17350

16172

3 Hours / 100 Marks Seat No. | | | | | | | | |

Instructions : (1) All Questions are *compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

Marks

1. Attempt any TEN of the following : **2 × 10 = 20**

(a) Define mechanics.

(b) Define rigid body.

(c) State four characteristics of force.

(d) Define free body diagram with neat sketch.

(e) State the conditions of equilibrium for concurrent force system.

(f) Define angle of repose.

(g) State the Law of friction.

(h) Locate the C.G. of solid cylinder of height 120 mm and diameter 60 mm.

(i) Locate the centroid of quarter circle of radius 50 mm.

(j) Distinguish between input and output of a machine.

(k) What is self locking machine ?

(l) Define ductility.

2. Attempt any FOUR of the following : **4 × 4 = 16**

(a) Two force of 200 kN and 400 kN acting at and away from the point and making an angle of 45° with each other. Find the resultant in magnitude and direction.

(b) A square ABCD has force acting along its sides as shown in Fig. No. (1). Find the value of resultant of the force system with respect to A point.

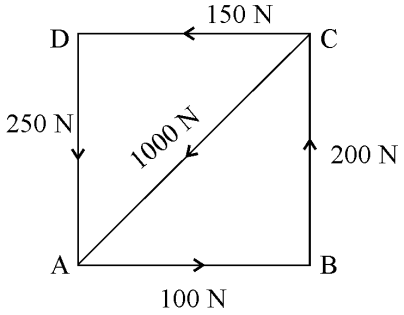


Fig. No. (1)

(c) Determine analytically magnitude, direction and position with respect to 10 kN force of given force system as shown in Fig. No. (2).

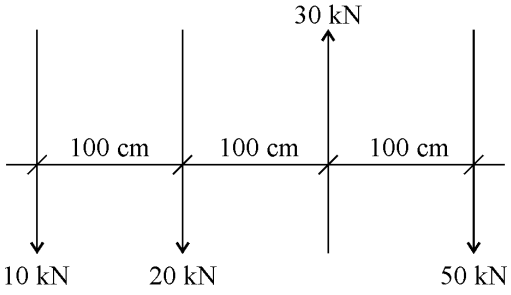


Fig. No. (2)

(d) Solve graphically Q. No. 2(c) for Resultant in both magnitude and direction w.r.t. point 10 kN force.

(e) The forces 20 N, 30 N, 40 N, 50 N, 60 N are acting at one of the angular points of a regular hexagon towards the other five angular points, taken in order. Find the magnitude and direction of the resultant force.

(f) Distinguish between scalar quantity and vector quantity and give two examples of each.

3. Attempt any FOUR of the following : **16**

(a) A body of weight 500 N is lying on a rough horizontal plane having a coefficient of friction as 0.3. Find the magnitude of the force, which can move the body while acting at an angle of 30° with the horizontal.

(b) An inclined plane as shown in Fig. No. (3) is used to unload slowly a body weighing 400 N from a truck 1.2 m high into the ground. The coefficient of friction between the underside the body and the plank is 0.3. State whether it is necessary to push the body down the plane or hold it back from sliding down. What minimum force is required parallel to the plane for this purpose ?

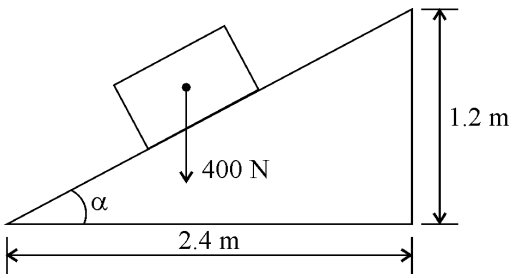


Fig. No. (3)

(c) State any four types of beams with neat sketch.

(d) An electric bulb of weight 20 N hangs vertically from a ceiling. Its wire is pulled by a horizontal force P, such that its wire makes an angle of 20° with vertical. Find force 'P' and torsion in wire.

(e) A smooth circular cylinder of radius 1.5 m is lying in a triangular groove, one side of which makes 15° angle and the other 40° angle with the horizontal. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weighs 100 N.

(f) A beam AB 6 m long rests on two supports 4 m apart, the right hand end is overhanging by 2 m. The beam carries a UDL of 10 kN/m over the entire length of the beam. Determine the reactions at the two supports.

4. Attempt any FOUR of the following : 16

(a) An I-section has the following dimensions – Bottom flange = 300 × 100, Top flange = 150 × 50, web = 300 × 50. Determine the position of centroid. (All dimensions are in mm.)

