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06CIV13/23

First/Second Semester B.E. Degree Examination, December 2010
Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing at least two from each part.*
2. Answer all objective type questions only on OMR sheet page 5 of the answer booklet.
3. Answer to objective type questions on sheets other than OMR will not be valued.

PART – A

1 a. Select the correct answer:

i) Surveying deals with
A) Sub soil exploration B) Estimation of quality and quantity of surface and subsurface water
C) Determination of correct distance between objects or stations
D) Design of super structure and substructures.

ii) Infrastructure development focuses on providing
A) Transportation facilities B) Water system and drainage facilities
C) Power supply and communication facilities D) All of these.

iii) Dams are
A) Constructed to cross a channel or flowing water B) Barrier or obstacle constructed across a water stream
C) Constructed across a tunnel D) None of the above.

iv) The roads connecting important towns, areas of production and market places, connecting with each other or with the main highway of a district are
A) Major district roads B) Arterial roads C) Expressways D) None of these. **(04 Marks)**

b. Briefly explain scope of the following in civil engineering:
i) Surveying ii) Geotechnical engineering iii) Hydraulics. **(09 Marks)**

c. What are the different types of roads? Explain. Also, sketch a typical cross-section of a road. **(07 Marks)**

2 a. Select the correct answer:

i) IF a number of forces are acting simultaneously on a particle, then each of them will produce the same effect, which it would have done while acting alone. This is known as:
A) The principle of physical independence of forces B) The principle of transmissibility of forces
C) The principle of resolution of forces D) None of the above.

ii) IN order to determine the effects of forces acting on a body, we must know
A) its magnitude and point at which it acts on the body B) direction of the line along which it acts
C) their nature (whether push or pull) D) All of the above.

iii) Free body diagram of a body shows
A) A body isolated from all external forces
B) A body isolated from all its surroundings and all external forces acting on it
C) A body shown separately from its surroundings and all external and internal forces acting on it
D) None of the above.

iv) The effect of a couple is unchanged if
A) the couple is rotated trough any angle B) the couple is shifted to any other position
C) the couple is replaced by another pair of forces, whose rotational affects are the same
D) All of the above. **(04 Marks)**

b. Classify the systems of forces & their characteristics with an illustration. **(10 Marks)**

c. Reduce the system shown in Fig.Q2(c), to (i) single force (ii) single force and couple at A (iii) single force and couple at B **(06 Marks)**

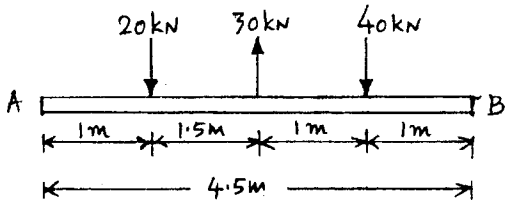

Fig.Q2(c)

3 a. Select the correct answer:

i) If a force F makes an angle θ with x-axis, the components of force with respect to x-axis and y-axis, respectively, are

A) F cosθ, F sinθ B) F sinθ, F cosθ C) F tanθ, F sinθ D) F sinθ, F secθ

ii) Direction of the resultant force can be determined by

A) $\tan\theta = \left(\frac{\Sigma V}{\Sigma H}\right)$ B) $\tan\theta = \left(\frac{\Sigma H}{\Sigma V}\right)$

C) $\tan\theta = \sqrt{(\Sigma H)^2 + (\Sigma V)^2}$ D) None of these

iii) Varignon's principle of moments can be stated as

A) Moment of resultant force R about 'X' = Moment of force P about 'X' × Moment of force Q about 'X'

B) Moment of resultant force R about 'X' = Moment of force P about 'X' ÷ Moment of force Q about 'X'

C) Moment of resultant force R about 'X' = Moment of force P about 'X' + Moment of force Q about 'X'

D) None of the above.

iv) Moment of a force is defined as

A) Linear effect of a force about a point B) Rotational effect of a force about a point

C) Turbulent effect of a force about a point D) All of these **(04 Marks)**

b. The four coplanar forces acting at a point are as shown in Fig.Q3(b). One of the forces is unknown and its magnitude is as shown by 'F'. The resultant is 500 N and is along x-axis. Determine the force 'F' and its inclination θ with x-axis. **(06 Marks)**

