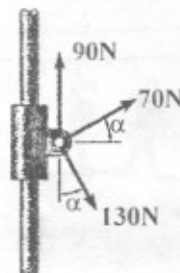


[3561]-203**F. E. (Semester - II) Examination - 2009****ENGINEERING MECHANICS****(June 2008 Course)****Time : 3 Hours]****[Max. Marks : 100****Instructions :**

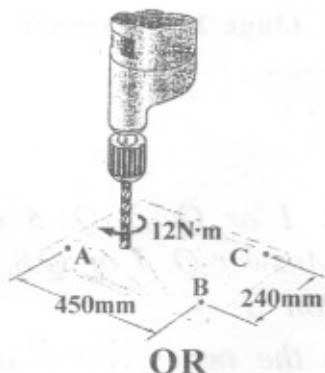
- (1) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 from section I. Answer Q. 7 or Q.8, Q.9 or Q. 10, Q. 11 or Q.12 from Section II.
- (2) Answer to the **two sections** should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and stream tables is allowed.
- (6) Assume suitable data, if necessary.

SECTION - I**Q.1) (A) State and prove Varignon's Theorem.****[06]**

- (B) A collar that can slide on a vertical rod is subjected to the three forces shown. Determine (a) the value of the angle α for which the resultant of the three forces is horizontal, (b) the corresponding magnitude of the resultant.

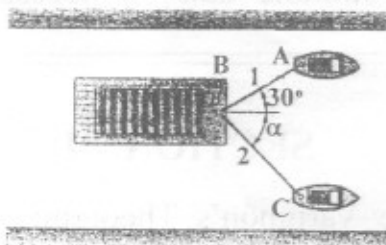
[06]

- (C) A piece of plywood in which several holes are being drilled successively has been secured to a workbench by means of two nails. Knowing that the drill exerts a 12 Nm couple on the piece of plywood, determine the magnitude of the resulting forces applied to the nails if they are located (a) at A and B, (b) at B and C, (c) at A and C. [06]

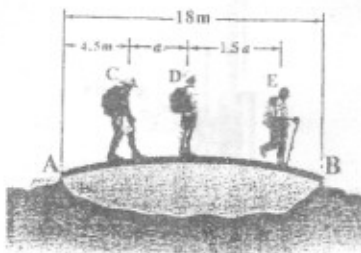


- Q.2) (A) State and explain 'Properties of Couple'. [06]

- (B) A barge is pulled by two tugboats. If the resultant of the forces exerted by the tugboats is a 5000 N force directed along the axis of the barge, determine the value of α for which the tension in rope 2 is minimum. [06]

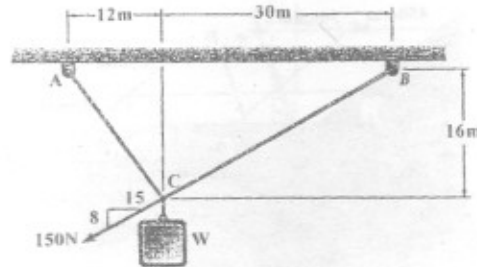


- (C) Three hikers are shown crossing a footbridge. Knowing that the weights of the hikers at points C, D and E are 200 N , 175 N and 135 N , respectively, determine the horizontal distance from A to the line of action of the resultant of the three weights when $a = 3.3 \text{ m}$. [06]

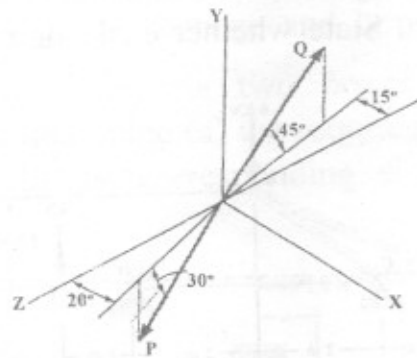


Q.3) (A) Explain with sketches any four types of Supports. [04]

(B) Two cables tied together at C are loaded as shown. Knowing that $W = 190\text{N}$, determine the tension (a) in cable AC, (b) in cable BC. [06]



