot 001793}{1 + 0 \cdot 03368t + 0 \cdot 000221t^2}\right]$

and for air $\mu_t = 0.00000\,1702\,[1 + 0.00329t + 0.000007t^2]$

Thus for decrease in temperature, the viscosity of liquid will increase, and in gases it will decrease.

Thus (*c*) is the correct choice.

7. Which of the following equations are forms of continuity equations ?

($\vec{V}$ is the velocity and $\forall$ is volume)

1. $A_1\vec{V}_1 = A_2\vec{V}_2$
2. $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$
3. $\int_s \rho\vec{V}.dA + \frac{\partial}{\partial t}\int_\forall \rho d\forall = 0$
4. $\frac{1}{r}\frac{\partial (rv_r)}{\partial r} + \frac{\partial v_z}{\partial z} = 0$

Select the correct answer using the codes given below :

Codes :

(*a*) 1, 2, 3 and 4
(*b*) 1 and 2
(*c*) 3 and 4
(*d*) 2, 3 and 4

Sol. (*b*) Equations 1 and 2 are correct.

8. Consider the following assumptions :

1. Steady flow.
2. Inviscid flow.
3. Flow along a stream line.
4. Conservative force field.

For Bernoulli's equation to be valid between any two points in a flow field, besides incompressible flow and irrotational flow, the assumptions required would include

(*a*) 1 and 2
(*b*) 1, 2 and 4
(*c*) 2, 3 and 4
(*d*) 1, 3 and 4

Sol. (*a*) The assumptions of steady flow and inviscid flow hold.

9. A pipe friction test shows that, over the range of speeds used for the rest, the non-dimensional friction factor '*f*' varies inversely with Reynolds Number. From this, one can conclude that the

(*a*) fluid must be compressible (*b*) fluid must be ideal

(*c*) pipe must be smooth (*d*) flow must be laminar

Sol. (*c*) The non-dimensional friction factor '*f*' is found to be function of Reynolds number. Thus whatever be the fluid or type of flow, as long as Reyonlds number is same, friction factor, '*f*' is also constant. Thus '*f*' is not function of (*a*), (*b*) or (*d*). However all such experiments are conducted on smooth pipe so that we are concerned with fluid friction in flow.

Further Reynold's number accounts for flow conditions and not pipe friction.Thus (c) is the correct choice.

10. Chezy's formula is given by (*m, i, C* and *V* are, respectively, the hydraulic mean depth, slope of the channel, Chezy's constant and average velocity of flow)

(*a*) $V = i\sqrt{mC}$ (*b*) $V = C\sqrt{im}$

(*c*) $V = m\sqrt{iC}$ (*d*) $V = \sqrt{miC}$

Sol. (*b*) According to Chezy's formula $V = C\sqrt{im}$

and thus (*b*) is the answer and all other choices are given to confuse.

11. In a rough turbulent flow in a pipe, the friction factor would depend upon

(*a*) velocity of flow (*b*) pipe diameter

(*c*) type of fluid flowing (*d*) pipe condition and pipe diameter

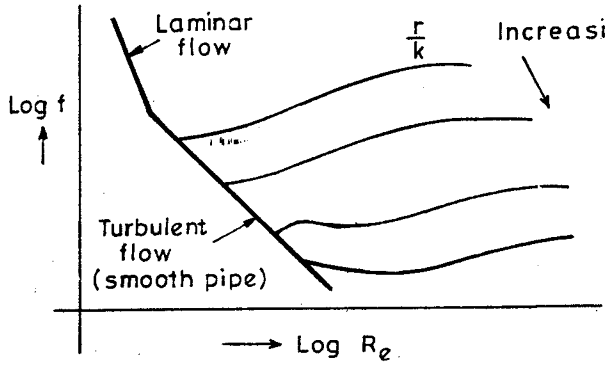

Fig. 5

Sol. (*d*) Fig. 5 shows a plot of log (friction factor '*f*') and log (Reynolds number '*Re*'). It would be seen that for smooth turbulent flow, *f* varies inversely as *Re*.

But in case of rough pipes, behaviour changes depending on value of relative smoothness r/k (radius/average diameter of sand particles)

Thus friction factor *f* for rough turbulent flow in a pipe depends upon pipe condition and pipe diameter .

Friction factor for laminar flow $f = \frac{64}{Re}$, *i.e.* it is independent of the relative roughness of pipe.

However in the turbulent flow, the friction factor, as observed from several experiments, is a function of the relative roughness, *i.e.* the pipe condition and pipe diameter. Thus (*d*) is the correct choice.

12. The differential manometer connected to a Pitot static tube used for measuring fluid velocity gives

(*a*) static pressure (*b*) total pressure
(*c*) dynamic pressure (*d*) difference between total pressure and dynamic pressure.

Sol. (*c*) Fig. 6 shows a pitot static tube used for measuring fluid velocity in a pipe and connected through points A and B to a differential manometer.

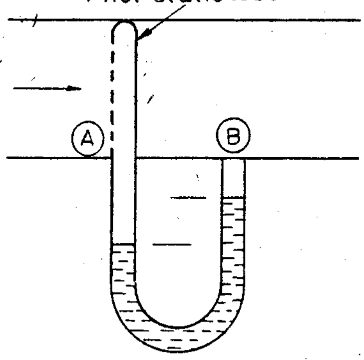

Fig. 6

Point A measures velocity head $\frac{v^2}{2g}$ + static pressure, whereas point B senses static pressure.