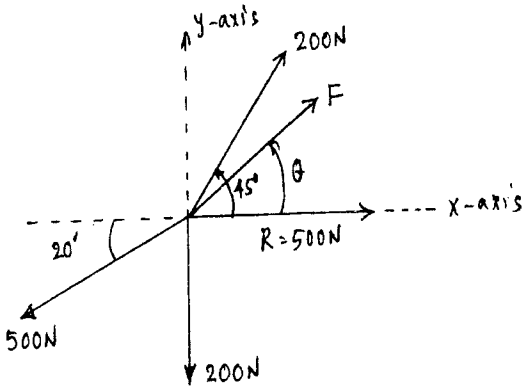

Fig.Q3(b)

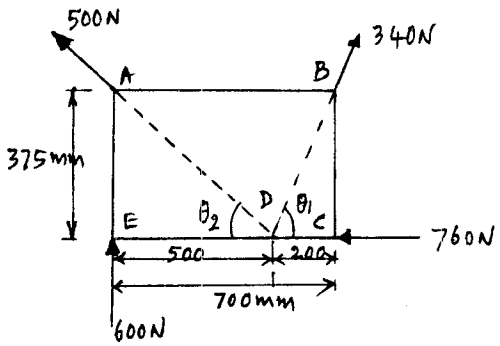

Fig.Q3(c)

c. Four forces act on a 700mm×375mm plate as shown in Fig.Q3(c). Find (i) the resultant of these forces (ii) locate the point where the line of action of the resultant intersects the edge AB of the plate. **(10 Marks)**

4 a. Select the correct answer:

i) The centre of gravity is a point

A) at which the whole area of the plane figure is concentrated

B) at which the whole volume of the body is concentrated

C) at which the whole weight of the body acts

D) All of the above

ii) The centroid in x-direction in general is

A) $\frac{\Sigma a}{\Sigma ax}$ B) $\frac{\Sigma ax}{\Sigma a}$ C) $\Sigma ax \times \Sigma a$ D) $\Sigma ax + \Sigma a$

iii) The centroid of a right angled triangle, with base as x-axis and opposite side as y-axis is

A) 1/3rd of h, 1/3rd of b B) 2/3rd of b, 2/3rd of h

C) 1/3rd of b, 2/3rd of h D) 2/3rd of b, 1/3rd of h

iv) The centroid of a circle with its origin as axes is given by

A) r, r B) 0, 0 C) 0, 4r/3π D) 4r/3π, 0 **(04 Marks)**

b. Locate the centroid of a triangle, from the first principles. **(06 Marks)**

c. Determine the location of the centroid of the shaded portion of the lamina, shown in Fig.Q4(c), with respect to the origin 'O'. **(10 Marks)**

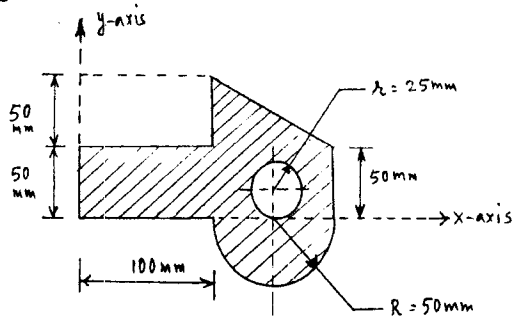

Fig.Q4(c)

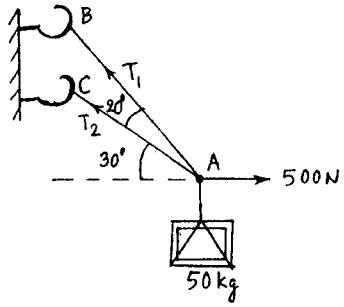

Fig.Q5(b)

PART – B

5 a. Select the correct answer:

i) An equilibrant is a force
A) unequal in magnitude, opposite in direction and collinear with the resultant
B) equal in magnitude, opposite in direction and non-collinear with the resultant
C) equal in magnitude, opposite in direction and collinear with the resultant
D) unequal in magnitude, opposite in direction and non-collinear with the resultant

ii) Equilibrium equations are
A) $\Sigma H = 0$ B) $\Sigma V = 0$ C) $\Sigma M = 0$ D) All of these

iii) Lami's theorem is applicable for
A) Coplanar forces B) Concurrent forces
C) Coplanar and concurrent forces D) Any types of forces.

