

17204

16172

3 Hours / 100 Marks

Seat No.

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- 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.
 - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Answer any TEN of the following :

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- (a) Explain the term law of machine.
- (b) How will you find whether machine is reversible or not ?
- (c) State V.R. of simple axle & wheel.
- (d) Differentiate between statics & dynamics.
- (e) What is Unit Newton force ?
- (f) State parallelogram law & forces of derive the equations for magnitude & direction of resultant force.
- (g) State Varignon's theorem.
- (h) What are the limitations of Lami's theorem ?
- (i) Differentiate between resultant & equilibrant.

- (j) What are the two advantages of friction ?
- (k) Define Angle of repose.
- (l) What is the relation between coefficient of friction & angle of repose ?
- (m) Calculate & show the centroid of circle of 50 mm diameter.
- (n) Differentiate between centroid & centre of gravity.

2. Answer any FOUR of the following :

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- (a) The velocity ratio of a certain machine is 50. Determine the effort required to lift a load of 1500 N if the efficiency of the machine is 40%.
- (b) Certain machine has a law of machine $P = 0.025 W + 20 \text{ N}$, with V.R. = 60. Calculate its efficiency at a load of 1 kN.
- (c) In a lifting machine, a load of 10 kN is raised by effort of 300 N. If the efficiency is 75%. Calculate MA & V.R., if the machine lifts 20 kN load by effort of 550 N. Find the law of machine.
- (d) In a differential axle & wheel, the dia. of wheel is 400 mm & that of axle are 100 mm & 80 mm, if an effort of 50 N can lift a load of 1500 N, find V.R. & efficiency of the machine.
- (e) A Screw Jack has effort wheel dia. of 200 mm & pitch is 5 mm. Find V.R., if load of 1000 N is lifted by an effort of 250 N. Find the efficiency of a machine.
- (f) In a Weston's Pulley block, the radius of the smaller wheel is $\frac{3}{4}$ than that of larger wheel. What load is lifted by the pulley block with an effort of 100 N at an efficiency of 50% ?

3. Answer any FOUR of the following :

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- (a) Find the components of the force 100 kN (push) acting at 270° with X-axis.
- (b) What are the components of 60 N force acting horizontal in two directions on other side, at an angle of 30° each ?
- (c) Find the algebraic sum of moments of all the forces shown in Fig. 1 about the point C.

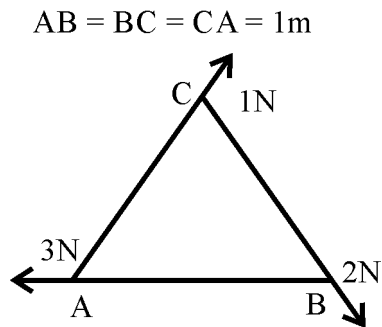


Fig. 1

- (d) Four forces of $30\text{ N } \uparrow$, $40\text{ N } \downarrow$, $70\text{ N } \uparrow$ & $60\text{ N } \downarrow$ are acting in a series. Distances between the forces are 400 mm, 600 mm & 800 mm respectively. Find the moment of a couple.
- (e) Find the angle between two equal forces P, if their resultant is also equal to P.
- (f) Find the resultant of all the forces as shown in Fig. 2. Mark its position & direction on a sketch.

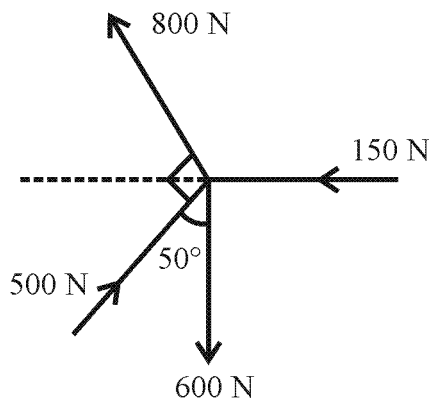


Fig. 2

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4. Answer any FOUR of the following :

- (a) Find the Resultant and Magnitude and direction of the forces acting on a regular pentagon shown in Fig. 3

