Sem-II May-June-2009 [FE-2008 Sem-II course]

Total No. of Questions : 12] [Total No. of Printed Pages : 7

[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.

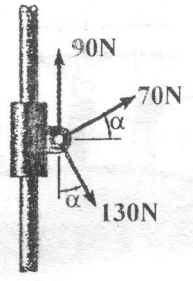
(5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and stream tables is allowed.

(6) Assume suitable data, if necessary.

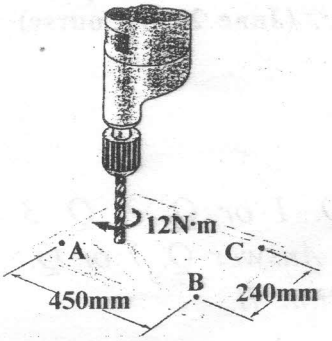
SECTION - I

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]**



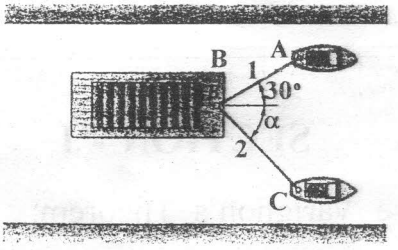
(C) A piece of plywood in which several holes are being drilled successively has been secured to a workbench by means of two nails. Knowing that the drill exerts a 12 Nm couple on the piece of plywood, determine the magnitude of the resulting forces applied to the nails if they are located (a) at A and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



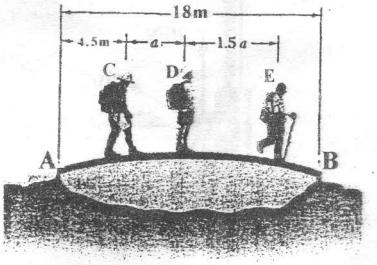
OR

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 5000N force directed along the axis of the barge, determine the value of α for which the tension in rope 2 is minimum. **[06]**

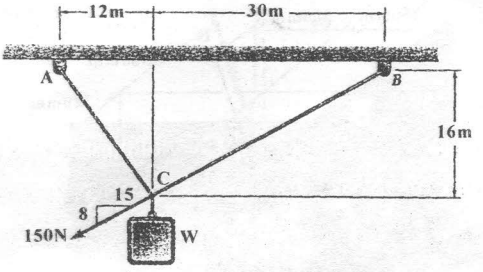


(C) Three hikers are shown crossing a footbridge. Knowing that the weights of the hikers at points C, D and E are 200N, 175N and 135N, respectively, determine the horizontal distance from A to the line of action of the resultant of the three weights when a = 3.3 m. **[06]**

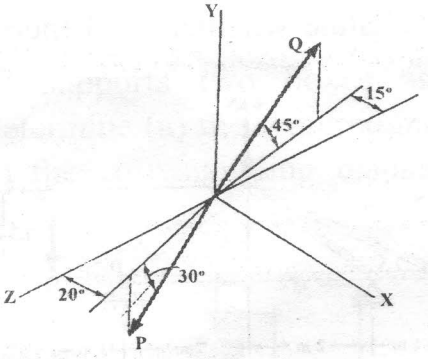


Q.3) (A) Explain with sketches any four types of Supports. **[04]**

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



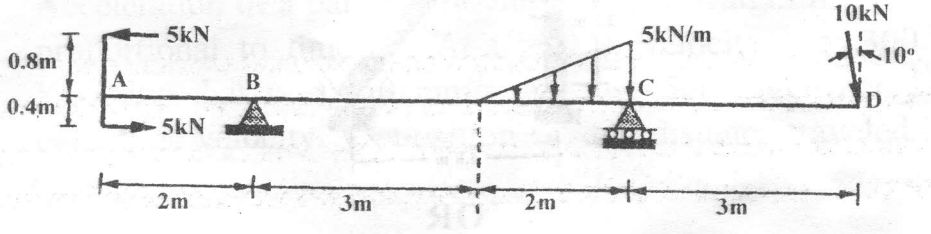
(C) Determine the magnitude and direction of the resultant of two forces shown knowing that P = 4 kN and Q = 8 kN. **[06]**