iv) For a smooth spherical surface, reaction acts
A) inclined to the plane of contact B) perpendicular to the plane of contact
C) horizontal to the plane of contact D) All of these. **(04 Marks)**

b. Determine the tension in cables AB and AC required to hold a 50 kg crate, shown in Fig.Q5(b). Take g = 9.81 m^2/sec. **(06 Marks)**

c. A system of connected flexible cables shown in Fig.Q5(c), is supporting two vertical forces 200 N and 250 N at points B and D. Determine the forces in various segments of the cable. **(10 Marks)**

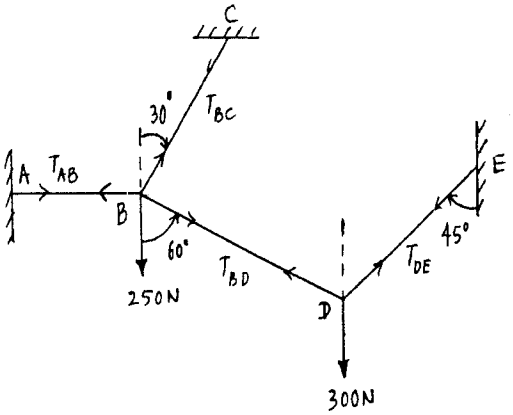

Fig.Q5(c)

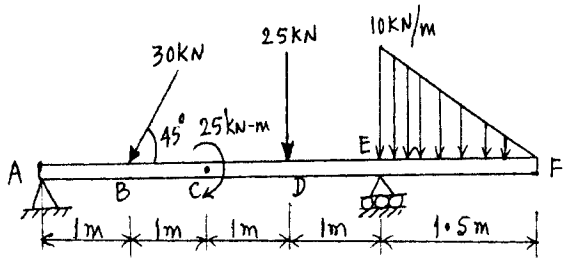

Fig.Q6(c)

6 a. Select the correct answer:

i) When the reaction at a support consists of a moment, a vertical force and a horizontal force, then that support is called as
A) Hinged support B) Roller support C) Fixed support D) Simple support

ii) A single span beam is statically determinate when
A) both the ends are fixed B) One end is fixed, other end is simply supported
C) One end is hinged and other is roller supported D) Both ends are hinged.

iii) A beam AB is fixed at one end, free at the other, and loaded by a concentrated load W at the free end. Then developed reaction R_A, will be equal to
A) W/3 kN B) W kN C) W/2 kN D) 2W/3 kN

iv) If W kN/m uniformly distributed load is acting on a simply supported beam AB, then reactions R_A and R_B will be equal to

A) W/3 kN,2W/3 kN B) W/4 kN,3W/4 kN C) 2W/3 kN,W/3 kN D) W/2 kN,W/2 kN **(04 Marks)**

b. What are the types of loads and supports a beam may have? **(06 Marks)**

c. A beam ABCDEF is hinged at A, supported on rollers at E and carries loads as shown in Fig.Q6(c). Determine the reactions at the supports. **(10 Marks)**

7 a. Select the correct answer:

i) Static friction is defined as

A) The friction acting on a body, when the contact surfaces are lubricated.

B) The friction acting on a body, which is actually in motion

C) The friction acting on a body, which is at rest

D) All of the above.

ii) If a body is placed on an inclined plane, then, the angle at which the body is just at the point or verge of sliding down, is called

A) Angle of friction B) Cone of friction C) Coefficient of friction D) Angle of repose.

iii) The magnitude of the force of friction between two bodies, one lying above the other, depends upon the roughness of the

A) upper body B) lower body C) both the bodies D) the body having more roughness

iv) A uniform ladder of weight W and length 'L' rests on horizontal ground and leans on a rough vertical wall with angle '0'. When a man stands on the ladder, the ladder slips towards