In actual practice point B is within the tube and not separate on the pipe. Thus manometer reads only dynamic pressure $\left(\frac{v^2}{2g}\right)$

13. The speed of the air emerging from the blades of a running table fan is intended to be measured as a function of time. The point of measurement is very close to the blade and the time period of the speed fluctuation is four times the time taken by the blade to complete one revolution. The appropriate method of measurement would involve the use of

(*a*) a Pitot tube (b) a hot wire anemometer
(c) high speed photography (d) a Schlieren system

Sol. A Pitot tube is used for measuring speed in closed duct or pipe. Hot wire anemometer is used for measuring average speed over a period of time and will not respond to fast changes as in question. High speed photography may be useful to measure blade speed but not of air.Thus the only choice left is (*d*).

(Note : Many times answer may be found by eliminating other alternatives).

14. Match List I with List II and select the correct answer using the codes given below the lists :

List I *(Discharge measuring device)*	**List II** *(Characteristic feature)*
A. Rotameter	1. Vena contracta
B. Venturimeter	2. End contraction
C. Orificemeter	3. Tapering tube

D. Flow nozzle	4. Convergent-divergent
	5. Bell mouth entry

Codes :	*A*	*B*	*C*	*D*
(*a*)	1	2	3	4
(*b*)	3	4	1	5
(*c*)	5	4	2	1
(*d*)	3	5	1	2

Sol. The rotatmeter involves tapering tube. Thus corresponding to A, the correct answer is 3 and lies in codes (*b*) and (*d*). Further venturimeter involves convergent-divergent portion, *i.e.* *B* matches with 4. Thus code (*b*) alone provides these choices.

(Note : In such questions, if one is confident, the correct code can be found quickly by considering a part of question. There is no need of wasting time in analysing all the choices. However if there is doubt, then other choices have to be considered to decide the right code.)

15. In turbulent flow over an impervious solid wall

(*a*) viscous stress is zero at the wall
(*b*) viscous stress is of the same order of magnitude as the Reynold's stress
(*c*) the Reynold's stress is zero at the wall
(*d*) viscous stress is much smaller than Reynold's stress.

Sol. (*d*) The correct choice is as per statement at (*d*)

16. The 'velocity defect law' is so named because it governs a

(*a*) reverse flow region near a wall
(*b*) slip-stream flow at low pressures
(*c*) flow with a logarithmic velocity profile a little away from the wall
(*d*) re-circulating flow near a wall.

Sol. (*c*) Fig. 7 shows the logarithmic variation of velocity near a wall. Velocity difference ($V_{max}-V$) is known as velocity defect. So velocity defect law occurs due to occurrence of flow with a logarithmic velocity profile a little away from the wall. Thus (*c*) is the correct choice.

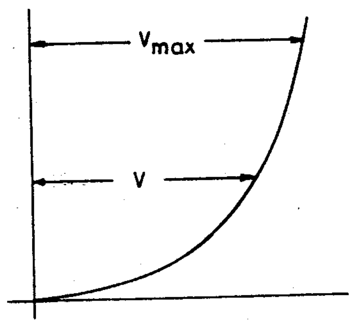

Fig. 7

17. The frictional head loss through a straight pipe (h_f) can be expressed as $h_f = \dfrac{4flv^2}{2gD}$ for both laminar and turbulent flows. For a laminar flow, 'f' is given by (Re is the Reynolds Number based on pipe diameter)

(*a*) 24/*Re* (*b*) 32/*Re*
(*c*) 64/*Re* (*d*) 128/*Re*

Sol. (*c*) The correct choice is $f = \dfrac{64}{Re}$.

18. The laminar boundary layer thickness in zero-pressure-gradient flow over a flat plate along the x-direction varies as (x is the distance from the leading edge)

(*a*) $x^{-1/2}$ (*b*) $x^{1/7}$
(*c*) $x^{1/2}$ (*d*) x

Sol. (*c*) The thickness of turbulent boundary layer varies as $x^{4/5}$ while the thickness of laminar boundary layer varies as $x^{1/2}$. Thus correct choice is (*c*).

19. In the region of the boundary layer nearest to the wall where vorticity is not equal to zero, the viscous forces are

(*a*) of the same order of magnitude as the inertial forces
(*b*) more than inertial forces
(*c*) less than inertial forces
(*d*) negligible

Sol. (*c*) The correct choice is as per statement at (*c*).

20. Drag on cylinders and spheres decreases when the Reynolds number is in the region of 2×10^5 since

(*a*) flow separation occurs due to transition to turbulence
(*b*) flow separation is delayed due to onset of turbulence
(*c*) flow separation is advanced due to transition to turbulence
(*d*) flow reattachment occurs

Sol. (*d*) In the region of 2×10^5 (Reynolds number), the boundary layer on the cylinders and sphere begins to become unstable and thus boundary layer is said to reattach and the seperation point moves back along the cylinder. Due to flow reattachment, a pressure recovery takes place over the back side and thus the drag force decreases.

21. Match the common observations in List I with the explanations in List II and select the correct answer using the codes given below the lists :

List I	List II
A. Singing of telephone wires	1. Vortex flow
B. Velocity profile in a pipe is initially parabolic and then flattens	2. Drag
C. Formation of cyclones	3. Vortex shedding
D. Shape of a rotameter tube	4. Turbulence
	5. Compressibility

Codes :

	A	B	C	D
(a)	5	2	1	4
(b)	3	4	5	2
(c)	3	4	1	2
(d)	5	2	1	4

Sol. (*c*) A. The singing of telephone wires occurs due to vortex shedding phenomenon.

