

# 17204

16117

**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 of the following:** **20**
- a) Define velocity ratio and mechanical advantages in a simple machine.
  - b) Define ideal machine and ideal effort.
  - c) Define effort lost in friction with formula.
  - d) State principle of transmissibility of forces.
  - e) What is Bow's notation? Explain with a sketch.
  - f) Define statics and dynamics.
  - g) What is space diagram and vector diagram?
  - h) State Lami's theorem.

P.T.O.

- i) What is relation between resultant and equilibrant?
- j) Define coefficient of friction and angle of repose.
- k) List any four laws of friction.
- l) State the formula of velocity ratio of differential axle and wheel with their meaning.

2. **Attempt any FOUR of the following:**

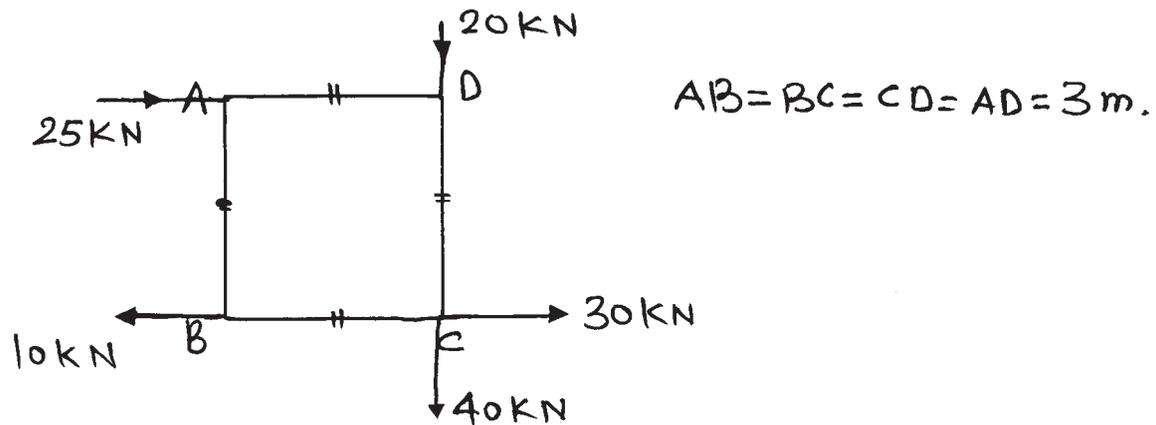
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- a) In a machine, an effort of 2 N lifted a load of 30 N. If the effort lost due to friction at this load is 0.5 N, find the VR and efficiency of the machine.
- b) A Weston's differential pulley block has 16 and 15 cogs. An efforts of 600 N lifts a load of 15 kN. Find VR, MA and efficiency.
- c) A screw jack has an effort wheel diameter of 300 mm and pitch is 6 mm. If a load of 1200 N is lifted by an effort of 200 N, find VR, MA and efficiency.
- d) A machine has  $VR = 25$  and law of machine is  $P = (0.01 W + 5)N$ . Find MA, efficiency and effort lost in friction when load is 1000 N. Also state whether the machine is reversible or not.
- e) In a differential axle and wheel, the diameter of wheel is 36 cm and that of axles are 9 cm and 6 cm. If the efficiency of machine is 80%, determine the load lifted by an effort of 100 N.
- f) A load of 1 kN is lifted by an effort of 56 N and 2 kN is lifted by an effort of 96 N. Find effort required to lift a load of 3 kN.

3. Attempt any FOUR of the following:

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- a) Resolve each of the following forces into orthogonal components.
- 350 N acting South-West away.
  - 200 N acting North-East away
  - 40 N acting  $40^\circ$  West of South away.
  - 400 N acting due South away.
- b) What are the components of 60 N force acting horizontal, in two directions on either side at an angle of  $30^\circ$  each?
- c) Find the moment about point B as shown in Figure No. 1

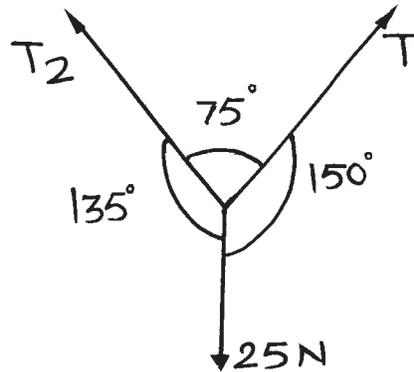
Fig. No. 1

- d) Find the resultant force and its direction if two forces 20 N and 40 N is acting along the adjacent sides of a parallelogram making an angle of  $60^\circ$ .
- e) ABCD is a square of 2 m side. Along sides AB, CB, DC and AD the forces of 10, 20, 30 and 40 N are acting respectively. Find resultant of forces from A.
- f) Three parallel forces of magnitude 100 N, 200 N and 400 N are acting vertically upward at A, B and C such that  $AB = 2\text{ m}$  and  $BC = 3\text{ m}$ . Find the resultant force graphically.

