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

[3561]-18

F. E. Examination - 2009

ENGINEERING MECHANICS

(2003 Course)

Time : 3 Hours] [Max. Marks : 100

Instructions :

(1) Answer Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6 from section I and Q.7 or Q.8, Q.9 or Q.10 and Q.11 or Q.12 from section II.

*(2) Answer to the **two sections** should be written in **separate answer-books**.*

(3) Figures to the rights indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Assume suitable data, if necessary and clearly mention.

(6) Use of electronic pocket calculator is allowed.

(7) Use of cell phone is prohibited in the examination hall.

SECTION - I

Q.1) (A) State Law of Parallelogram of forces and obtain an expression for magnitude and direction of resultant force. [05]

(B) State and explain principle of transmissibility of force with example. [05]

(C) Locate the centroid of the shaded area shown in Fig. 1(C). [08]

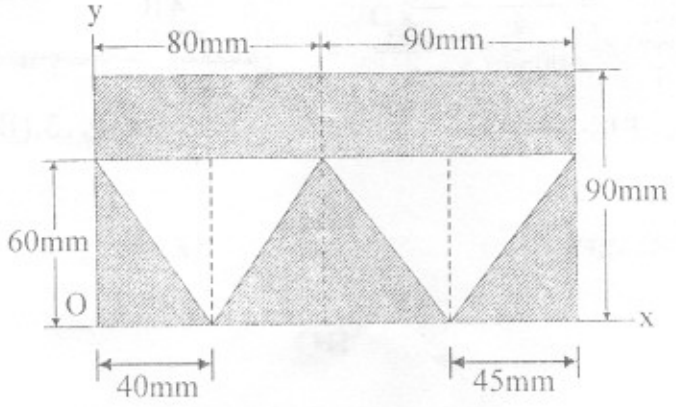

Fig. 1.(C)

OR

Q.2) (A) Three forces are acting along the sides of the triangle as shown in **Fig. 2.(A)**. Find the direction of resultant and the values of force 'P' if the magnitude of resultant force is 100N. **[08]**

(B) Knowing that $W_A = 100$ N and $\theta = 30°$, determine the smallest and largest value of W_B for which the system is in equilibrium. Refer **Fig.2.(B)**. **[10]**

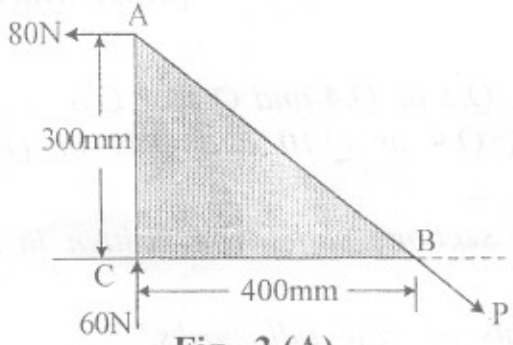

Fig. 2.(A)

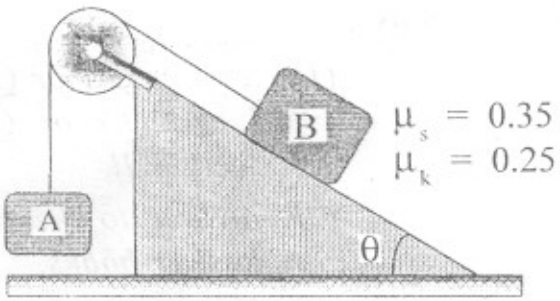

Fig. 2.(B)

Q.3) (A) A pin jointed truss is loaded and supported as shown in **Fig. 3.(A).** Identify the zero force members. Also find the forces in other members and components of reaction at A and D. **[08]**

(B) Determine the reaction at supports B and C for the beam ABCD loaded and supported as shown in **Fig. 3.(B)** if w = 1.5 kN/m. **[08]**

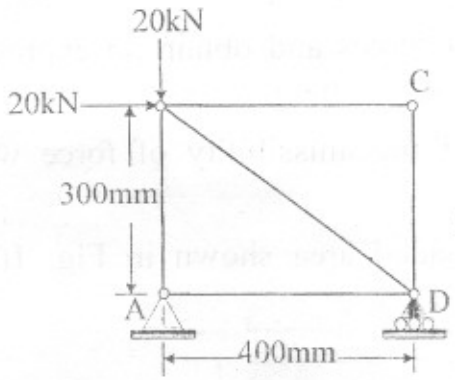

Fig. 3.(A)

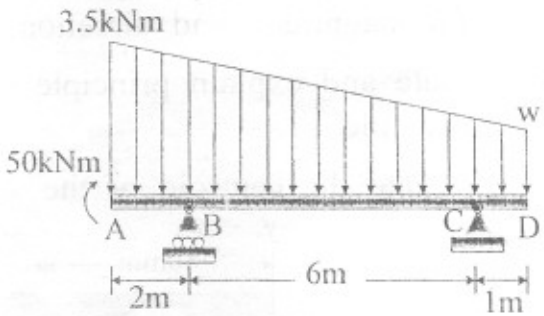

Fig. 3.(B)