B. The velocity profile in a pipe is initially parabolic (laminar flow condition) and then flattens due to turbulent flow.

C. Formation of cyclone occurs due to vortex flow.

D. Shape of a rotameter tube (taper shape) is given considering the phenomenon of drag.

Thus the choices for A, B, C and D are 3, 4, 1 and 2 and the correct answer is (*c*).

22. In turbomachinery, the relevant parameters are volume flow rate, density, viscosity, bulk modulus, pressure difference, power consumption, rotational speed and a characteristic dimension. According to Buckingham pi (π) theorem, the number of independent non-dimensional groups for this case is

(*a*) 3 (*b*) 4

(*c*) 5 (*d*) 6

Sol. (*d*) In this case, the number of physical quantities given are $n = 8$. Number of fundamental dimensions $m = 3$.

According to Buckingham π theorem, number of independent non-dimensional groups = $n - m = 8 - 3 = 5$

Thus (*c*) is the correct choice.

23. List I gives 4 dimensionless numbers and List II gives the types of forces which are one of the constitutents describing the numbers. Match List I with List II and select the correct answer using the codes given below the lists :

List I	List II
A. Euler number	1. Pressure force
B. Froude number	2. Gravity force
C. Mach number	3. Viscous force
D. Webber number	4. Surface tension
	5. Elastic force

Codes :

	A	B	C	D
(a)	2	3	4	5
(b)	3	2	4	5
(c)	2	1	3	4
(d)	1	2	5	4

Sol. (*d*) Euler number is concerned with pressure force and this chocie is available for A in code (*d*) only. If one is confident, then there is no need to look for items B, C and D. However a cross check will show that Froude number is concerned with gravity force, Mach number with elastic force, and Weber number with surface tension. Hence the answer is (*d*) only.

24. The realisation of velocity potential in fluid flow indicates that the

(*a*) flow must be irrotational
(*b*) circulation around any closed curve must have a finite value
(*c*) flow is rotational and satisfies the continuity equation
(*d*) vorticity must be non-zero

Sol. (*a*) The realisation of velocity potential in fluid flow indicates that the flow must be irrotational.

25. Both free vortex and forced vortex can be expressed mathematically as functions of tangential velocity V at the corresponding radius r. Free vortex and forced vortex are definable through V and r as

	Free Vortex	***Forced vortex***
(*a*)	$V = r \times$ const.	$Vr =$ const.
(*b*)	$V \times r =$ const.	$V^2 = r \times$ const.
(*c*)	$V \times r =$ const.	$V = r \times$ const.
(*d*)	$V^2 \times r =$ const.	$V = r \times$ const.

Sol. (*b*) Free vortex can be expressed mathematically as $V \times r$ = constant and the forced rotex as $V^2 = r \times$ constant.

Thus correct choice is (b).

26. The degree of reaction of a turbomachine is defined as the ratio of the

(*a*) static pressure change in the rotor to that in the stator
(*b*) static pressure change in the rotor to that in the stage
(*c*) static pressure change in the stator tc that in the rotor
(*d*) total pressure change in the rotor to that in the stage.

Sol. (*b*) The degree of reaction of a turbomachine is defined as the ratio of the static pressure change in the rotor to that in the stage.

27. Chances of occurrence of cavitation are high if the

(*a*) local pressure becomes very high
(*b*) local temperature becomes low
(*c*) Thoma cavitation parameter exceeds a certain limit
(*d*) local pressure falls below the vapour pressure

Sol. (*d*) Chances of occurrence of cavitation are high whenever the local pressure falls below the vapour pressure when the water bubbles are formed and these on rupture cause cavitation.

28. The specific speed of a hydraulic pump is the speed of geometrically similar pump working against a unit head and

(*a*) delivering unit quantity of water
(*b*) consuming unit power
(*c*) having unit velocity of flow
(*d*) having unit radial velocity

Sol. (*a*) The specific speed of a hydraulic pump is the speed of a geometrically similar pump working against a unit head and delivering unit quantity of water.

(It may be noted that specific speed of hydraulic pump = $\frac{N\sqrt{Q}}{H^{3/4}}$)

29. In the statement, "in a reaction turbine installation, the head of water is decreased and the rpm is also decreased at a certain condition of working. The effect of each of these changes will be to X power delivered due to decrease in head and to Y power delivered due to decrease in rpm", $\frac{N\sqrt{Q}}{H^{3/4}}$ X and Y stand respectively for

(a) decrease and increase
(b) increase and increase
(c) decrease and decrease
(d) increase and decrease

Sol. **(a)** We have to find the effect of decrease of head and decrease of speed on power developed.

For hydraulic reaction turbines, $P \propto H^{\frac{3}{2}}$

Thus decrease of head would result in decrease of power delivered.

The speed $N \propto \frac{1}{\sqrt{P}}$ or $P \alpha \frac{1}{N^2}$

Thus decrease in speed will result in increase of power.

Thus (a) is the right choice.

The following twelve items consist of two statements, one labelled the 'Assertion A' and the other labelled the 'Reason R'. You are to examine these two statements carefully and decide if the assertion A and the Reason R are individually true and if so, whether the Reason is a correct explanation of the Assertion. Select your answers to these items using the codes given below and mark your answer sheet accordingly.

Codes :

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not a correct explanation of A.
(c) A is true but R is false
(d) A is false but R is true

30. **Assertion A :** A perfect gas is one that satisfies the equation of state and whose specific heats are constant.

