

(3 Hours)

[Total Marks: 80]

- N. B.
1. Question No. 1 is Compulsory.
  2. Answer any three questions out of remaining questions.
  3. Assume any suitable data wherever required but justify the same.
  4. Figures to the right indicate full marks.
  5. Take  $g = 9.81 \text{ m/s}^2$

- Q1. (a) If resultant of two forces is 200 N vertical, determine magnitude and direction of  $F_2$  (refer fig No. 1). [4]

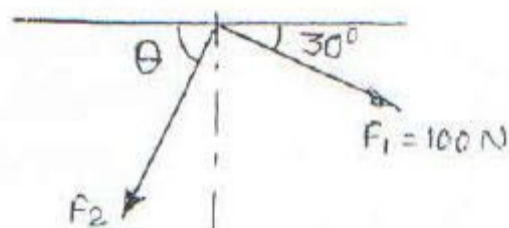


Fig No. 1

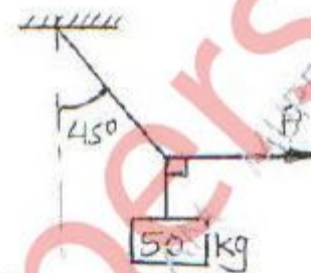


Fig No. 2

- (b) Determine value of  $P$  to maintain equilibrium by using Lami's theorem (refer fig No. 2). [4]
- (c) Explain with neat sketch, angle of repose and find relationship between angle of repose and angle of friction. [4]
- (d) For the particle a-t diagram is shown in fig No. 3. Construct s-t and v-t diagrams. [4]

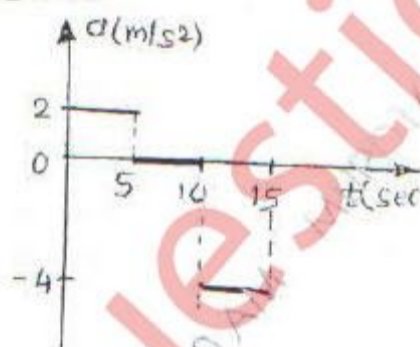


Fig No. 3

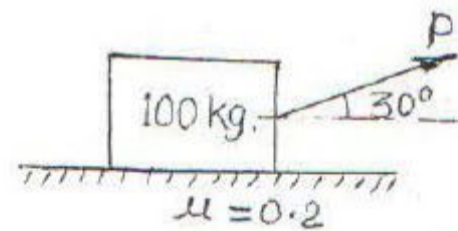


Fig No. 4

- (e) A 100 kg block resting on horizontal plane is pulled by force  $P$  to accelerate the block at  $3 \text{ m/s}^2$  to right hand side as shown in fig No. 4. Determine  $P$ . [4]

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- Q2. (a) Determine magnitude, direction and position of resultant from O for the force system as shown in fig No. 5 [6]

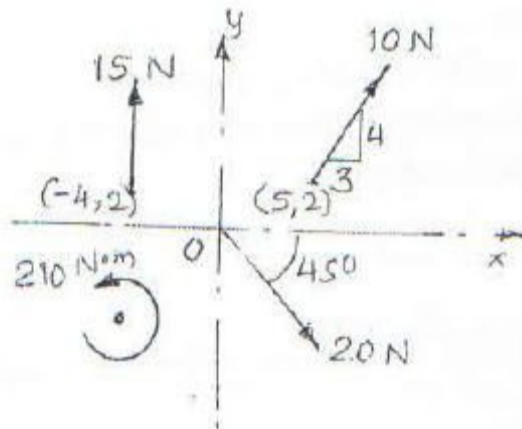


Fig No. 5

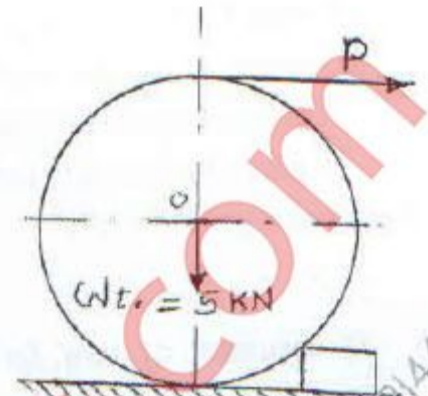


Fig No. 6

- (b) An inextensible string is wound around the cylinder of diameter  $d$  m and the cylinder is just pulled over an obstacle of height 20 cm by pulling the string as shown in fig No.6. Determine pull P required. [8]
- (c) A marble of mass  $m$  is dropped from certain height  $H$  on the horizontal floor. It rises to half the height  $H$  after second bounce. Determine coefficient of restitution between marble and the floor. [6]
- Q3. (a) Determine the centroid of shaded area as shown in fig No. 7. [8]