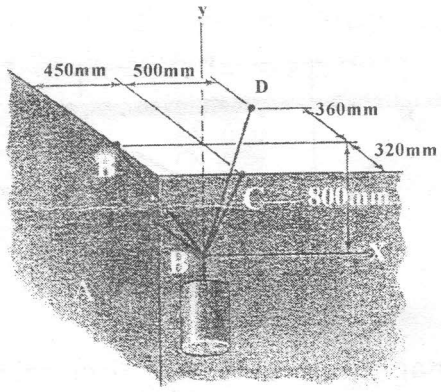
OR

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]**

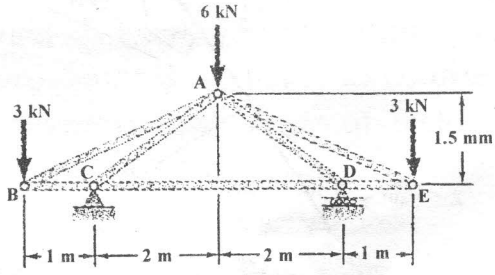
(B) A beam ABCD having self weight 2 kN/m is subjected to additional load as shown in fig. Find the support reaction at 'B' and 'C'. **[06]**



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

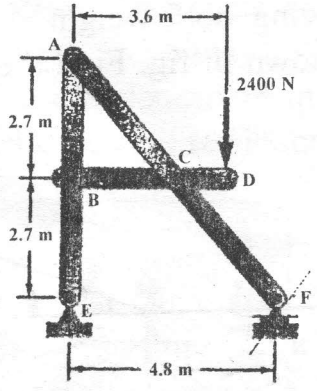


Q.5) (A) Using the method of joints, determine the force in each member of the truss shown. State whether each member is in tension or compression. [08]



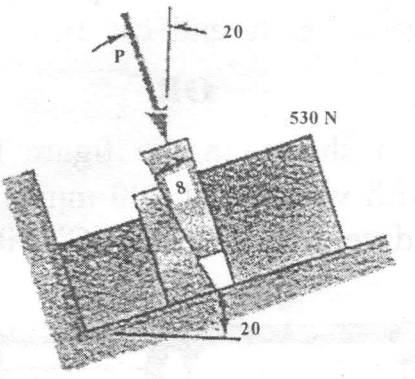
(B) State the condition for a perfect truss explaining the symbols used if any. Also define redundant and deficient truss. [04]

(C) Determine the components of the forces acting on each member of the frame shown. [04]



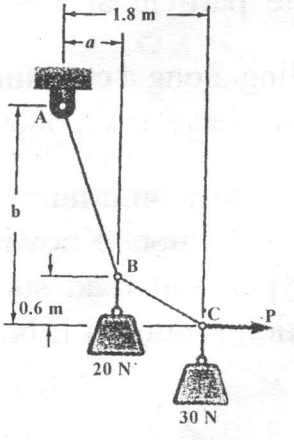
OR

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 = 2.7m, determine (a) the required magnitude of the horizontal force P, (b) the corresponding distance a. **[04]**



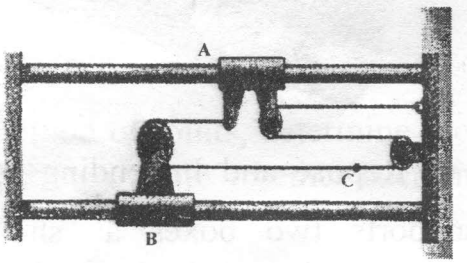
SECTION - II

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 = 1s., 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 = 0s, 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 radical and transverse components of acceleration. **[08]**

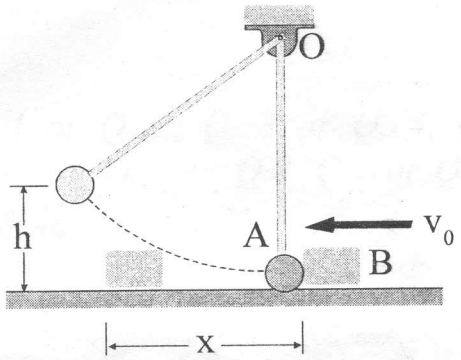
(B) An automobile is moving on a hump with radius = 50 m, along a road, at a speed 40 kmph. Knowing that the co–efficient of friction between types and road surface is 0.4, determine the tangential acceleration produced if brakes are suddenly applied. **[08]**

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_o = 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]**
