Total No. of Questions : 12] **[Total No. of Printed Pages : 9**

[3661]-108

F. E. (Semester - II) Examination - 2009

ENGINEERING MATHEMATICS

(June 2008 Pattern)

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) Answers to the **two** sections should be written in **separate answer-books**.*

(3) Figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Use of logarithmic tables, slide rule, electronic pocket calculate is allowed.

(6) Assume suitable data, if necessary.

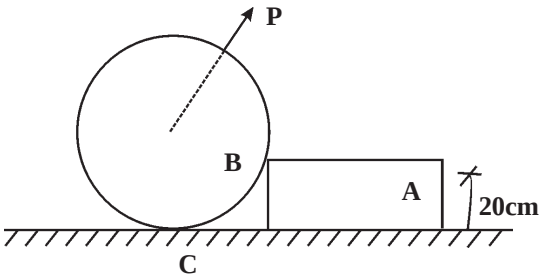
SECTION - I

Q.1) (A) Define resultant of a System of Forces. What are the various methods to determine the resultant of concurrent forces ? **[06]**

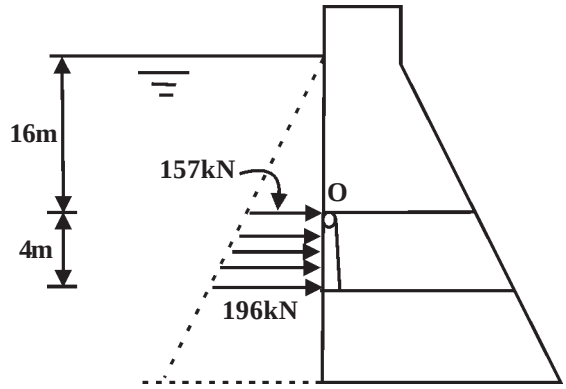
(B) A uniform wheel of 50 cm diameter and 1 kN weight rests against a regid rectangular block of thickness 20 cm. Considering all surfaces smooth, determine

(i) Least pull to be applied through the centre of wheel to just turn it over the corner of block.

(ii) Reaction of block **[06]**



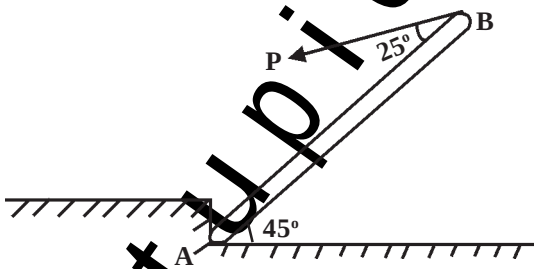
(C) Determine moment of hydrostatic force on the dam gate about hinge 'O'. **[06]**



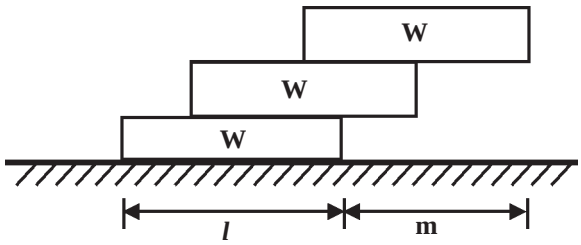
OR

Q.2) (A) Explain how a system of non-concurrent forces can be reduced to an equivalent force-couple system. **[06]**

(B) A joist of length 4m and weighing 200N is raised by pulling a rope as shown in figure. Determine the tension T induced in the rope and reaction at end A of joist. **[06]**



(C) Three identical boxes, each having length *l* and weight W are placed as shown in figure. Find out the maximum possible distance 'm' through which the top box can extend out from the bottom so that there is no possibility of topping the stack. **[06]**