Reason R : The enthalpy and internal energy of a perfect gas are functions of temperature only.

Sol. (b) For perfect gas, both the assertion *A* and reason *R* are true. However *R* is not the explanation for *A*. *A* provides definition of perfect gas. *R* provides further relationship for enthalpy and internal energy but can't be reason for definition of perfect gas.

Hence correct choice is (*b*).

31. **Assertion A :** Air standard efficiency of thermodynamic cycles is higher than actual efficiency of engines.

Reason R : Air is not a perfect gas.

Sol. (c) It is true that air standard efficiency of thermodynamic cycles is higher than efficiency of engines. Thus assertion *A* is true. However reason *R* is false because air can be considered as perfect gas. Thus correct choice is (*c*).

32. **Assertion A :** Iso-octane has been chosen as the reference for S.I. engine fuels and has been assigned a value of octane number 100.

Reason R : Among the fuels, iso-octane ensures the highest compression ratio at which an S.I. engine can be operated without knocking.

Sol. (*a*) Both assertion and reason given are true. Also the reason R is the correct explanation of the assertion. Thus correct choice is (*a*).

33. **Assertion A :** The thrust of a turboprop engine increases with the increase in flight speed.

Reason R : With the increase in flight speed, there is an increase in the pressure and density of the air at the compression inlet due to the ram effect.

Sol (*d*) The thrust of turboprop engine is proportional to $V_j - V_a$

(V_j = velocity of jet relative to engine and V_a = velocity of approach of air)

Further propulsive efficiency $\eta_p = \dfrac{2}{\dfrac{V_j}{V_a}+1}$

$\therefore$ with increase in V_a, η_p increases but thrust decreases. Thus assertion A is false.

However reason R is true. Thus correct choice is (*d*).

34. **Assertion A :** Liquid oxygen-liquid hydrogen propellant system has a higher specific impulse relative to the liquid oxygen-hydrocarbon system.

Reason R : Hydrogen has a higher burning velocity than hydrocarbons.

Sol. (*a*) Both assertion and reason are true and also R provides correct explanation for A. Thus choice (*a*) is correct.

35. **Assertion A** : Excess air in the case of natural draught system is more when compared to artificial draught system in a boiler.

Reason R : To ensure complete combustion of a fuel, a quantity of air in excess of the theoretical minimum is supplied.

Sol. (*d*) Assertion A is not true because excess air is controlled by forced draft fan. However reason R is true. Thus (*d*) is the correct choice.

36. **Assertion A :** The isothermal efficiency of a reciprocating compressor becomes 100% if perfect cooling of the fluid during compression is attained.

Reason R : Work done in a reciprocating compressor is less if the process of compression is isothermal rather than polytropic.

Sol. (*a*) Both assertion and reason are correct and R provides correct explanation for A. Thus (*a*) is the correct choice.

37. **Assertion A :** In turbomachines, stalling is a local phenomenon while surging affects the whole machine.

Reason R : Stalling occurs when flow breaks away from the blades while surging causes complete breakdown of the flow.

Sol. (*a*) Both A and R are true and R provides satisfactory explanation for A. Thus (*a*) is the right choice.

38. **Assertion A :** The driving motor of a fan with backward curved blades cannot be overloaded whatever be the flow rate.

Reason R : The power curve of fan with backward curved blades increases to a maximum at about 70% of the maximum flow rate and then falls.

Sol. (*a*) Both *A* & *R* are true.

39. **Assertion A :** The rate of condensation over a rusty surface is less than that over a polished surface.

Reason R : The polished surface promotes dropwise condensation which does not wet the surface.

Sol. (*a*) Both *A* and *R* are true and *R* provides satisfactory explanation for *A*. Thus (*a*) is the right choice.

40. **Assertion A :** In remote places, the use of absorption refigeration system plant is more advantageous when compared to vapour compression plant.

Reason R : The absorption system can use relatively low temperature heat as energy source.

Sol. (*c*) Assertion *A* is correct but reason is not true. The correct reason should have been that no electricity is required for operation of absorption refrigeration system plant.

41. **Assertion A :** When a circular cylinder is placed normal to the direction of flow, drag force is essentially a function of the Reynolds number of the flow.

Reason R : As Reynolds Number is about 100 and above, eddies formed break away from either side in periodic fashion, forming a meandering street called the Karman Vortex street.

Sol. (*a*) Both *A* and *R* are true and *R* provides a correct explanation of *A*. Thus (*a*) is the right choice.

42. Consider the following statements :

The definition of

1. temperature is due to Zeroth Law of Thermodynamics.
2. entropy is due to First Law of Thermodynamics.
3. internal energy is due to Second Law of Thermodynamics.
4. reversibility is due to Kelvin-Planck's statement.

Of these statements

(*a*) 1, 2 and 3 are correct (*b*) 1, 3 and 4 are correct

(*c*) 1 alone is correct (*d*) 2 alone is correct

Sol. (*c*) Out of 4 definitions given, only first definition is correct and balance three are wrong.

Thus (*c*) is the right choice.

43. Given :

p = pressure,

T = Temperature,

v = specific volume,

which one of the following can be considered as property of a system ?

(*a*) $\int p\ dv$ (*b*) $\int v\ dp$

(*c*) $\int\left(\frac{dT}{T}+\frac{p.dv}{v}\right)$ (*d*) $\int\left(\frac{dT}{T}-\frac{v.dp}{T}\right)$

Sol. (*d*) p is a function of v and both are connected by a line path on p and v coordinates. Thus $\int pdv$ and $\int vdp$ are not exact differentials and thus not properties.