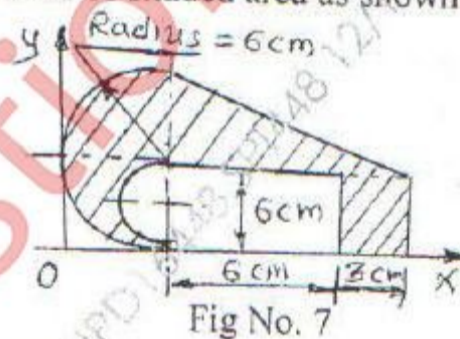


Fig No. 7

- (b) Determine magnitude and direction of resultant. Tensions in wires AB, AD and AC are 100 N, 150 N and 200 N respectively. (refer fig No. 8) [6]

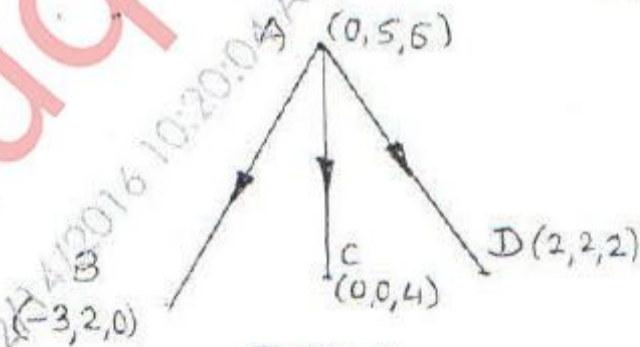


Fig No. 8

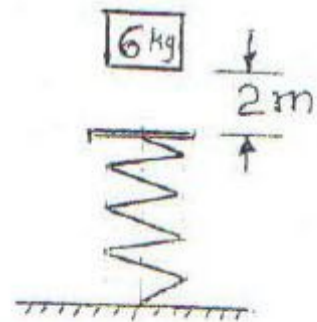


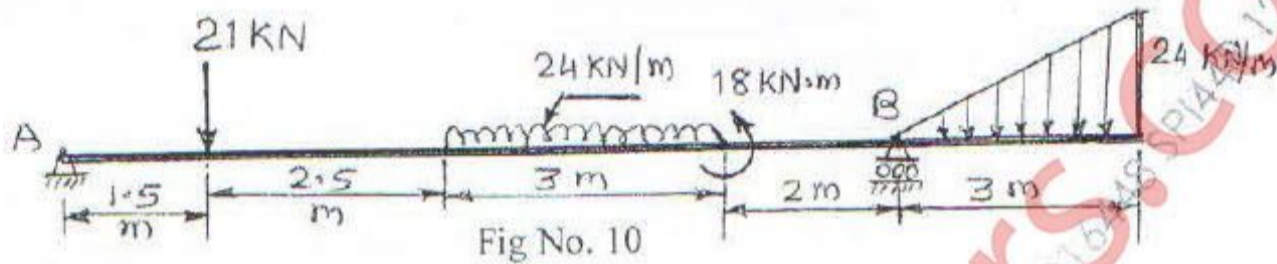
Fig No. 9

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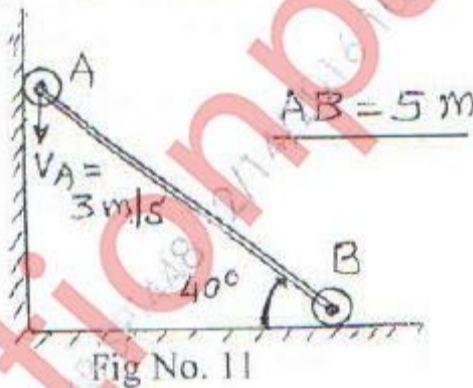


- (c) A block of mass 6 kg falls from height 2 m onto a spring whose stiffness is 12 N/mm. Find velocity of block when spring gets compressed by 0.1 m. (refer fig No. 9) [6]