Q.3) (A) State conditions of equilibrium for –

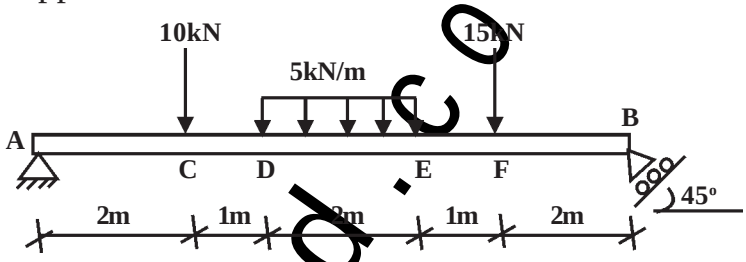
(i) Co-planer Concurrent Forces

(ii) Concurrent Forces in Space

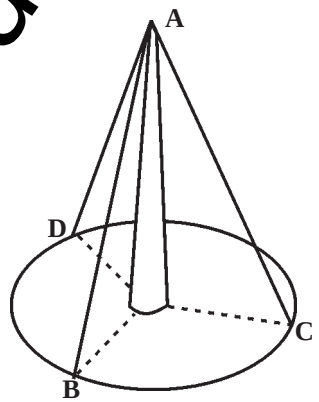
(iii) Co-planer Non-concurrent Forces

(iv) Non-concurrent Forces in Space [

(B) Find support reactions for the beam loaded as shown in figure. [



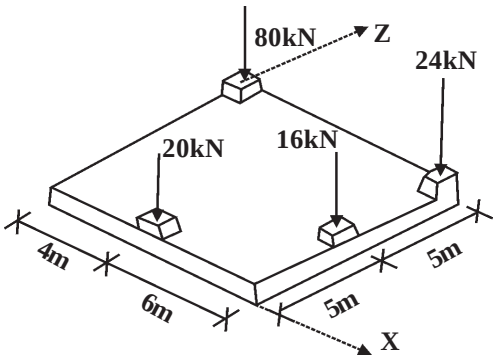
(C) A mast of height 'h' is supported by three cables AB, AC and AD placed equidistant around the circumference of circle of radius r on the ground level. Determine the resultant of tensions at A if tension in each cable is T. [



OR

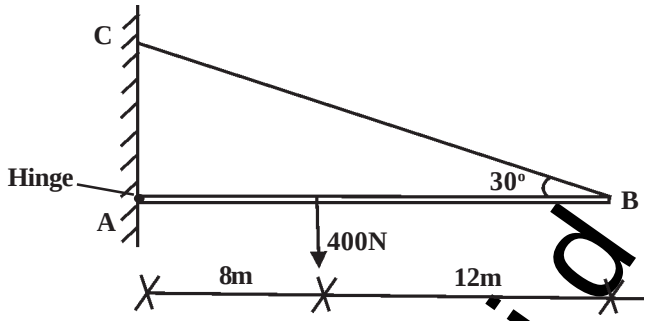
Q.4) (A) How do you convert the uniformaly distributed load and uniformaly varying load in equivalent point load. [

(B) A square foundation mat supports four columns as shown in figure. Determine magnitude and point of application of resultant of four loads.



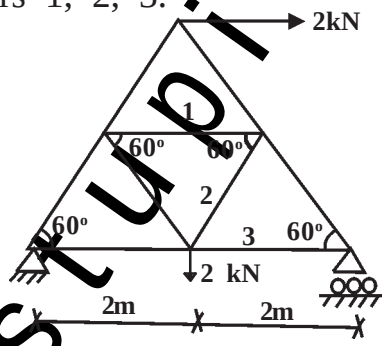
[

(C) The rail AB of foundary crane is horizontal and is 20m long. End A is hinged to vertical wall and end B is tied to a tie rod BC making an inclination of 30° with the rail. The other end C of tie rod is connected to wall. If a load of 400 N is placed on rail at a distance of 8m from end A, find the tension produced in the tie rod and reaction developed at end A. **[06]**

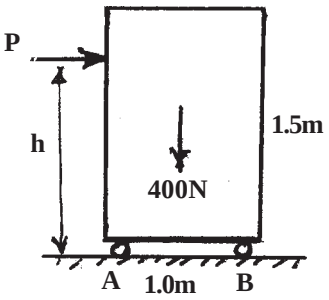


Q.5) (A) Name different methods of finding out the forces in members of a truss. When do you use these Methods ? **[04]**