If X and Y are two properties of a system, then dx and dy are exact differentials. If the differential is of the form $Mdx + Ndy$, then the test for exactness is $\left[\frac{\partial M}{\partial y}\right]_x = \left[\frac{\partial N}{\partial x}\right]_y$

Now applying above test for $\int\left(\frac{dT}{T} - \frac{vdP}{T}\right)$

$$\left[\frac{\partial(1/T)}{\partial p}\right]_T = \left[\frac{\partial(-v/T)}{\partial T}\right]_P = \left(\frac{\partial(-R/P)}{\partial T}\right)_P \qquad (\because vp = RT)$$

$$\therefore \qquad O = 0$$

Thus $\left[\frac{dT}{T} - \frac{pdv}{T}\right]$ is exact and may be written as ds, where s is a point function and hence a property

For $\int\left(\frac{dT}{T} + \frac{pdv}{v}\right)$, $\qquad \left[\frac{\partial(1/T)}{\partial v}\right]_T = \left[\frac{\partial(p/v)}{\partial T}\right]_V = \left(\frac{\partial(RT/v^2)}{\partial T}\right)_V$

or $\qquad O = \frac{R}{v^2}$

This differential is not exact and hence is not a point function and hence $\int\left(\frac{dT}{T} + \frac{pdv}{v}\right)$ is not a point function and hence not a property.

Thus (*c*) is the correct answer.

44. Which one of the following systems can be considered to be containing a pure substance ?

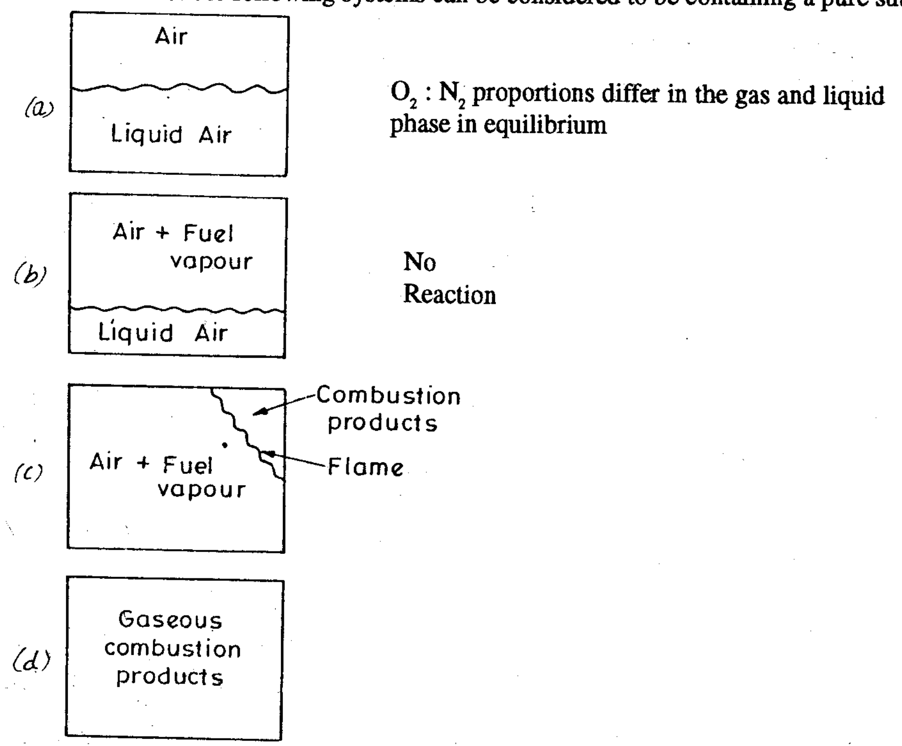

Fig. 8

Sol. (*a*) Air and liquid air can be considered to be containing a pure substance, because air is also considered to be a perfect gas. All other mixtures are not pure substances.

45. Consider the following statements about critical point of water :

1. The latent heat is zero.

2. The liquid is denser than its vapour.

3. Steam generators can operate above this point.

Of these statements

(*a*) 1, 2 and 3 are correct (*b*) 1 and 2 are correct
(*c*) 2 and 3 are correct (*d*) 1 and 3 are correct

Sol. (*d*) At critical point, the latent heat in zero and steam generators can operate above this point as in the case of once through boilers.

The density of liquid and its vapour is however same and thus statement 2 is wrong.Thus correct choice is (*d*).

46. Match List I with List II and select the correct answer using the codes given below the lists :

List I *(Cycle operating between fixed temperature limits)*	**List II** *(Characteristic)*
A. Carnot cycle	1. Efficiency depends upon cut-off ratio and compression ratio
B. Brayton cycle	2. Efficiency depends upon volume compression ratio
C. Otto cycle	3. Efficiency depends only upon pressure ratio
D. Diesel cycle	4. Efficiency depends only upon temperature limits
	5. Efficiency depends upon specific heats of the working substance

Codes :

	A	*B*	*C*	*D*
(*a*)	3	4	2	5
(*b*)	4	2	1	5
(*c*)	4	3	2	1
(*d*)	3	4	5	1

Sol. (*c*) In the case of Carnot cycle ; $\eta = \frac{T_1 - T_2}{T_1}$ and thus depends only upon temperature limits.Thus A matches with 4.