4. Attempt any FOUR of the following:

16

- a) Find the tensions in the string as shown in Figure No. 2

Fig. No. 2

- b) A sphere of weight 400 N rests in a groove of smooth inclined surfaces which are making  $60^\circ$  and  $30^\circ$  inclination with horizontal. Find the reactions at the contact surfaces.
- c) A body of weight 100 N is suspended by two strings of 4 m and 3 m lengths attached at the same horizontal level 5 m apart. Find the tensions in the strings.
- d) A simply supported beam has a span of 4 m. Find the position of a concentrated load on it such that the left hand reaction is three times the right hand reaction.
- e) A simply supported beam of span 10 m carries a centre load of 25 kN and a u.d.l of 25 kN/m throughout. Find support reaction.
- f) Distinguish between resultant and equilibrant.

5. Attempt any FOUR of the following:

16

- a) A body of weight 2000 N rests on a horizontal plane. If the coefficient of friction is 0.4. Find the horizontal force required to move the body.
- b) A block of 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force at  $30^\circ$  up the horizontal to just move the block.

- c) A body of weight 600 N is resting on a rough inclined plane of  $40^\circ$ . If the  $\mu = 0.58$ , what force is required to prevent the body from falling down the plane.
- d) Find the horizontal force required to drag a body of weight 100 N along a horizontal plane. If the plane is raised gradually upto  $15^\circ$ , the body will begin to slide.
- e) Calculate the magnitude and direction of resultant force of the force system as shown in Figure No. 3. Use Analytical method.

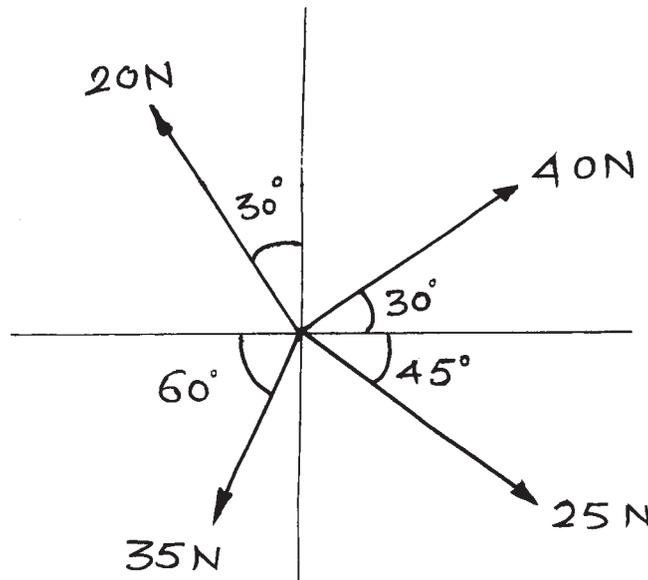


Fig. No. 3

- f) Find the magnitude, direction and position of resultant force of four parallel like forces as shown in Figure No. 4. Use Graphical method.

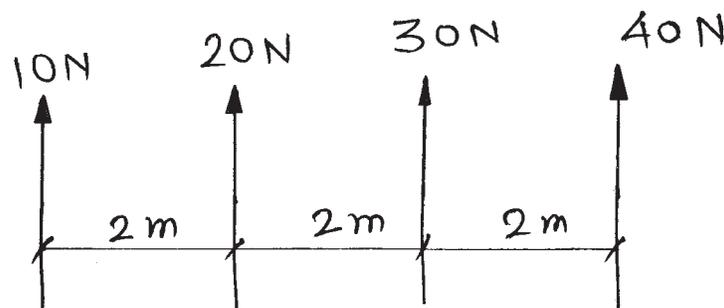


Fig. No. 4

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

- a) Find the centroid of L-section  $90 \times 60 \times 8$  mm.
  - b) Find centroid of T-section with flange  $120 \times 12$  mm and vertical web  $180 \times 18$  mm.
  - c) A square of 400 mm side from which a circle of 400 mm diameter is cut-off from the centre. Find centroid of the remaining area.
  - d) Locate centre of gravity of a right circular cone and sphere. State formula for volume.
  - e) A solid cone having base diameter 6 cm and height 6 cm is kept co-axially on a solid cylinder having same diameter and height 10 cm. Find centre of gravity of combination.
  - f) A frustum of a cone has top diameter 40 cm and bottom diameter 60 cm with height 18 cm. Find centre of gravity.
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