(B) A truss is loaded and supported as shown in figure. Find forces in members 1, 2, 3. **[06]**



(C) A steel shelf 1.5m high 1.0m wide and weighing 400N is mounted on bushes A and B. These bushes do not rotate when the shelf is moved along the floor. Assuming that the coefficient of friction between the bushes and floor is 0.75, work out force required just to cause the shelf to move. If the shelf is not to tip over, determine the maximum height at which the force can be applied. **[06]**



OR

Q.6) (A) Define the terms :

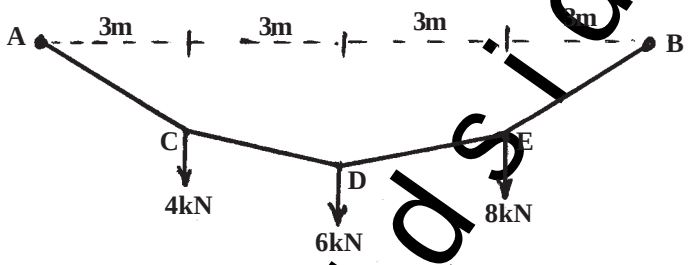
(i) Coefficient of Friction

(ii) Angle of Friction

(iii) Angle of Repose

(iv) Cone of Friction **[04]**

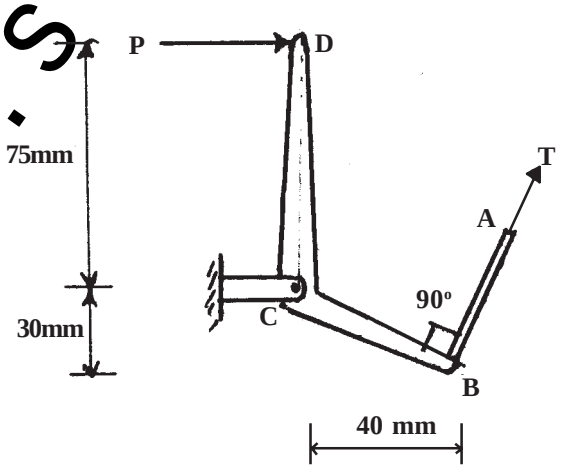
(B) A cable AB supports three loads as shown in figure. If the dip at central load is 2m, work out the components of reaction at supports, the sag under 4kN load and tension in portion CD and DE of the cable. **[06]**



(C) The lever BCD is hinged at C and is attached to a control rod at B. If P = 200N, Determine :

(i) the tension in rod AB

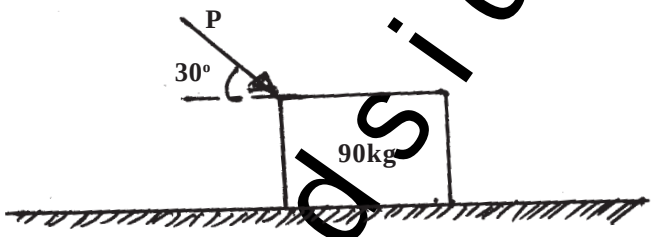
(ii) the reaction at C **[06]**



SECTION - II

Q.7) (A) The acceleration of point 'A' is defined by the relation $a = 600x\ (1 + kx^2)$, where 'a' and 'x' are expressed in m/s^2 and meters respectively and k is constant. Knowing that the velocity of A is 7.5 m/s when x = 0 and 15 m/s when x = 0.45m, determine the value of k. **[08]**

(B) A 90 kg block rests on a horizontal plane. Find the magnitude of the force 'P' required to give the block an acceleration of 3 m/s^2 to the right. The coefficient of friction between the block and the plane is $_k = 0.25$. **[09]**



OR

Q.8) (A) Two ships 'A' and 'B' are at a given instant 4km away from each other and both are on south-east line. Ship 'A' is travelling at 8 kmph due east and ship 'B' is travelling at 12 kmph due north. Determine –

(i) Velocity of 'B' with respect to 'A'.