For Brayton cycle, $\eta = 1 - \frac{1}{(r_p)^{\frac{r-1}{r}}}$

i.e. efficiency depends upon only pressure ratio and thus for B, correct choice is 3. These two alone provide correct choice as (c). However it may be noted that efficiency of Otto cycle depends on volumes compression ratio and the efficiency of Diesel cycle depends upon cut off ratio and compression ratio *i.e.* C matches 2 and D matches 1. Accordingly (c) which matches all the above four is the right answer.

47. One reversible heat engine operates between 1600 K and T_2 K, and another reversible heat engine operates between T_2K and 400 K. If both the engines have the same heat input and output, then the temperature T_2 must be equal to

(*a*) 1000 (*b*) 1200
(*c*) 1400 (*d*) 800

Sol. (*d*) Two reversible heat engines operate between limits of

$1600K$ and T_2
and T_2 and $400K$

Both have the same heat input and output,

i.e. $\frac{T_1 - T_2}{T_1}$ is same for both $\therefore \frac{1600 - T_2}{1600} = \frac{T_2 - 400}{T_2}$

or $T_2 = 800K.$

48. A heat engine using lake water at 12°C as source and the surrounding atmosphere at 2°C as sink executes 1080 cycles per min. If the amount of heat drawn per cycle is 57 J, then the output of the engine will be

(*a*) 66 W (*b*) 56 W
(*c*) 46 W (*d*) 36 W

Sol. (*d*) Here $T_1 = 273 + 12 = 285°K$

$T_2 = 273 + 2 = 275°K.$

Heat drawn per cycle = 57J and no. of cycles per mt. = 1080 $= \frac{1080}{60} = 18$ cycles/sec.

$$\eta = \frac{T_1 - T_2}{T_1} = \frac{285 - 275}{285} = \frac{10}{285} = \frac{\text{work}}{\text{heat input}} = \frac{\text{work}}{57}$$

or work done per cycle $= \frac{10 \times 57}{285}$

and work done per sec. $= \frac{570}{285} \times 18$ J/s $= 36$ Watts.

Thus (*d*) is the correct answer.

49. A regenerative steam cycle renders

(*a*) increased work output per unit mass of steam
(*b*) decreased work output per unit mass of steam
(*c*) increased thermal efficiency
(*d*) decreased work output per unit mass of steam as well as increased thermal efficiency.

Sol. (*d*) In regenerative steam cycle, a part of steam is extracted from turbine and utilised to heat up condensate. In this way some work is lost per unit mass of steam corresponding to steam extracted out, but its heat is not wasted to cooling water but conserved within the cycle thus increasing thermal efficiency. Accordingly (*d*) is the correct answer.

50. Which one of the following diagrams represents Otto cycle on temperature (T)-entropy (s) plane ?

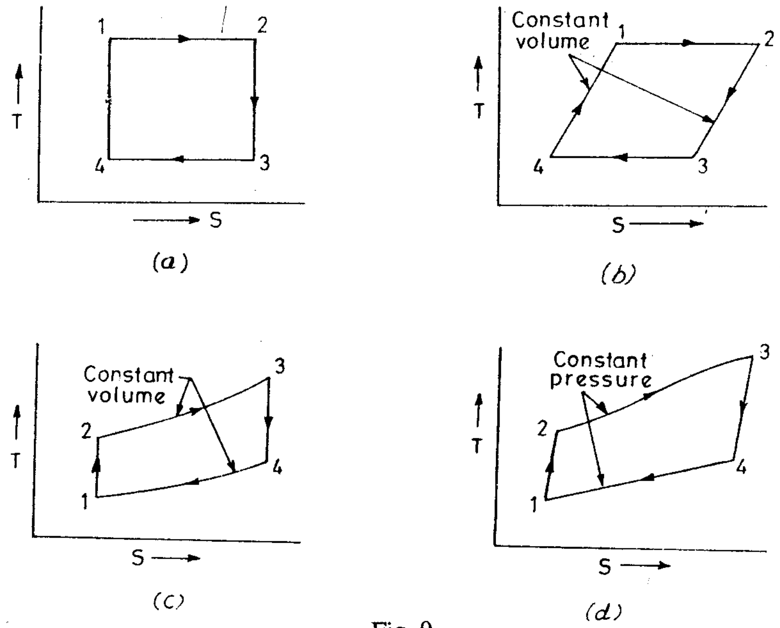

Fig. 9

Sol. (*c*) Otto cycle involves two isentropics and two constant volume processes. Thus (*c*) is the right diagram.

51. For constant maximum pressure and heat input, the air standard efficiency of gas power cycles is in the order

(*a*) Diesel cycle, dual cycle, Otto cycle
(*b*) Otto cycle, Diesel cycle, dual cycle
(*c*) Dual cycle, Otto cycle, Diesel cycle
(*d*) Diesel cycle, Otto cycle, dual cycle

Sol. (*a*) Fig. 10 shows the variation of thermal efficiency of three cycles with variation in compression ratio.

Thus for same heat input and same max. pressure it will be seen that the order of efficiency is diesel, dual, Otto.

i.e. (*a*) provides right answer.

