

17350

15116

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. Attempt any TEN Questions :

20

- (a) Define 'Scalar quantity' giving two examples.
- (b) Define 'moment of a force'.
- (c) State Lami's theorem.
- (d) Draw or show by sketch cantilever beam.
- (e) Enlist one advantage and one disadvantage of friction.
- (f) Define 'angle of friction'.
- (g) Locate centroid of



Triangle



Quarter Circle

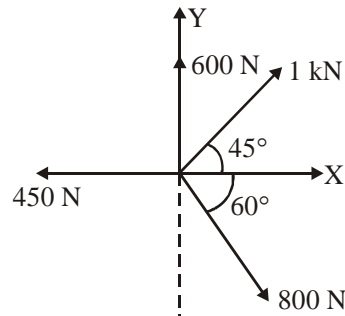
- (h) Define MI.
- (i) What is condition for machine to be ideal ?
- (j) Show graphically law of machine and write mathematical expression.
- (k) Define 'ductility'.
- (l) What do you mean by 'hoop stress' ?

P.T.O.

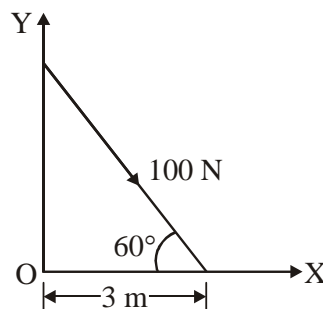
2. Attempt any FOUR Questions :

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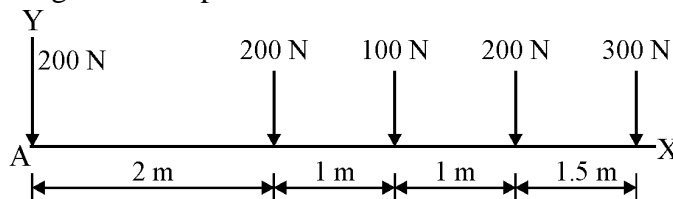
- (a) Determine analytically the resultant of the four concurrent forces shown in fig.



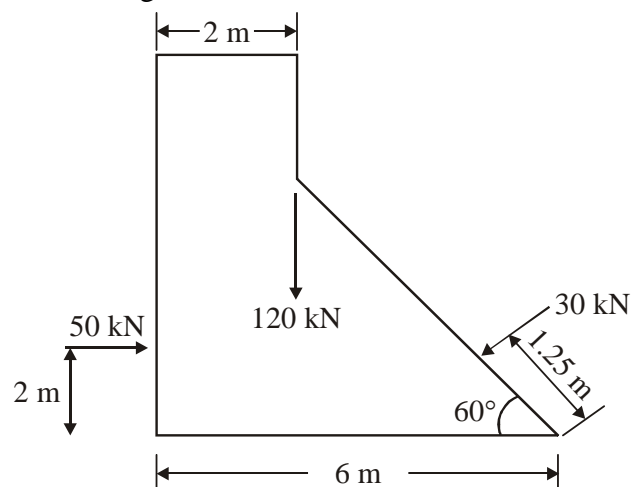
- (b) Determine the moment of the force of 100 N about point 'O'.



- (c) Determine analytically the resultant of the coplanar parallel force system shown in fig. from the point A.



- (d) Define space diagram and polar diagram.
 (e) The forces acting on a 1 m length of the dam are shown. Determine the resultant force acting on the dam. Where does the resultant intersect the base ?

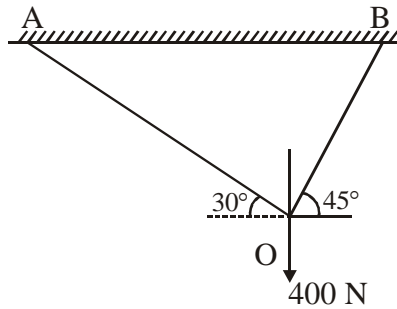


- (f) What is a couple ? State three characteristics of couple.