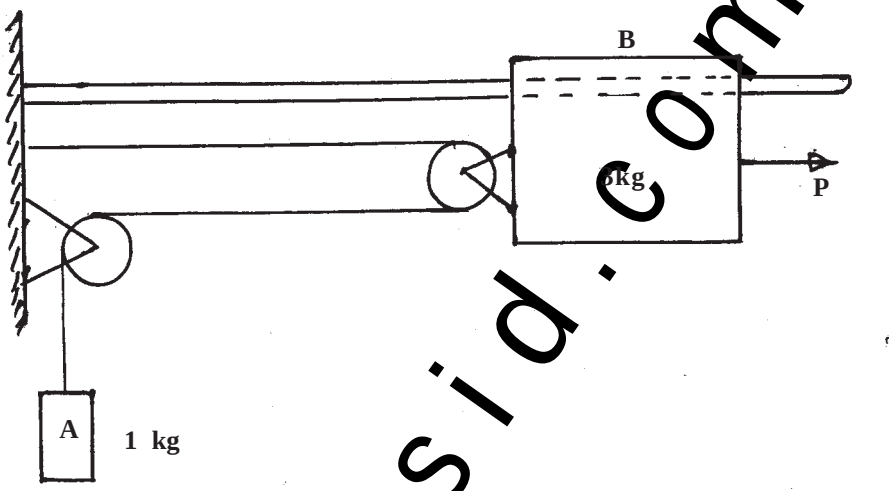
(ii) The shortest distance between the two ships.

(iii) Time to get the shortest distance. **[08]**

(B) The system shown in fig. is initially at rest. Neglecting friction, determine

(i) The force 'P' required if the velocity of the collar 'B' is to be 5m/s after 2 sec.

(ii) The corresponding tension in the cable. **[09]**



Q.9) (A) A speed of racing car is increasing at constant rate from 100 kmph to 120 kmph over a distance of 180 m along a curve of 240 m radius. Determine magnitude of total acceleration of car after it has travelled 120m along the curve. **[08]**

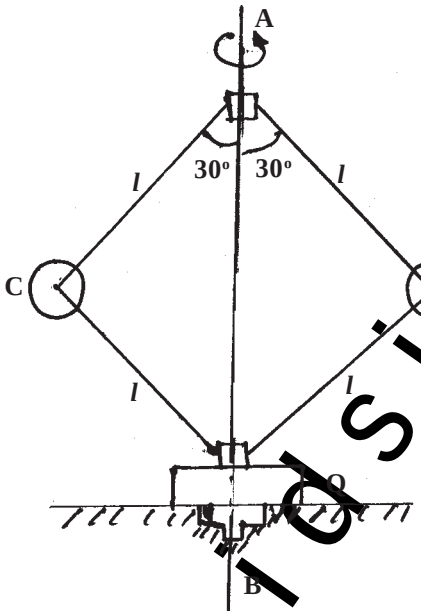
(B) A motor cyclist is moving in a spherical cage of 3.6 m radius in a circus show. The mass of motor cycle and the rider together is 240 kg. What shall be the minimum speed with which the Motor Cyclist can pass through the highest point without loosing the contact inside the cage ?

