

- Instructions :**
- (1) All questions are compulsory.
  - (2) Illustrate your answers with neat sketches wherever necessary.
  - (3) Figures to the right indicate full marks.
  - (4) Assume suitable data, if necessary.
  - (5) Preferably, write the answers in sequential order.
  - (6) Use of non programmable calculator is permissible.

1. Attempt any **FIVE** of the following :

[10]

- (a) How will you find whether machine is reversible or not?
- (b) Differentiate between statics and dynamics.
- (c) State Varignon's theorem.
- (d) Define Simple Machine.
- (e) Define force and write its S.I. unit.
- (f) State Bow's Notation. Where it is used?
- (g) List the conditions of equilibrium for co-planer non-concurrent forces.

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

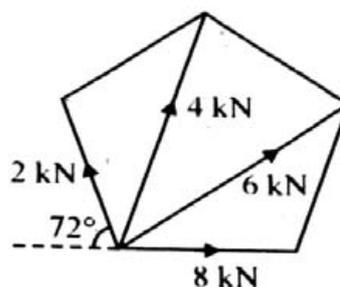
[12]

- (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) In a differential axle and wheel, the diameter of wheel is 400 mm and that of axle are 100 mm and 80 mm, if an effort of 50 N can lift a load of 1500 N, find V.R. and efficiency of the machine.
- (c) A Weston differential pulley consists of a lower block and a upper block. The upper block has two pulleys, one of which has a radius of 125 mm and other has a radius of 115 mm. If the efficiency of the machine is 40%, calculate the effort required to raise a load of 1500 N.
- (d) A double purchase crab used in a laboratory has following dimensions :  
Diameter of load drum = 160 mm  
Length of the handle = 360 mm  
No. of teeth on pinions = 20 and 30  
No. of teeth on spur wheel = 75 and 90  
When tested it was found that an effort of 90 N was required to lift a load of 1800 N and an effort of 135 N was required to lift a load of 3150 N. Determine :
  - (i) Law of machine
  - (ii) Probable effort to lift a load of 4500 N

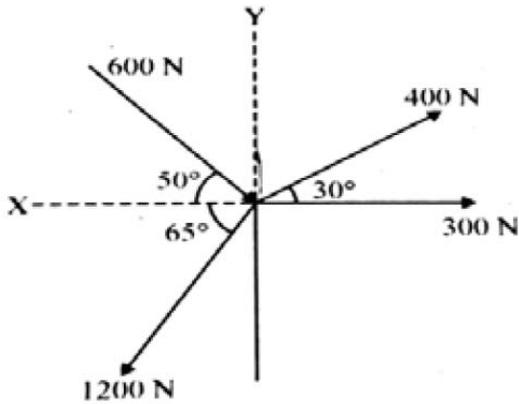
3. Attempt any **THREE** of the following :

[12]

- (a) What are the components of 60 N force acting horizontal in two directions on other side, at an angle of  $30^\circ$  each?
- (b) Four forces of  $30\text{ N } \uparrow$ ,  $40\text{ N } \downarrow$ ,  $70\text{ N } \uparrow$  and  $60\text{ N } \downarrow$  are acting in a series. Distances between the forces are 400 mm, 600 mm and 800 mm respectively. Find the moment of a couple.
- (c) Forces of 2, 4, 6 and 8 kN act on regular pentagon as shown in Figure. Find analytically the resultant in magnitude and direction.



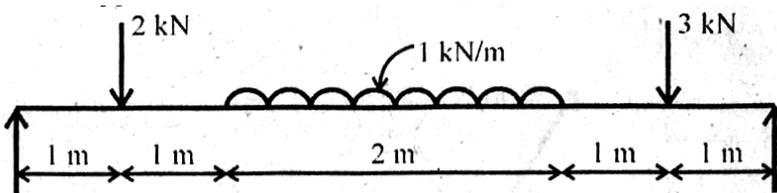
- (d) A concurrent force system is shown in Fig. No.2 Find graphically the resultant of this force system.



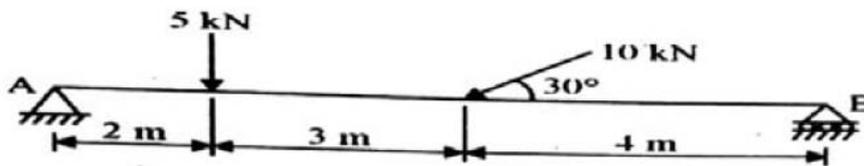
4. Attempt any **THREE** of the following :

[12]

- (a) Six parallel forces of magnitude 1000 N, 1500 N, 1800 N, 2000 N, 2400 N and 2700 N are acting at 1, 3, 5, 7, 8 m from the 1<sup>st</sup> force. Forces 1<sup>st</sup>, 3<sup>rd</sup> and 5<sup>th</sup> are acting upwards while other acting downwards. Find the resultant force analytically.  
 (b) Find the support reaction of the beam graphically. See figure.



- (c) State and explain Lami's theorem. List limitation of Lami's theorem.  
 (d) Find analytically the reaction at supports as shown in Figure.



- (e) A simply supported beam of 4 m span is loaded with an u.d.l. of 5 kN/m for 2 m from left end and a point load of 30kN at 1m from right end .Find the support reactions using graphical method.

5. Attempt any **TWO** of the following :

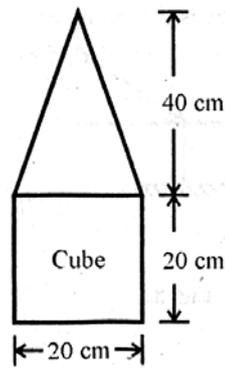
[12]

- (a) A beam of span 4 m is simply supported at its ends. It carries concentrated load of 15 kN and 20 kN at 1 m and 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.  
 (b) A body of weight 150N is resting on a rough horizontal plane and can be just moved by a force of 50 N applied horizontally. Find the coefficient of friction. Also find magnitude and direction of resultant reaction.  
 (c) A heavy stone of mass 500kg is on a hill slope of 600 incline. If the coefficient of friction between ground and stone is 0.4 is the stone stable ? Justify.

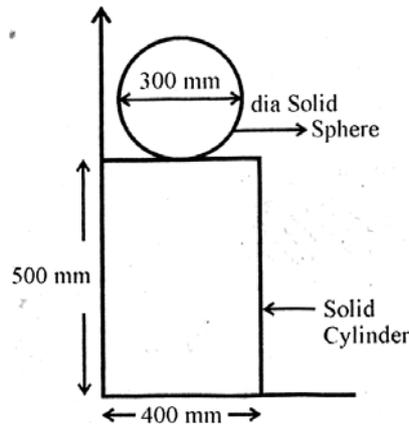
6. Attempt any **TWO** of the following :

[12]

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



(b) Find the centre of gravity of composite solid w.r.t x and y-axis. See figure.



(c) The frustum of a cone has top diameter 30 cm and bottom diameter 60 cm with height 18 cm. Find the center of gravity of frustum.

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