A) left at the ground and towards up at the wall

B) left at the ground and towards down at the wall

C) right at the ground and towards up at the wall

D) right at the ground and towards down at the wall **(04 Marks)**

b. Explain : i) Types of friction ii) Laws of friction **(06 Marks)**

c. A 4m ladder weighing 200 N is placed against a vertical wall is shown in Fig.Q7(c). As a man weighing 800 N, reaches a point 2.7m from A, the ladder is about to slip. Assuming that the coefficient of friction between the ladder and the wall is 0.2, determine the coefficient of friction between the ladder and the floor. **(10 Marks)**

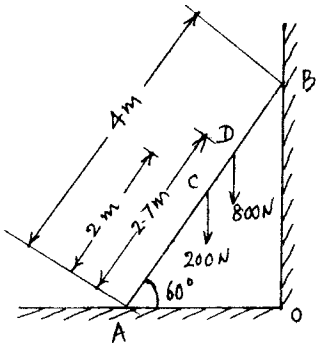

Fig.Q7(c)

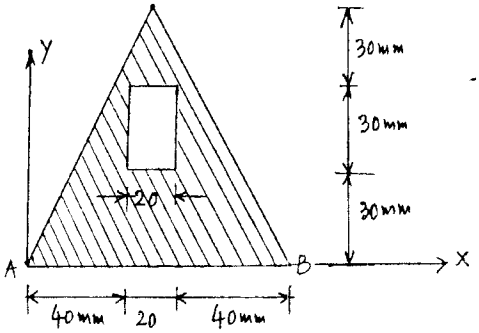

Fig.Q8(c)

8 a. Select the correct answer:

i) Radius of gyration way be defined mathematically as

A) $\sqrt{\frac{A}{I}}$ B) $\sqrt{\frac{I}{A}}$ C) $\frac{I}{A}$ D) $\frac{A}{I}$

ii) Moment of inertia of a plane area about 1-1 axis parallel to centroidal axis is equal to

A) $\frac{I_{xx}}{A\bar{y}^2}$ B) $I_{xx} \times A\bar{y}^2$ C) $I_{xx} - A\bar{y}^2$ D) $I_{xx} + A\bar{y}^2$

iii) The moment of inertia of triangle about the base is given by

A) $\frac{\pi}{64}(D^4 - d^4)$ B) $\frac{bh^3}{36}$ C) $\frac{bh^3}{12}$ D) $\frac{\pi d^3}{256}$

iv) Moment of inertia of a semicircle about centroidal axis is given by

A) $0.055\ r^4$ B) $0.11\ r^4$ C) $0.11\ d^4$ D) $\frac{\pi d^4}{64}$ **(04 Marks)**

b. State and prove the parallel axis theorem. **(04 Marks)**

c. Determine the moment of inertia and radii of gyration of the area shown in Fig.Q8(c), about the base AB and the centroidal axis parallel to AB. **(12 Marks)**

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10CIV13

First Semester B.E. Degree Examination, January 2011
Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, choosing at least two from each part.***
2. ***Answer all objective type questions only on OMR sheet page 5 of the answer booklet.***
3. ***Answer to objective type questions on sheets other than OMR will not be valued.***

PART – A

1 a. Choose the correct answer :

i) Geotechnical engineering involves the study of
A) Water B) Soil C) Air D) All of these.

ii) Shoulders are the components of
A) Roads B) Bridges C) Buildings D) Dams

iii) A bridge constructed at some angle to the river flow is
A) Skew bridge B) Square bridge C) Steel bridge D) Lift bridge

iv) A bascule bridge is a
A) Floating bridge B) Arch bridge C) Suspension bridge D) Movable bridge

(04 Marks)

b. Explain the types of roads as per the Nagpur-road plan. **(06 Marks)**

c. Draw a neat cross-section of the gravity dam and mark important features on it. **(04 Marks)**

d. Explain the following bridges, with neat sketches:
i) Suspension bridge ii) Arch bridge **(06 Marks)**

2 a. Choose the correct answer :

i) Effect of a force on a body depends in
A) Magnitude B) Direction C) Position or line of action D) All of these.

ii) When trying to turn a key into a lock, following is applied.
A) Coplanar forces B) Moment C) Lever D) Couple.

iii) A single force and a couple acting in the same plane upon a rigid body
A) Balance each other B) Can not balance each other
C) Produce moment of a couple D) One equivalent.

iv) Moment of a force
A) occurs about a point B) measures the capacity to do useful work
C)occurs when bodies are in motion D)measures the ability to produce turning about axes