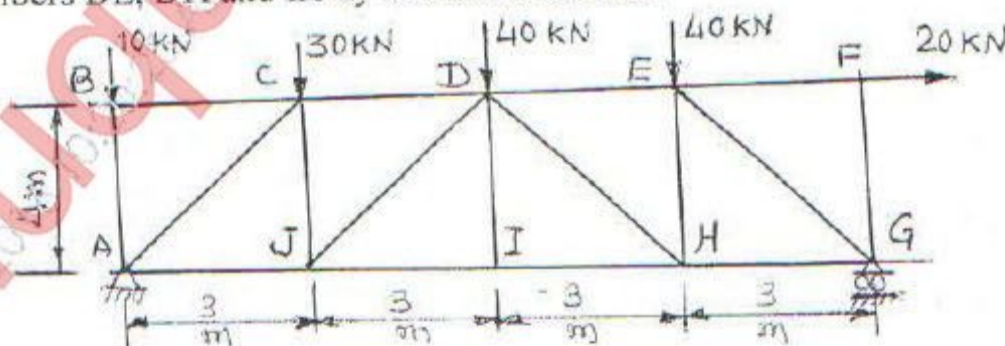
- Q4. (a) Determine support reactions of the beam loaded as shown in fig No. 10. [8]



- (b) A particle is projected with velocity  $u$  at an angle of elevation  $60^\circ$  with horizontal. It reaches to the height of 5 m in 2 sec. determine velocity  $u$  and the range. [6]
- (c) Two wheels are attached to ends of rod AB as shown in figure No.11. Determine angular velocity of rod AB and velocity of end B. [6]



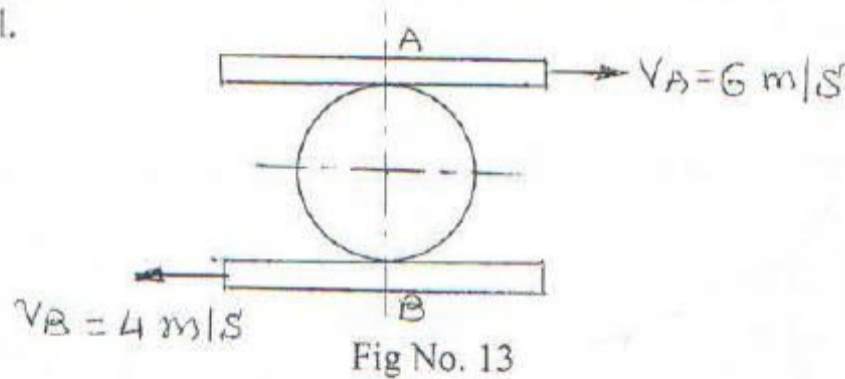
- Q5. (a) A truss is loaded as shown in the figure No.12. Determine support reactions. State zero force members with reasons and determine forces in members DE, DH and IH by method of section. [8]



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- (b) A roller of diameter 0.8 m rolls without slipping between two parallel plates as shown in figure No.13. Locate ICR and find angular velocity of the wheel. [6]



- (c) Two trains start from Vadala station at the same time. Train A moves with acceleration  $5 \text{ m/s}^2$  towards Vashi and train B with acceleration  $3 \text{ m/s}^2$  towards Bandra. Tracks from Vadala to Vashi and Vadala to Bandra make  $30^\circ$  with each other. Determine velocity of train A with respect to train B after 10 seconds. [6]

- Q6 (a) A force of 100 N acts along AB. Coordinates of A and B are  $(-1, 1, 1) \text{ m}$  and  $(-2, 3, 4) \text{ m}$ . Find moment of force about origin O. [4]
- (b) Determine how much weight can be lifted by applying  $P = 500 \text{ N}$ . Weight of block B is 200 N, and that of wedge A is 100 N. (refer fig No. 14). [8]
- (c) A particle travels on a circular path whose arc distance travelled is defined by  $S = (0.5t^3 + 3t^2) \text{ m}$ . If total acceleration is  $10 \text{ m/s}^2$  at  $t = 2 \text{ sec}$ , find radius of curvature. [4]
- (d) Two masses are positioned as shown in fig No. 15. If 5 kg mass is released from rest, find the speed at which 5 kg mass will hit the ground. [4]