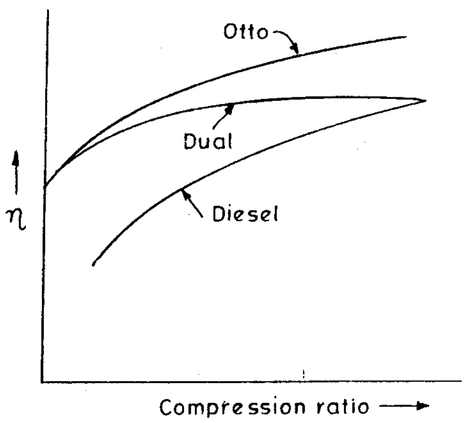

Fig. 10

52. The use of regenerator in a gas turbine cycle

(*a*) increases efficiency but has no effect on output
(*b*) increases output but has no effect on efficiency
(*c*) increases both efficiency and output
(*d*) increases efficiency but decreases output

Sol. (*a*) The addition of regenerator in gas turbine reduces the heat required from external source but work output remains same and efficiency increases. Thus (*a*) is the correct choice.

53. Volumetric analysis of sample of dry products of combustion gave the following results :

CO_2 = 10% CO = 1%

O_2 = 8% N_2 = 81%

Their proportions by weight will be

(*a*) 440 : 28 : 256 : 2268 (*b*) 22 : 14 : 256 : 1134

(*c*) 440 : 14 : 28 : 2268 (*d*) 22 : 28 : 14 : 1134

Sol. (*a*) Conversion from volumetric to gravimetric is done as below :

gas	*% volume*	*Mol. weight*	*Proportional weight*
	(1)	*(2)*	*(1) × (2)*
CO_2	10	44	440
CO	1	28	28
O_2	8	32	256
N_2	81	28	2268

Their proportion by weight are as per (*a*).

54. The minimum weight of air required per kg of fuel for complete combustion of a fuel is given by

(*a*) $11 \cdot 6C + 34 \cdot 8\left(H - \frac{O}{8}\right) + 4 \cdot 35S$ (*b*) $11 \cdot 6C + 34 \cdot 8\left(H + \frac{O}{8}\right) + 4 \cdot 35S$

(*c*) $11 \cdot 6C + 34 \cdot 8\left(H - \frac{O}{8}\right) + 4 \cdot 35S$ (*d*) $11 \cdot 6C + 34 \cdot 8\left(H + \frac{O}{8}\right) + 4 \cdot 35S$

Sol. (*a*) Oxygen required for C, H_2, S and O_2 in fuel respectively is

$$\frac{8}{3}C + 8H_2 + S - O_2$$

or

$$\frac{8}{3}C + 8\left(H_2 - \frac{O_2}{8}\right) + S$$

Since atmospheric air contains 23% by weight of oxygen,

$$\therefore \quad \text{minimum air required per kg of fuel} = \frac{100}{23}\left[\frac{8}{3}C + 8\left(H_2 - \frac{O_2}{8}\right) + S\right]$$

$$= 11 \cdot 6C + 34 \cdot 8\left(H_2 - \frac{O_2}{8}\right) + 4 \cdot 35S.$$

Thus (*a*) is the correct answer.

55. Match List I with List II and select the correct answer using the codes given below the lists :

List I	List II
A. Pre-combustion chamber	1. Compression swirl
B. Turbulent chamber	2. Masked inlet valve
C. Open combustion chamber	3 Spark ignition
D. F-head combustion chamber	4. Combustion induced swirl
	5. M-chamber

Codes :

	A	*B*	*C*	*D*
(*a*)	4	5	3	2
(*b*)	1	3	5	2
(*c*)	2	3	1	5
(*d*)	4	1	2	3

Sol. (*a*) The correct choice is A-4, B-5, C-3, D-2.

56. Consider the following statements comparing I.C. engines and gas turbines :

1. Gas turbines are simple, compact and light in weight.
2. Complete expansion of working substance is possible in I.C. engines and not in gas turbines.
3. There is flexibility in the design of different components of gas turbines as different proceses take place in different components.
4. Even low grade fuels can be burnt in gas turbines.

Of these statements

(*a*) 1, 2 and 3 are correct (*b*) 1, 3 and 4 are correct
(*c*) 2, 3 and 4 are correct (*d*) 1, 2 and 4 are correct

Sol. (*a*) Low grade fuel can't be burnt in gas turbine since it leads to poor life of turbine blades, etc. First three statements are correct.

57. Which of the following factors increase detonation in the SI engine ?

1. Increased spark advance.
2. Increased speed.
3. Increased air-fuel ratio beyond stoichiometric strength.
4. Increased compression ratio.

Select the correct answer using the codes given below :

Codes :

(*a*) 1 and 3 (*b*) 2 and 4
(*c*) 1, 2 and 4 (*d*) 1 and 4

Sol. (*d*) Detonation in the S.I. engines is increased by increasing spark advance and increased compression. The increased speed and lean mixtures do not have much influence.Thus 1 and 4 are correct statements and (*d*) is the right choice.

58. Which one of the following curves is a proper representation of pressure differential (*y*-axis) *vs* velocity of air (*x*-axis) at the throat of a carburettor ?

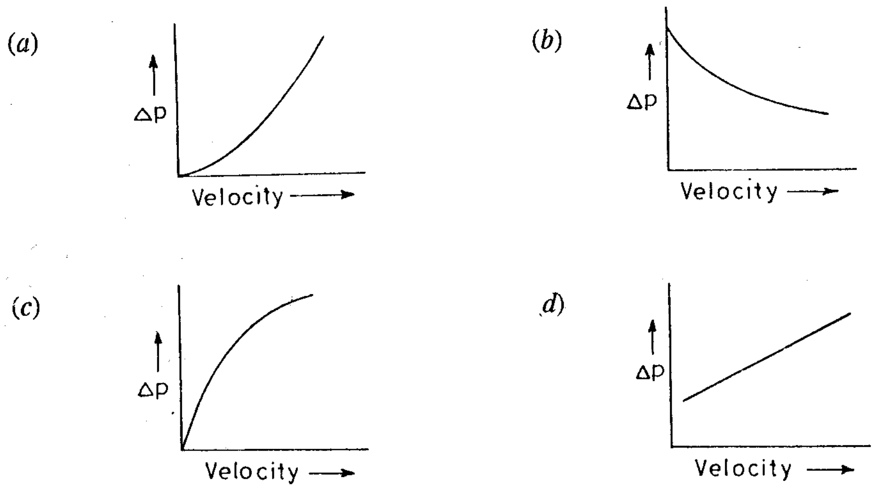

Fig. 10

Sol. (*c*) The relationship between ΔP & v is $\Delta P \propto v^2$ which is represented by curve (*c*).