(04 Marks)

b. State the law of transmissibility of force. **(02 Marks)**

c. Differentiate between the resultant and the equilibrant. **(04 Marks)**

d. Determine the angle α for which the moment of the 500 N force shown in Fig.Q2(d), is maximum about 'O'. Also, find the maximum moment. **(10 Marks)**

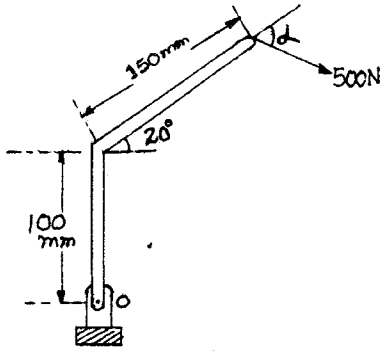

Fig.Q2(d)

3 a. Choose the correct answer :

i) Two forces each equal to P/2 act at right angles. Their effect may be neutralized by the third force, acting along their bisector in the opposite direction, with a magnitude of

A) P B) $\sqrt{2}P$ C) – P/2 D) $P/\sqrt{2}$

ii) In a coplanar concurrent forces system, if $\Sigma V = 0$, then the resultant is

A) Horizontal B) Vertical C) Moment D) None of these

iii) The Varignon's theorem is not applicable for the forces, which are

A) coplanar non-cocurrent B) non-coplanar, non-concurrent

C) concurrent D) parallel.

iv) The magnitude of the resultant of two forces of magnitudes P and $\sqrt{2}$ P is "P". Then the angle between the two forces is

A) 135° B) 90° C) 45° D) 30° **(04 Marks)**

b. The sum of the two concurrent forces P and Q is 500 N and their resultant is 400N. If the resultant is perpendicular to "P", find P, Q and the angle between P and Q. **(06 Marks)**

c. The forces acting on 1m length of a dam are shown in Fig.Q3(c). Determine the resultant force acting on the dam. Calculate the point of intersection of the resultant with the base. **(10 Marks)**

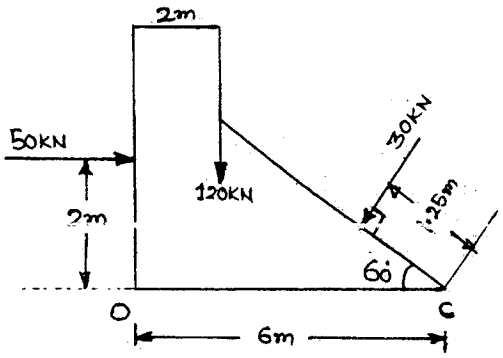

Fig.Q3(c)

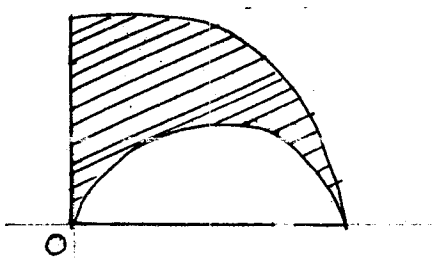

Fig.Q4(c)

4 a. Choose the correct answer :

i) The centre of gravity of a plane lamina will not be its geometrical centre if it is a

A) Square B) Rectangle C) Right angled triangle D) Equilateral triangle

ii) The centroid of an equilateral triangle of side 'a' is ____from any of the three sides,

A) $\frac{a\sqrt{3}}{2}$ B) $\frac{a\sqrt{2}}{3}$ C) $\frac{a}{2\sqrt{3}}$ D) $\frac{a}{3\sqrt{2}}$

iii) The centroid of a semicircle of radius (r), with respect to its base is

A) $3r/3\pi$ B) $3r/8\pi$ C) $4r/3\pi$ D) $4r/\pi$.

iv) Moment of the total area about its centroidal axis is

A) Twice the area B) Three times the area C) Zero D) None of these. **(04 Marks)**

b. Determine the centroid of a sector of radius r by the method of integration. **(06 Marks)**

c. Find the centroid of the shaded area shown in Fig.Q4(c), obtained by cutting a semicircle of diameter 100m from the quadrant of a circle of radius 100mm. **(10 Marks)**