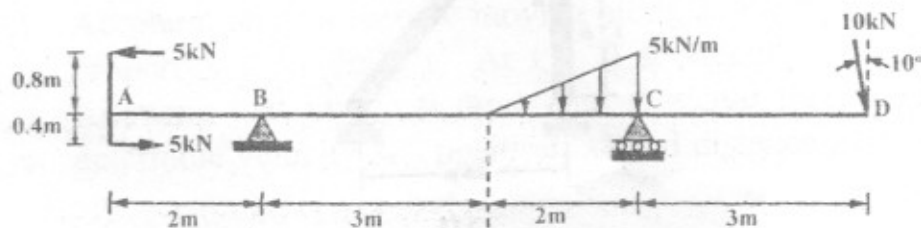
(C) Determine the magnitude and direction of the resultant of two forces shown knowing that $P = 4\text{ kN}$ and $Q = 8\text{ kN}$. [06]



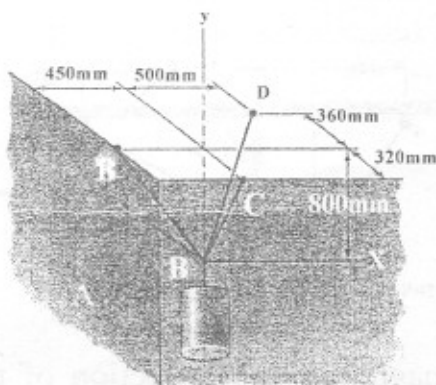
OR

Q.4) (A) A force F acts from point A towards point B in space. Write a vector expression for the force in terms of co-ordinates of points A and B. [04]

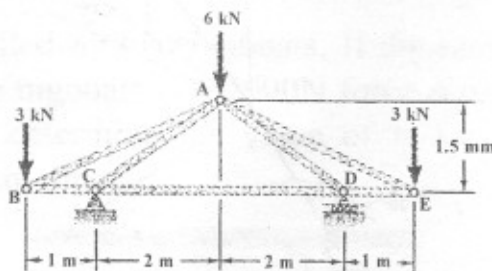
(B) A beam ABCD having self weight 2 kN/m is subjected to additional load as shown in fig. Find the support reaction at 'B' and 'C'. [06]



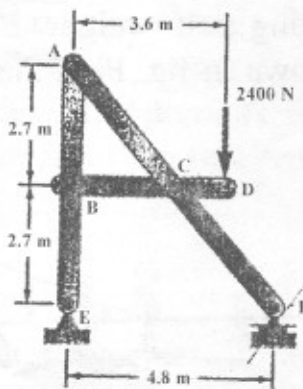
- (C) A container is supported by three cables that are attached to a ceiling as shown. Determine the weight W of the container knowing that the tension in cable AD is 4.3 kN. [06]



- Q.5) (A) Using the method of joints, determine the force in each member of the truss shown. State whether each member is in tension or compression. [08]

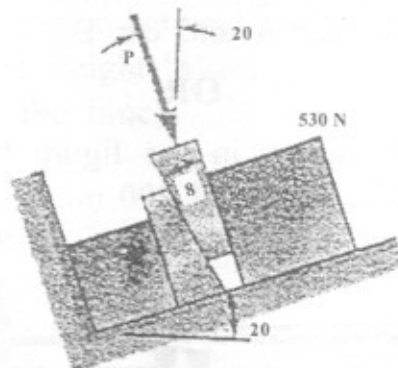


- (B) State the condition for a perfect truss explaining the symbols used if any. Also define redundant and deficient truss. [04]
- (C) Determine the components of the forces acting on each member of the frame shown. [04]

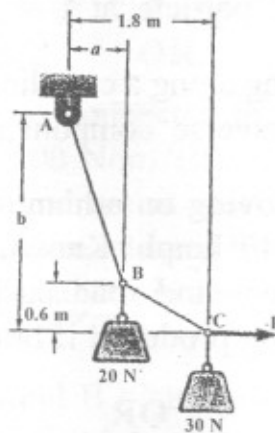


OR

- Q.6) (A) Two 8° wedges of negligible weight are used to move and position a 530 N block. Knowing that the coefficient of static friction is 0.40 at all surfaces of contact, determine the magnitude of the force P for which motion of the block is impending. [08]



- (B) Explain Angle of Repose and Impending Motion. [04]
- (C) Cable ABC supports two boxes as shown. Knowing that $b = 2.7\text{m}$, determine (a) the required magnitude of the horizontal force P , (b) the corresponding distance a . [04]



