17204

21415

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 : **20**

(a) Define mechanical advantage and velocity ratio.

(b) What are the characteristics of an ideal machine ?

(c) Define input and output of a machine.

(d) Differentiate between concurrent and non-concurrent force system with a neat sketch.

(e) What is Bow's notation ? Explain with a sketch.

(f) State any two characteristics of a force.

(g) What is the use of funicular polygon ?

(h) How is resultant different from equilibrant ?

(i) State Lami's theorem and its limitations.

(j) State any four laws of friction.

(k) Define limiting friction.

(l) State the velocity ratio for worm and worm wheel and explain the terms involved.

2. Attempt any FOUR of the following : 16

(a) For a certain machine, the law is P = (0.09 W + 6) N. Calculate the effort required to lift a load of 6 kN. Also calculate maximum M.A. and identify the type of machine if velocity ratio of the machine is 20.

(b) A load of 1400 N can be lifted by an effort of 40 N in a differential axle and wheel. The diameter of wheel is 40 cm and diameters of axles are 10 cm and 8 cm. Find efficiency and effort lost in friction of the machine.

(c) The diameters of bigger and smaller pulleys of Weston's differential pulley block are 250 mm and 100 mm respectively. Determine the effort required to lift a load of 3 kN with 80% efficiency.

(d) Resolve the following forces into its orthogonal components :

(i) 25 kN force inclined at 140° with positive X-axis and acting towards the point.

(ii) 400 N force acting due south.

(e) A man pulls a hand roller on a cricket pitch and in doing so, exerts a pull of 150 N inclined at an angle of 30° to the horizontal. Find the force tending to move the roller forward. If $\mu = 0.30$, find weight of roller.

(f) State any four properties of couple with examples.

3. Solve any FOUR of the following questions : 16

(a) Two forces 50 N and 'Q' have a resultant of 200 N. If the angle between the two forces is 45°, find Q and the direction of the resultant.

(b) Determine the resultant of the forces in Fig. (1) in magnitude and direction with respect to point A.

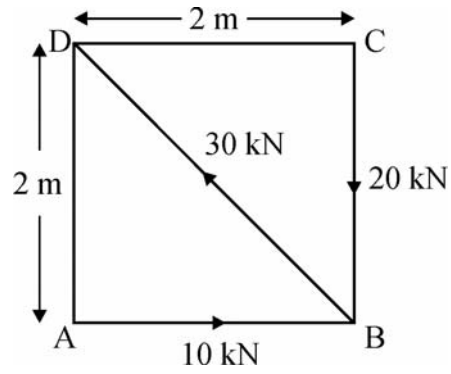

Fig. (1)

(c) Following forces act at a point :

(i) 25 N inclined at 30° towards North of East.

(ii) 20 N towards North.

(iii) 35 N towards North-West and

(iv) 30 N inclined at 40 °C South of West.

Find the magnitude and direction of resultant force.

(d) Calculate the resultant in magnitude, direction and position with respect to 30 N force for the parallel force system shown in Fig. (2).

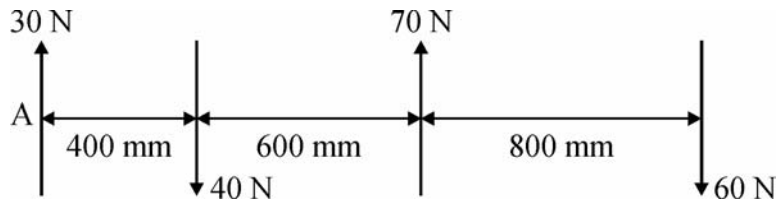

Fig. (2)

(e) Explain the following :

(i) Resolution of a force

(ii) Composition of a force system

(f) Solve 3(d) by graphical method.

4. Solve any FOUR of the following : 16

(a) State graphical conditions of equilibrium for concurrent system and parallel system.

(b) A sphere of weight 300 N is resting in a groove of smooth inclined surfaces making 60° & 30° inclination to the horizontal. Find the reactions at the contact surfaces.

(c) Find the equilibrant of forces equal to 2 kN, 3 kN, 4 kN, 5 kN and 6 kN respectively acting along the lines from the corners to the centre of the pentagon.

(d) Explain the different types of beam with neat sketches.

(e) Find the support reactions of the simply supported beam shown in Fig. (3).

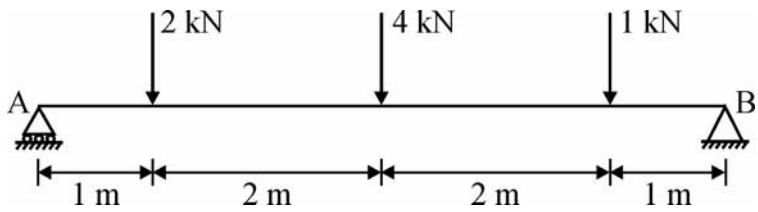

Fig. (3)

(f) Find the beam reactions for the beam loaded and supported as shown in Fig. (4).

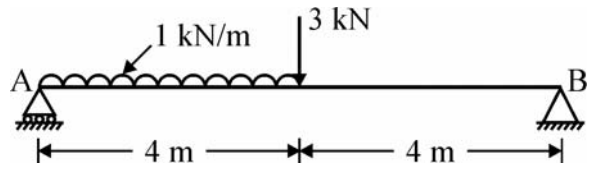

Fig. (4)

5. Answer any FOUR of the following : 16

(a) A body of weight 400 N resting on rough horizontal plane is just pulled by a force of 120 N, when force is applied at an angle of 30° with the horizontal. Calculate the co-efficient of friction and normal reaction.

(b) A body weighing 200 N is resting on a rough horizontal plane and can be just moved by a force of 65 N applied horizontally. Find co-efficient of friction. Also find the magnitude and direction of the resultant reaction.

(c) A body of weight 300 N, resting on an inclined plane inclined at an angle of 30° with the horizontal, just started to move down the plane. Calculate :

(i) coefficient of friction

(ii) angle of friction

(iii) angle of repose

(d) Draw a neat sketch of ladder showing all active and reactive forces of resting against a smooth wall.

(e) The following are the observations made on a certain machine which has velocity ratio 20 :

Load (N)	Effort (N)
100	10
200	14

Find :

(i) Law of machine

(ii) Effort lost in friction at a load of 300 N

(f) For a geared pulley block, the following data is available :

No. of cogs on the effort wheel = 60

No. of teeth on the pinion = 10

No. of teeth on the spur = 90

No. of cogs on the load wheel = 15

If the maximum effort required to lift a load is 50 N, calculate the maximum load that can be lifted by the machine at 70% efficiency.

6. Attempt any FOUR of the following : 16

(a) Find the centroid of an inverted T-section from the bottom, if flange is 60 cm × 10 cm and web is 10 cm × 60 cm.

(b) Find the position of centroid of a quarter circle having 80 cm as diameter.

(c) Locate the centroid of angle section 90 mm × 100 mm × 10 mm. (90 mm side is vertical)

(d) A hemisphere of diameter 100 mm is placed on top of a cylinder whose diameter is also 100 mm. Find the C.G. of the composite solid from the base of the cylinder, if its height is 120 mm.

(e) The frustum of a cone has top diameter 40 mm and bottom diameter is 60 mm with height 18 mm. Locate its centre of gravity from its bottom.

(f) A right circular cone of base diameter 120 mm and height 210 mm is placed on the base of a hemisphere of the same diameter. Calculate the centre of gravity.

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