PART – B

5 a. Choose the correct answer :

i) A free body diagram is a diagram

A) drawn by free hand B) of a body suspended freely in air

C) of a body in vacuum, free from any influence from the surroundings

D) drawn by detaching the body from its attachments with surroundings and replacing the attachments with force vector.

ii) A particle acted upon by the two forces of equal magnitude is in equilibrium. The angle between the forces is

A) 0° B) 90° C) 180° D) 45°

iii) If a body is in equilibrium, it is concluded that
A) no force is acting on the body B) the resultant of all the forces acting on it is zero
C) the moment of the forces about any point is zero D) Both (B) and (C).

iv) Three forces of magnitudes F_1=100N, F_2=100N and $F_3=100\sqrt{3}$ N act on a particle in a plane. The particle remains in equilibrium, only if the angle between F_1 and F_2 is
A) 30° B) 45° C) 60° D) 90° **(04 Marks)**

b. A 3 kN crate is to be supported by a rope and pulley arrangements shown in Fig.Q5(b). Determine the magnitude and direction of the force 'F', which should be exerted at the free end of the rope. **(06 Marks)**

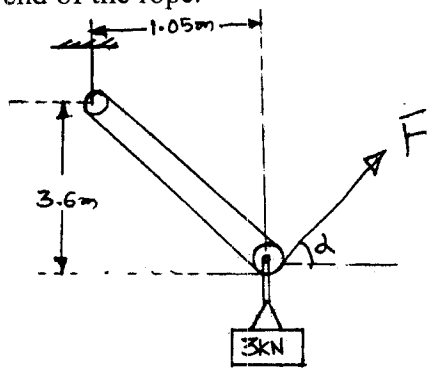

Fig.Q5(b)

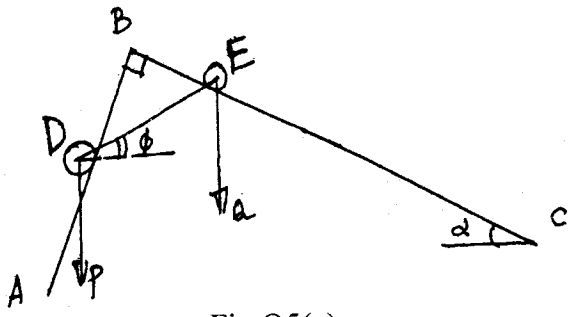

Fig.Q5(c)

c. Two rollers of weights "P" and "Q" are connected by a flexible string DE and rest on two mutually perpendicular planes AB and BC as shown in Fig.Q5(c). Find the tension (T) in the string and angle "ϕ", that it makes, with the horizontal, when system is in equilibrium. Given P = 600N, Q = 1000N, α = 30°. Assume that the string is inextensible and passes freely through the slots in the smooth inclined planes AB and BC. **(10 Marks)**

6 a. Choose the correct answer :

i) Fixed beams have
A) one end fixed & other end simply supported B) both ends fixed
C) both ends roller supported D) one end fixed & other end free.

ii) GVL stands for
A) General varying load B) Gradually vertical load
C) Gradually varying load D) General variable load.

iii) A truss is perfect when
A) m = 2J – 3 B) 2J = m + 3 C) m = 3J – 2 D) 2J = m – 3

iv) The minimum number of members to form a perfect truss is
A) 1 B) 2 C) 3 D) 4 **(04 Marks)**

b. Determine the reactions at the supports A and B, for the beam shown in Fig.Q6(b). **(06 Marks)**

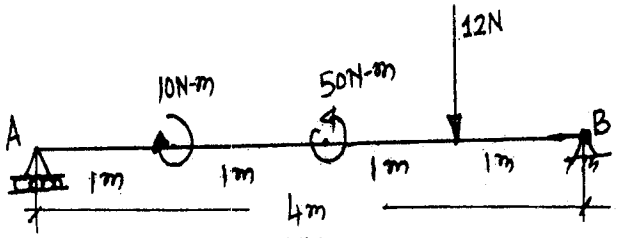

Fig.Q6(b)