(b) A body consists of a right circular solid cone of height 40 mm and radius 30 mm placed on a solid hemisphere of radius 30 mm and axis are coincide and are of the same material. Find the position of C.G. of the body.

(c) A semicircular area is removed from a trapezium as shown in Fig. No. (4). All dimensions are in mm. Locate centroid ($\bar{x}$ & $\bar{y}$).

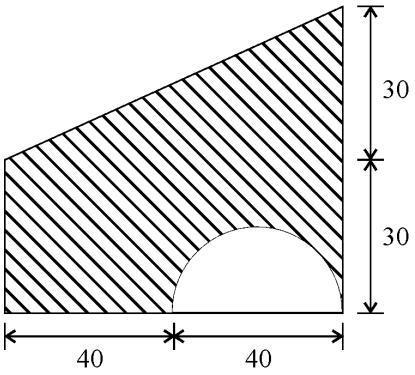
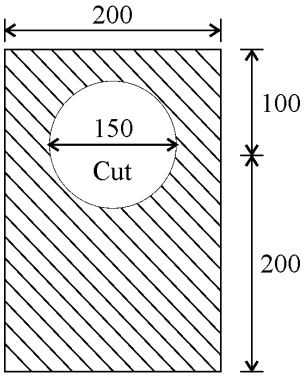


Fig. No. (4)

(d) Find the C.G. of a given Fig. No. (5). Circle is removed. All dimensions are in mm.



(e) Distinguish between static friction and dynamic friction.

(f) A body of weight of 800 N resting on a inclined plane at an angle of 30° with the horizontal just started to move down the plane. Calculate the coefficient of friction.

P.T.O.

5. Attempt any FOUR of the following : **16**

(a) Draw a neat sketch of single purchase crab showing all components and names.

(b) An effort of 1000 N is required to lift a load of 25 kN. On this machine an effort of 1500 N lifts a load of 36 kN. Find the law of machine.

(c) Define reversible and non-reversible machine. State the conditions of reversibility of a machine.

(d) In a certain weight lifting machine, a weight of 1 kN is lifted by an effort of 25 N. While the weight moves up by 100 mm, the point of application of effort moves by 8 m. Find mechanical advantage and velocity ratio and percentage of efficiency of the machine.

(e) The larger and smaller diameters of differential wheel and axle are 80 mm and 20 mm respectively. The effort is applied to the wheel of diameter 250 mm. What is the VR ? Also calculate the efficiency when a load of 1050 N is lifted by an effort of 25 N.

(f) Write the relation between MI, area and radius of gyration. State SI units of them. Calculate the radius of gyration of a circular lamina of diameter 80 mm about its diameter.

6. Attempt any TWO of the following : **8 × 2 = 16**

(a) The bar is as shown in Fig. No. (6). Find stresses in the three parts and total extension of the bar. Take $E = 2 \times 10^5$ N/mm^2.

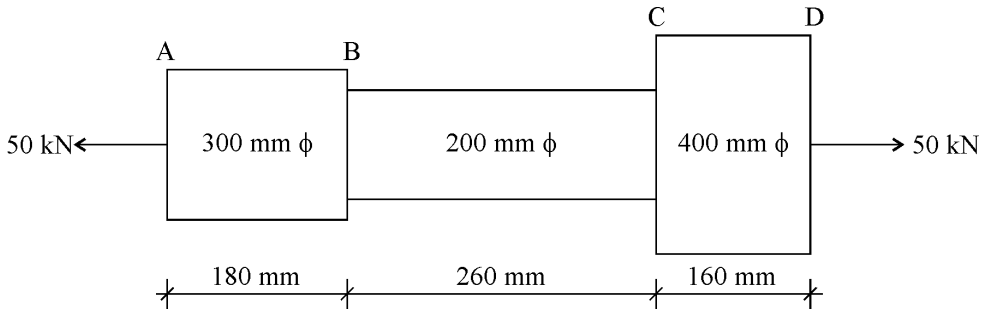


Fig. No. (6)

(b) State Hook's law and draw stress-strain curve for mild steel under tensile bading. Also explain the behaviour of the material with respect to salient points on the graph. Define any two of the points on the graph.

(c) Find the angle of twist per metre length of a hollow shaft of 100 mm external and 60 mm internal diameter, if the shear stress is not to exceed 35 MPa. Take modulus of rigidity (c) = 85 GPa.

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