If he is moving with 36 kmph, what force is transmitted to the cage ? **[08]**

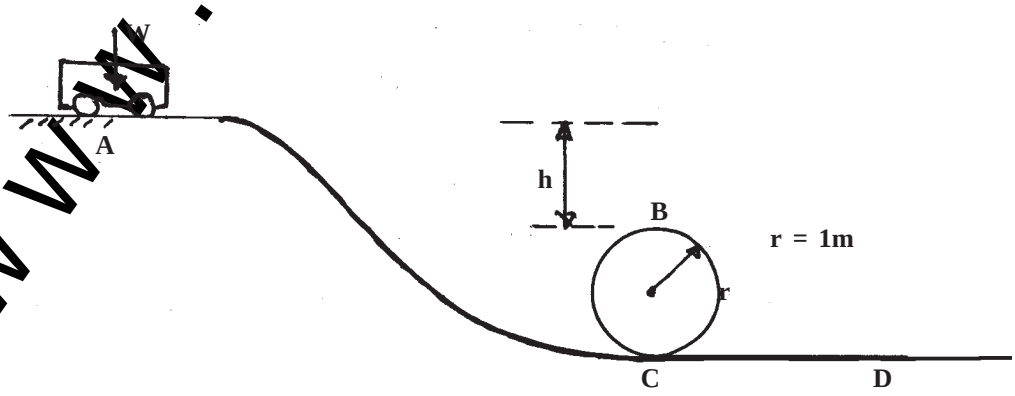
OR

Q.10) (A) A projectile is fired with an initial velocity of 240 m/s at a target 'B' located 600 m above the gun and at a horizontal distance of 3600m. Neglecting air resistance determine the value of the firing angle . **[08]**

(B) At what uniform speed of rotation around the vertical axis AB will the ball 'C' and 'D' of equal weight 'W' begin to lift the weight 'Q' of the device as shown in fig. ? Neglect all frictions and weights of four hinged bars of length '*l*'. The weight 'Q' can slide freely along the shaft 'AB'. Take W = 44.5N, Q = 89N, *l* = 250mm. **[08]**



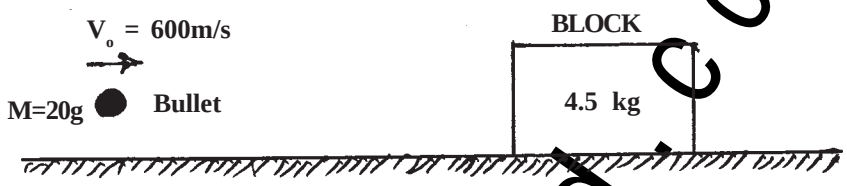
Q.11) (A) A small weight 'W' starts from rest from point 'A' and rolls without friction along the loop 'ABCD'. What is the least height 'h' above the top of the loop at which car can start without falling off the track at point 'B' and for such starting position, what velocity the car will have along the portion CD of the track ? **[09]**



(B) A 20 g bullet is fired with a velocity of magnitude V_o = 600 m/s. into a 4.5 kg block of wood which is stationary. Knowing that the coefficient of kinetic friction between the block and the floor is 0.4, determine

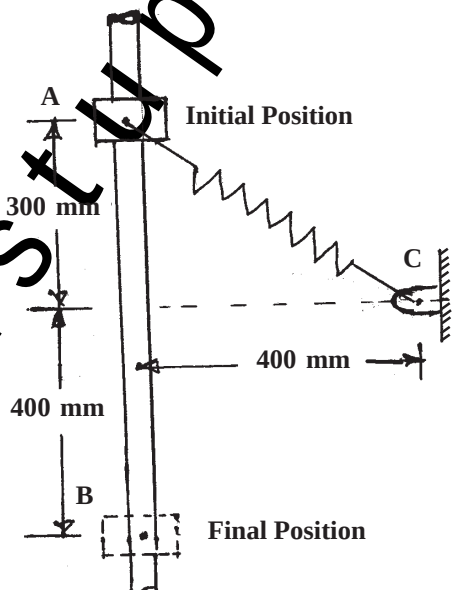
(i) How far the block will move.

(ii) The percentage of the initial energy lost in friction between the block and the floor. Refer the fig. **[08]**



OR

Q.12) (A) A collar of mass 10 kg moves on a vertical guide as shown in fig. Neglecting friction between the guide and collar, find the velocity of the collar after it has fallen 700 mm, starting from rest from the position A as shown. The unstretched length of the spring is 200mm and its stiffness is 200 N/m. **[09]**



(B) A ball 'A' of mass 0.25 kg, moving on smooth horizontal table with velocity of 10 m/s, strikes on identical stationary ball 'B' on the table. Find the velocity of ball 'B' just after the impact. Consider the impact as perfect plastic. **[08]**