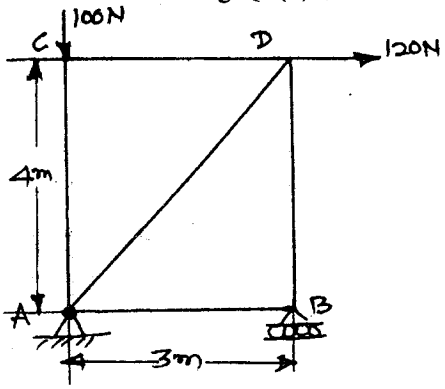

Fig.Q6(c)

c. Find the support reactions and member forces for the pin-jointed plane truss shown in Fig.Q6(c), by method of joints. **(10 Marks)**

7 a. Choose the correct answer :

i) The angle which an inclined surface makes with the horizontal, when a body placed on it is on the point of moving down, is known as,
A) angle of friction B) angle of limiting friction
C) angle of inclination D) angle of repose.

ii) If the angle of friction is zero, a body will experience
A) infinite friction B) zero friction
C) the force of friction normal to the plane
D) the force of friction in the direction of motion.

iii) The coefficient of friction depends on
A) area of contact B) shape of the surface C) strength of the surface D) All of these.

iv) The tangent of the angle of friction is of
A) angle of repose B) coefficient of friction C) cone of friction D) limiting friction.

(04 Marks)

b. i) Define : A) Angle of friction (ϕ), B) Coefficient of friction (μ). **(02 Marks)**

ii) Determine the value of "θ" for impending motion of the blocks. Take coefficient of friction (μ) for all contact surfaces as 0.25. [Refer Fig.Q7(b)(ii)]. **(06 Marks)**

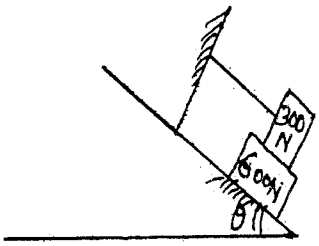

Fig.Q7(b)(ii)

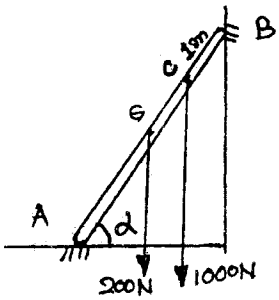

Fig.Q7(c)

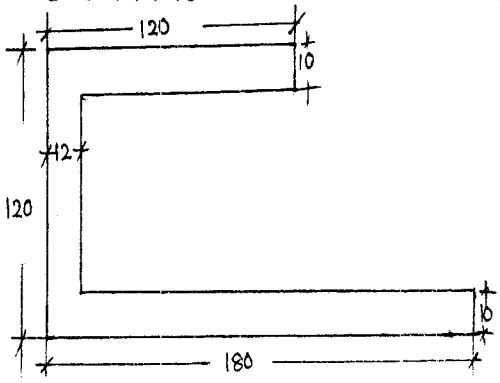

Fig.Q8(c)

c. The ladder shown in Fig.Q7(c), is 4m long and is supported by a horizontal floor and vertical wall. The coefficient of friction at the wall is 0.25 and at the floor is 0.50. The weight of the ladder is 200 N, considered concentrated at "G". The ladder supports a vertical load of 1000N at "C". Determine the reactions at A and B and compute the least value of "α" at which, the ladder may be placed without slipping. **(08 Marks)**

8 a. Choose the correct answer :

i) The ratio of the moment of inertia for triangle (b×h) coinciding with its base to a centroidal axis parallel to the base is
A) $bh^3/2$ B) $bh^3/4$ C) $bh^3/8$ D) $bh^3/12$

ii) The radius of gyration of a circular area of radius "r" is
A) r/2 B) r/4 C) 2r/3 D) 3r/4

iii) The unit of moment of inertia of an area is
A) kg.m B) $kg.m^2$ C) $kg.m^4$ D) m^4

iv) If I_G is the moment of inertia of a rectangle about its centroidal axis and I_{AB} is the moment of inertia about its base then
A) $I_G > I_{AB}$ B) $I_G < I_{AB}$ C) $I_G = I_{AB}$ D) None of these. **(04 Marks)**

b. Derive the expression for the moment of inertia of a semicircular lamina of radius (r) about its centroidal axis parallel to the diameter. **(04 Marks)**

c. Determine the radius of gyration about the centroidal axes for the lamina shown in Fig.Q8(c). All dimensions are in mm. **(12 Marks)**

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