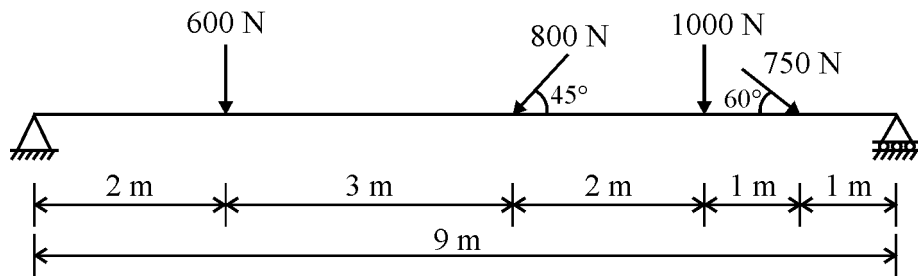
3. Attempt any FOUR Questions :

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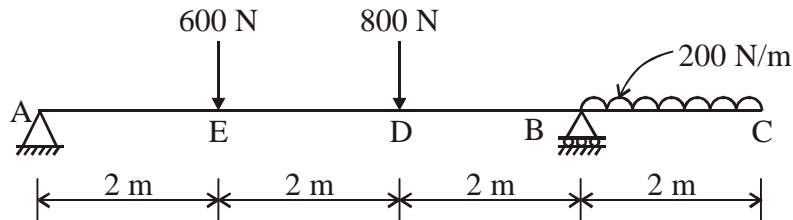
- (a) Define the term 'free body diagram'. What is the purpose of drawing a free body diagram.
- (b) A weight of 400 N is hung with the help of two strings AO & BO as shown in fig. Compute the forces in the strings AO & BO.



- (c) Determine the reactions at the supports A & B for beam loaded as shown in fig.



- (d) Determine the reactions at the supports A & B of the overhanging beam shown in fig. by graphical method.



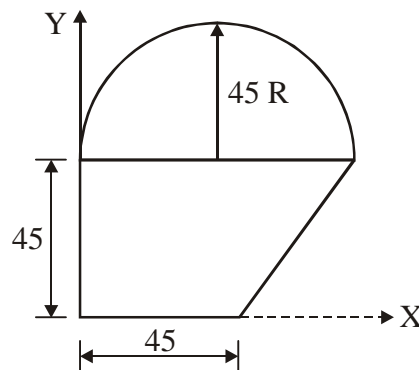
- (e) Enlist four laws of friction.
- (f) A block weighing 400 N is resting on a horizontal plane. Determine the force P required to be applied at 30° to the horizontal as shown in fig. to move the block. If $\mu = 0.25$



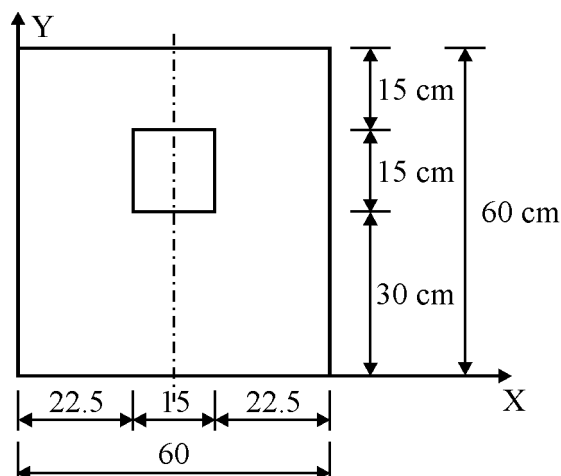
4. Attempt any FOUR Questions :

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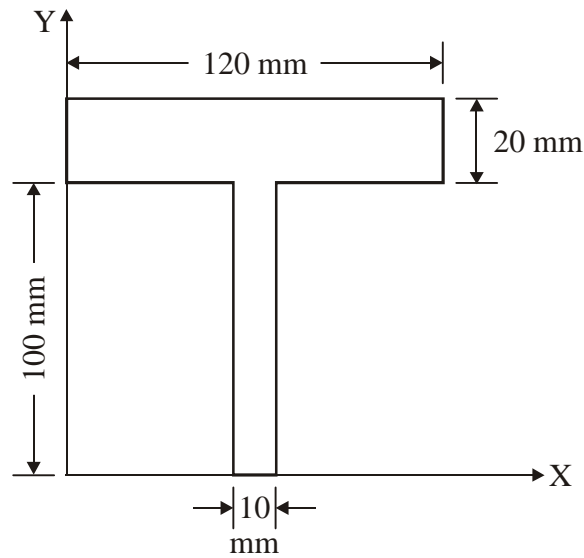
- (a) A block weighing 200 N is in contact with an inclined plane. Will the block move down under its own weight ? Determine the magnitude of a force applied parallel to the plane to prevent the motion down the plane. $\mu_s = 0.2$ and angle of inclined plane is 30° .
- (b) A body weighing 100 N rests on a plane making angle of 10° . A horizontal force of 30 N is just sufficient to cause motion impend up the plane. Determine value of coefficient of friction.
- (c) Locate the centroid of the plane area shown below :