59. Match List I with List II and select the correct answer using the codes given below the lists :

List I *(Elements of a complete carburettor)*	**List II** *(Rich-mixture requirement)*
A. Idling system	1. To compensate for dilution of charge
B. Economiser	2. For cold starting
C. Acceleration pump	3. For meeting maximum power range of operation
D. Choke	4. For meeting rapid opening of throttle

Codes :

	A	*B*	*C*	*D*
(*a*)	1	2	3	4
(*b*)	1	3	4	2
(*c*)	2	3	4	1
(*d*)	4	1	2	3

Sol. (*b*) The idling system is used to compensate for dilution of charge, economiser is for meeting maximum power range of operation, acceleration pump for meeting rapid opening of throttle valve, and choke is used for cold starting.

Thus (*b*) is the right code.

60. Match List I with List II and select the correct answer using the codes given below the lists :

List I *(S.I. Engine problem)*	**List II** *(Characteristic of fuel responsible for the problem)*
A. Cold starting	1. Front end volatility
B. Carburettor icing	2. Mid-range volatility
C. Crankcase dilution	3. Tail end volatility

Codes :	A	B	C
(a)	1	2	3
(b)	1	3	2
(c)	2	3	1
(d)	3	1	2

Sol. **(a)** Code (a) provides correct matching.

61. Besides mean effective pressure, the data needed for determining the indicated power of an engine would include

(a) piston diameter, length of stroke and calorific value of fuel
(b) piston diameter, specific fuel consumption and calorific value of fuel
(c) piston diameter, length of stroke and speed of rotation
(d) specific fuel consumption, speed of rotation and torque

Sol. **(c)** Indicated power is concerned with $p_m LAN$, *i.e.* mean effective pressure, length of stroke, piston diameters and speed of rotation.

Thus (c) is the right choice.

62. For a typical automobile C.I. engine, for conditions of increasing engine speed match List I with List II and select the correct answer using the codes given below the lists :

List I (Performance parameter)	List II (Tendency, qualitatively)
A. Power output	1. Increasing and then decreasing
B. Torque	2. Decreasing and then increasing
C. Brake specific fuel consumption	3. Increasing throughout the range
	4. Decreasing throughout the range

Codes :	A	B	C
(a)	1	2	3
(b)	1	4	3
(c)	2	3	4
(d)	3	1	2

Sol. **(d)** Code (d) provides the correct matching.

63. Consider the following statements :

I. The performance of an S.I. engine can be improved by increasing the compression ratio.

II. Fuels of higher octane number can be employed at higher compression ratio.

Of these statements

(a) both I and II are true
(b) both I and II are false
(c) I is true but II is false
(d) I is false but II is true

Sol. **(d)** The performance of S.I. engine can't be improved by increasing the compression ratio because of preignition and detonation.

Since high octane number tends to suppress detonation, to some extent fuels of higher octane number will be helpful at higher compression ratio.

Thus (*d*) is the best answer.

64. Match List I with List II and select the correct answer using the codes given below the lists :

List I (*Name of Propellant*)	**List II** (*Type of propellant*)
A. Nitric acid	1. Fuel
B. Hydrogen	2. Monopropellant
C. Fuming nitric acid-hydrazine	3. Oxidizer
D. Methyl nitratemethyl alcohol	4. Compounded liquid monopropellant
	5. Hypergolic propellant

Codes :	*A*	*B*	*C*	*D*
(*a*)	2	1	4	5
(*b*)	1	2	5	4
(*c*)	3	1	5	4
(*d*)	3	1	4	5

Sol. (*c*) Code (*c*) provides the correct choice.

65. Match List I with List II and select the correct answer using the codes given below the lists :

List I	**List II**
A. Fast Reactor	1. Breeding
B. Sodium Cooled Reactor	2. Graphite
C. Pressurized Water Reactor	3. Magnetic Pump
D. Gas-cooled Reactor	4. Natural uranium

Codes :	*A*	*B*	*C*	*D*
(*a*)	1	3	4	2
(*b*)	1	4	2	3
(*c*)	3	1	2	4
(*d*)	3	1	4	2

Sol. (*a*) The correct code is (*a*) since fast reactor is related with breeding, magnetic pump is needed for sodium cooled reactor, mainly natural uranium (with some enriched uranium) is used in pressurised water reactor, and graphite is moderator for gas cooled reactor.

66. The energy released in the fission of one U-235 nucleus is approximately

(*a*) 100 MeV (*b*) 200 MeV

(*c*) 300 MeV (*d*) 400 MeV

Sol. (*b*) The energy released in the fission of one U-235 nucleus is approximately 200 MeV.

67. Which one of the following modes of heat transfer would take place predominantly, from boiler furnace to water wall ?