OR

Q.4) (A) The maximum allowable tension in the cable as shown in **Fig. 4.(A)** is 10 kN. Determine the magnitude of load W_1 and W_2 for the equilibrium. Also find the reactions at A and D. **[08]**

(B) Determine the tension in cable ABD and the reaction at support C as shown in **Fig. 4.(B)** for equilibrium. **[08]**

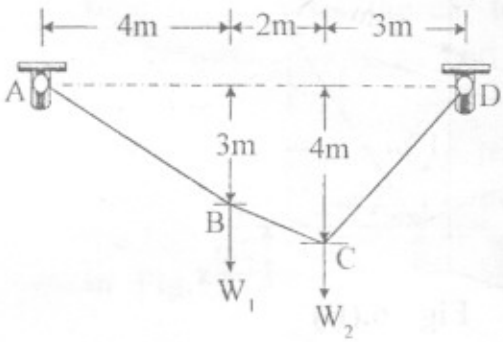

Fig. 4.(A)

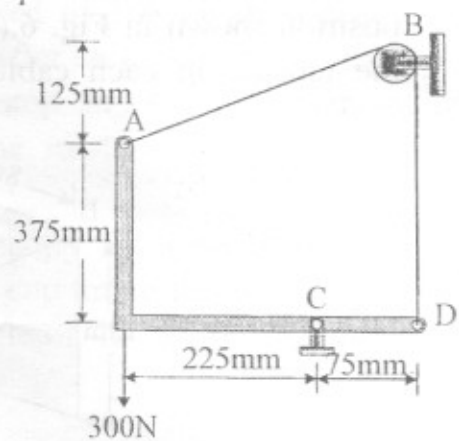

Fig. 4.(B)

Q.5) (A) Determine the support reactions at A and B for the beam shown **in Fig. 5.(A)** by virtual work method. **[08]**

(B) A square foundation mat supports the four columns shown in **Fig. 5.(B)**. Find the magnitude and point of application of the resultant of the four loads. **[08]**

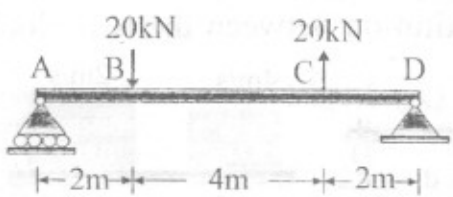

Fig. 5.(A)

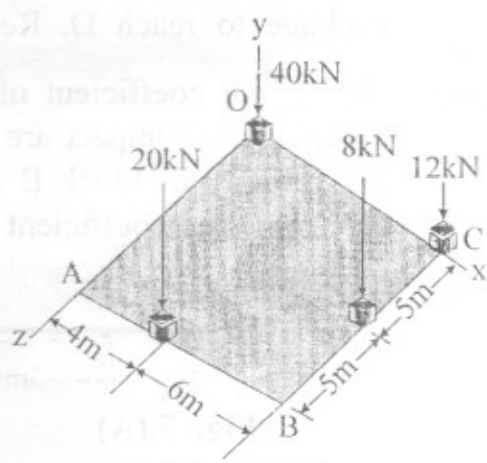

Fig. 5.(B)

OR

Q.6) (A) State the principle of virtual work and its application to solve the problem of mechanism with suitable example. [08]

(B) A 200 kg cylinder is hung by means of two cable AB and AC, which are attached to the top of a vertical wall. A horizontal force P perpendicular to the wall holds the cylinder in the position shown in **Fig. 6.(B)**. Determine the magnitude of P and the tension in each cables. [08]

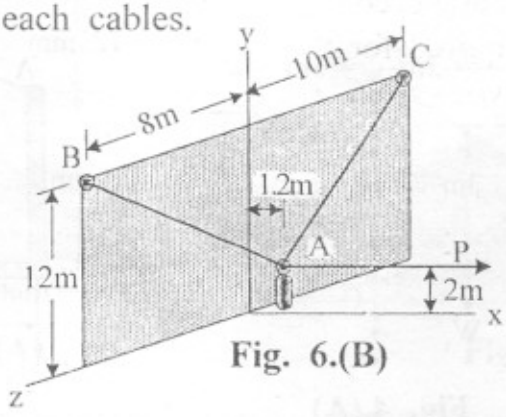

Fig. 6.(B)

SECTION - II

Q.7) (A) A block is released from rest at A and moves along the plane ABCD. It has an acceleration of 4.8 m/s^2 as it moves from A to B and C to D, and its velocity is constant between B and C. If the velocity of the block at D is 7.2 m/s. determine (a) the distance d between C and D, (b) the time required for the package to reach D. Refer **Fig. 7.(A)**. [08]

(B) Define the coefficient of restitution. The velocities of the two blocks before impact are as shown in **Fig. 7.(B)**. If after impact the velocity of block B is observed to be 2.5 m/s to the right, determine the coefficient of restitution between the two blocks. [08]

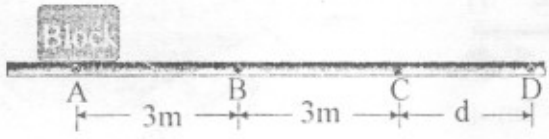

Fig. 7.(A)