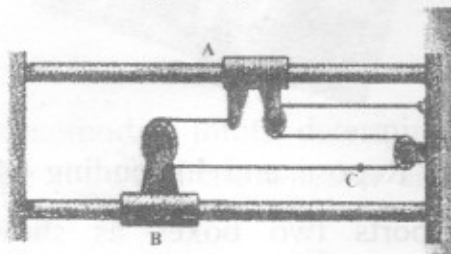
SECTION - II

- Q.7) (A) Acceleration of a particle moving along a straight line is directly proportional to time ' t '. At $t = 0$ s, velocity $v = 300$ mm/s. Knowing that $v = 250$ mm/s and $x = 500$ mm when $t = 1$ s., determine velocity ' v ', position ' x ' and distance traveled in 5s. [08]

- (B) A light train made up of 2 cars 'A' and 'B' is traveling along a straight path at 54 kmph when brakes are applied to car 'A'. Braking force applied is 40 kN. Mass of car A is 25000 kg and that of car B is 20000 kg. Determine the distance traveled by the train before coming to a stop. Also find the force in the coupling between car A and car B. [09]

OR

- Q.8) (A) On the position shown in the figure below, collar B moves towards left with velocity of 200 mm/s. Determine the velocity of collar A and velocity of point 'C' with respect to collar B. [08]

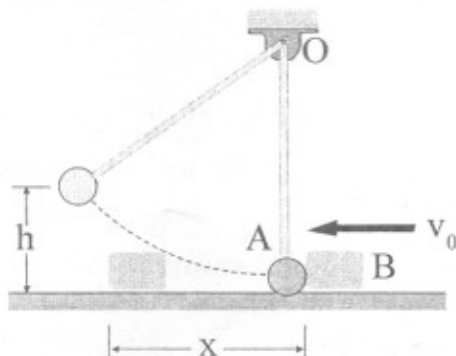


- (B) A particle of mass 10kg is acted upon by a force $F = (20 t^2 - 40)$ N, where 't' is time in s. At $t = 0$ s, velocity 'v' of the particle is 5 m/s and position $x = 0$ m. Find velocity and position of the particle at $t = 2$ sec. [09]
- Q.9) (A) For a particle traveling along a curvilinear path, derive expressions for radial and transverse components of acceleration. [08]
- (B) An automobile is moving on a hump with radius = 50 m, along a road, at a speed 40 kmph. Knowing that the co-efficient of friction between tyres and road surface is 0.4, determine the tangential acceleration produced if brakes are suddenly applied. [08]

OR

- Q.10)(A) For a particle traveling along a curvilinear path, derive expression for acceleration in path variables. [08]
- (B) A small block of mass 100 gm is kept on a rotating disc at radial distance 15 mm from centre of rotation. If co-efficient of friction between the block and surface of disc is 0.2, find out the rotational speed ' ω ' at which the block will slide. [08]

- Q.11)(A)** A block B of mass 1.1 kg is moving on the horizontal surface with velocity $v_0 = 1.8$ m/s and hits the sphere A of mass 0.68 kg, which is at rest and hanging from a chord attached at O, as shown in the figure below. The co-efficient of friction between the horizontal surface and the block is 0.6 and the co-efficient of restitution between the block and sphere is 0.8. Find out after impact, height 'h' reached by the sphere and distance 'x' moved by the block. [09]



- (B) A block of mass 5 kg is moving up a plane making an angle of 30° with horizontal, at 8 m/s. Find out the time required for the block to reach highest position up the plane if co-efficient of friction is 0.4. Also find the distance traveled. [08]

OR

- Q.12)(A)** A 30 kg block 'A' is connected to 50 kg block 'B' by a spring with constant $k = 200$ N/m. The blocks are placed on a smooth horizontal surface and are at rest when the spring is stretched by 1 m. If the blocks are released from rest, determine the velocity of blocks A and B at the instant spring comes to unstretched condition. [09]
- (B) Two swimmers A and B of mass 75 kg and 50 kg respectively dive off the end of a 200 kg boat. Each swimmer has a relative horizontal velocity of 3 m/s when leaving the boat. If the boat is initially at rest, find its final velocity assuming that both the swimmers dive simultaneously. [08]