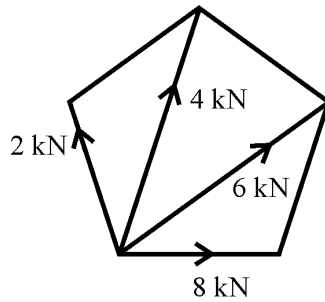


Fig. 3

- (b) Six parallel forces of magnitude 1000 N, 1500 N, 1800 N, 2000 N, 2400 N & 2700 N are acting at 1, 3, 5, 7, 8 m from the 1st force. Forces 1st, 3rd and 5th are acting upwards while other acting downwards. Find the resultant force analytically.
- (c) Write any four properties of a couple.
- (d) Find graphically the resultant of a concurrent force system. See Fig. 4

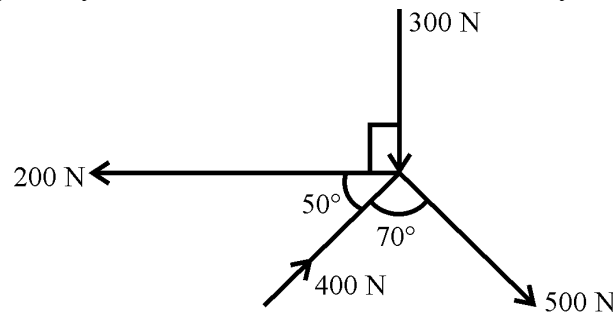


Fig. 4

- (e) Find the support reaction of the beam graphically. See Fig. 5

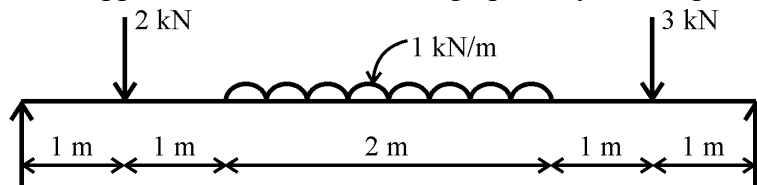


Fig. 5

- (f) Calculate reaction at roller support and hinge support by graphical method of Fig. 6

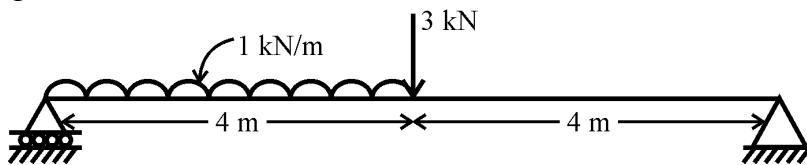


Fig. 6

5. Answer any FOUR of the following :

- (a) A horizontal force P as shown in Fig. 7 keeps the weight of 100 N in equilibrium. Find the magnitude P and tension in the string T .

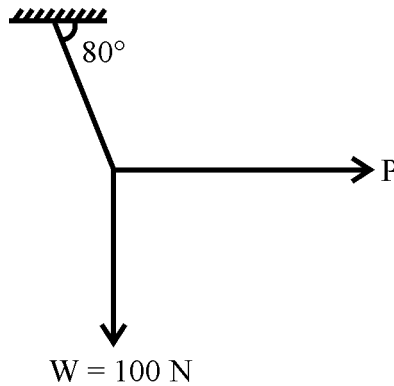


Fig. 7

- (b) A sphere of weight 400 N rests in a groove of smooth inclined surfaces which are making 60° & 30° inclination to the horizontal. Find the reactions at the contact surfaces.
- (c) A beam of span 4 m is simply supported at its ends. It carries concentrated load of 15 kN & 20 kN at 1 m & 2 m from left hand support respectively. It carries U.D.L. of 10 kN/m for 2 m from the right end. Determine reactions at the support.
- (d) A parcel weighing 200 N is just on the point of moving horizontally by a force of 52 N. What is the coefficient of friction ?
- (e) Find the value of W if the body is in limiting equilibrium. See Fig. no. 8

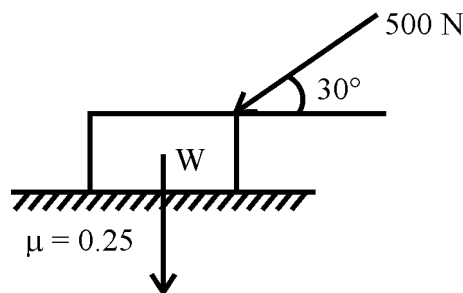


Fig. 8

- (f) A 200 N block is at rest on a 30° incline. The coefficient of friction between block and the incline is 0.20. Compute the value of a horizontal force P that cause motion to impend up the incline.