- (d) Locate the centroid of a plane square lamina $60\text{ cm} \times 60\text{ cm}$, from which a square area $15\text{ cm} \times 15\text{ cm}$ is removed as shown in fig.



- (e) Calculate MI of the following plane lamina.



- (f) Locate centroid of (show with fig)
- Cylinder
 - Hemisphere.

5. Attempt any FOUR questions :

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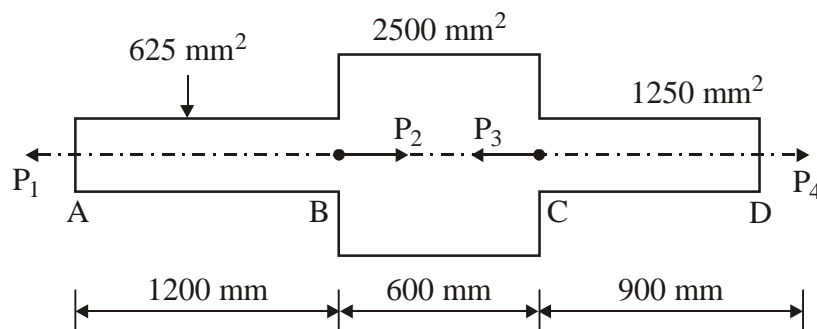
- Calculate MI of a I-Section with two flanges $150 \text{ mm} \times 15 \text{ mm}$ & web $100 \text{ mm} \times 12 \text{ mm}$.
- In an experimental test conducted on a hoisting machine, it was observed that an effort of 80 N was applied to lift a load of 20 kN, whereas an effort of 60 N was required to lift a load of 12 kN. The VR of machine was 500. Determine law of machine.
- The threads of a screw jack have a pitch of 10 mm. Determine the effort p required to raise a load of 21 kN. The efficiency of the screw is 40%. The effort is applied to the end of tommy bar at a distance of 300 mm from centre of the screw.

- (d) In a double purchase crab the number of teeth in the pinions are 20 and 30, whereas the number of teeth of the spur wheels are 40 and 50 respectively. If the diameter of the barrel is 200 mm, determine the effort required at the end of the handle to lift a load of 1.5 kN. The effort handle is 35 cm long and η is 35%.
- (e) A differential wheel and axle is used to lift a load of 2.5 kN. The diameters of the larger and smaller portions of the drum are 200 mm and 150 mm respectively. The length of the handle is 400 mm. Determine the VR & MA if an effort of 80 N is required to lift the load. Also determine efficiency of machine.
- (f) (i) What is difference between ideal machine and actual machine ?
 (ii) What is the condition for machine to be ideal and to be reversible ?

6. Attempt any FOUR of the following :

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- (a) Determine the velocity ratio of a differential pulley block when the diameter of the sheaves of the upper block are $D = 300$ mm and $d = 280$ mm.
- (b) State Hooke's law. What is relations between Young's modulus and modulus of rigidity ?
- (c) Enlist any four assumptions in theory of pure torsion.
- (d) A member ABCD is subjected to point loads P_1 , P_2 , P_3 and P_4 as shown in fig. Calculate force P_2 necessary for equilibrium if $P_1 = 45$ kN, $P_3 = 450$ kN, $P_4 = 130$ kN. Determine the total elongation of the member. $E = 2.1 \times 10^5$ N/mm².



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- (e) For a given material the Young's modulus is $1.10 \times 10^5 \text{ N/mm}^2$ and the modulus of rigidity is $0.43 \times 10^5 \text{ N/mm}^2$. Find the bulk modulus and lateral contraction of a round bar of 40 mm diameter \times 2.5 m length, when stretched by 2.5 mm.
- (f) Explain different types of stresses.
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