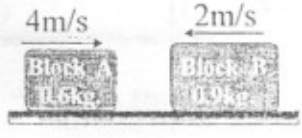

Fig. 7.(B)

OR

Q.8) (A) Airplane A is flying due east at 700 kmph, while plane B is flying at 500 kmph at the same altitude and in the direction west of south. Knowing that the speed of B with respect to A is 1125 kmph, determine the direction of the flight path of B. [08]

(B) A motorist traveling at a speed of 108 kmph suddenly applies the brake and comes to rest after skidding 75 m. Determine the time required for the car to stop and the coefficient of friction μ_k between the tyres and the road. [08]

Q.9) (A) Derive an expression of trajectory for a projectile projected on horizontal surface and hence determine the initial velocity v_0 of the ball if it is shot at an angle of 40° with horizontal as shown in **Fig. 9.(A)**. [08]

(B) A small 0.2 kg sphere B is given a downward velocity v_0 and swing freely in the vertical plane, first about O and then about the peg A after the cord comes in contacts with the peg. Determine the largest allowable velocity v_0 if the tension in the cord is not exceed 10N. Ref. **Fig. 9.(B)**. [08]

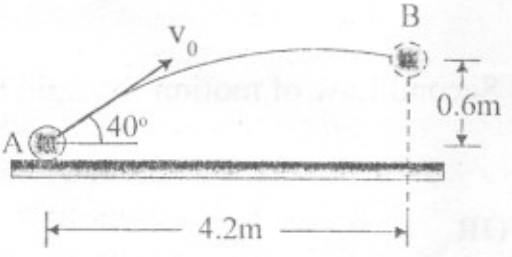

Fig. 9.(A)

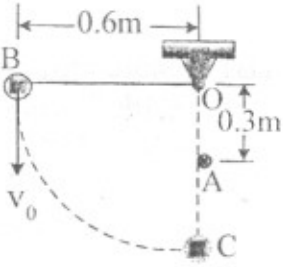

Fig. 9.(B)

OR

Q.10) (A) Derive an expression for normal and tangential components of acceleration for curvilinear motion of particle. [08]

(B) A small sphere of weight W = 10N is held as shown by the wires AB and CD. If wire AB is cut, determine the tension in the other wire (a) before AB is cut, (b) immediately after AB has been cut. Refer Fig. **10.(B)** [08]

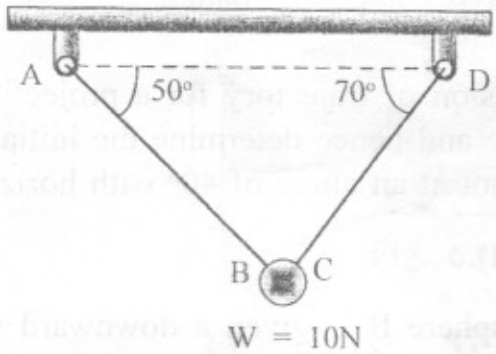

Fig. 10.(B)

Q.11)(A) A flywheel executes 1800 revolutions while it comes to rest from a speed of 6000 rpm. For uniform accelerated motion, determine the time required for the flywheel to (a) come to rest, (b) execute the first 900 revolutions. [10]

(B) State and explain Newton's Second Law of motion for rigid body with suitable example. [08]

OR

Q.12)(A) The motion of rod AB is guided by pins attached at A and B which slide in the slots shown in **Fig. 12.(A)**. At the instant shown, $\theta = 40^{\circ}$ and the pin B moves upward to the left with a constant velocity of 150 mm/s. determine the angular velocity of the rod and the velocity of the pin at end A. [09]

(B) The double pulley as shown in **Fig. 12.(B)** has a mass moment of inertia of 20 kg.m^2 and is intially at rest. The outside radius is 400 mm and inner radius is 200 mm. Determine (a) the angular acceleration of pulley, (b) the angular velocity of pulley after point A on the cord has moved 3 m. **[09]**

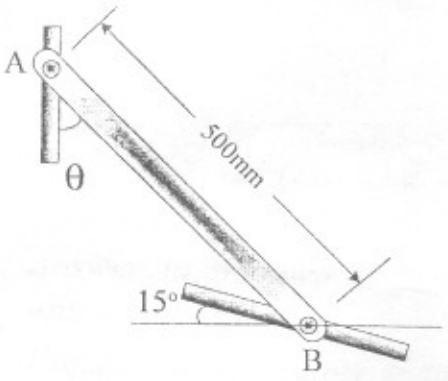

Fig. 12.(A)

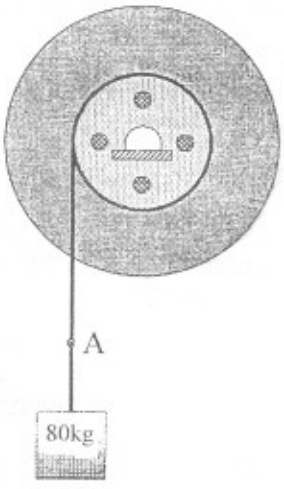

Fig. 12.(B)