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6. Answer any FOUR of the following :

- (a) A L section consists of two legs $100 \text{ mm} \times 20 \text{ mm}$ each with 120 mm as overall depth.
- (b) Find the Centroidal position of shaded area with respect to AB. See Fig. 9.

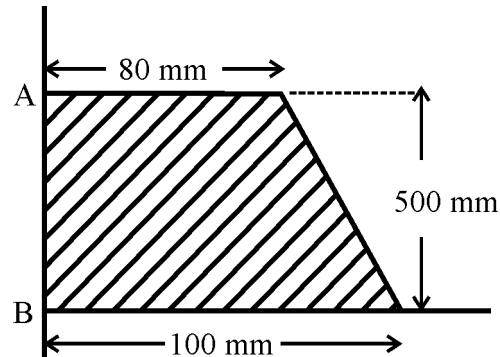


Fig. 9

- (c) Locate Centroid of Shaded Area. See Fig. 10

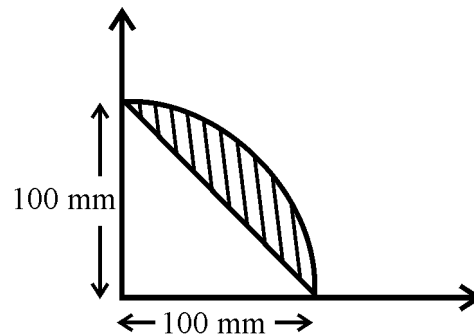


Fig. 10

- (d) A solid cone of height 40 cm is placed on a cube of side 20 cm as shown in Fig. 11. Locate the position of C.G. with respect to tip of the cone.

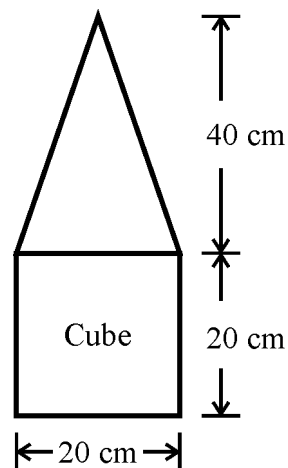


Fig. 11

- (e) Find the centre of gravity of composite solid w.r.t. x & y -axis. See Fig. 12.

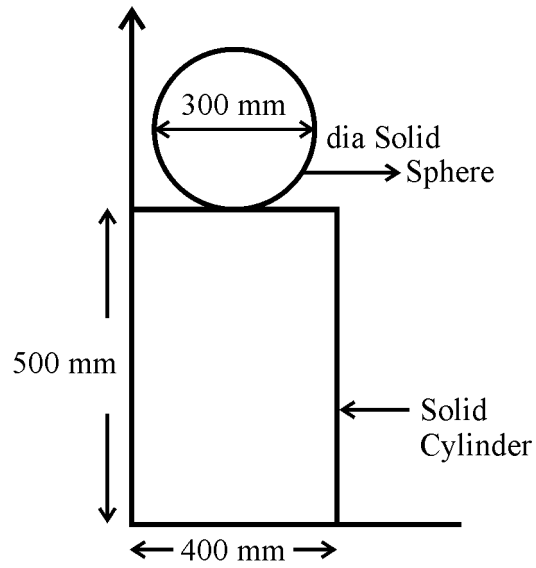


Fig. 12

- (f) A frustum of solid circular cone of top diameter 30 cm, bottom diameter 60 cm and height of 50 cm. Find the centre of gravity of the frustum.

