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

[3761]-108

F. E. (Semester - II) Examination - 2010

ENGINEERING MECHANICS

(June 2008 Pattern)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) *Attempt Q.1 or Q.2, Q.3 or Q.4, 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) *Answers 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.*

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

(7) *Use of electronic non-programmable pocket calculator is allowed.*

SECTION - I

Q.1) (A) Determine the resultant force in magnitude and direction for concurrent force system as shown in **Fig. 1(A).** **[08]**

(B) Locate the centroid of the shaded area as shown in **Fig. 1(B)** with respect to origin O. **[08]**

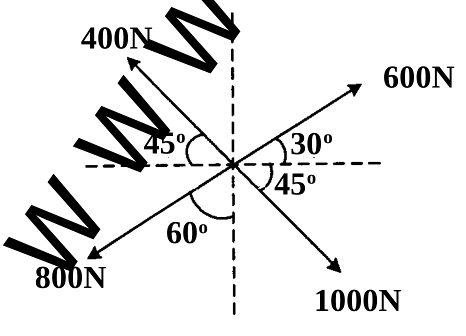


Fig. 1(A)

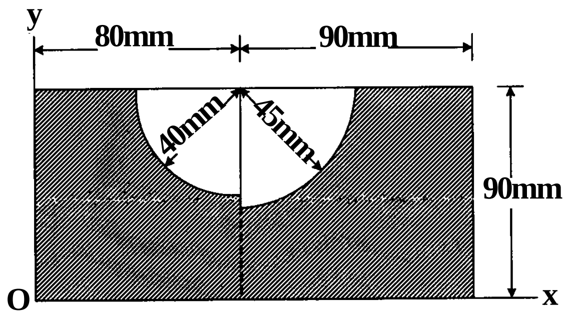


Fig. 1(B)

OR

Q.2) (A) Two forces F_1 = 500N and F_2 = 300N are acting at point A as shown in **Fig. 2(A).** If the resultant of two force has a magnitude of 750N and acts vertically downward, determine the angle θ and ϕ. **[08]**

(B) A 600N force is applied at an angle θ = 20º. Determine the equivalent force couple system at point A and O. For what value of θ the results at point A and O should be identical. Refer **Fig. 2(B).** **[08]**

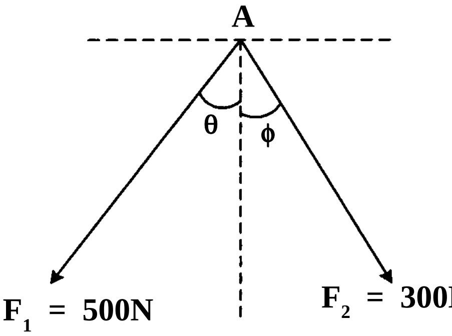


Fig. 2(A)

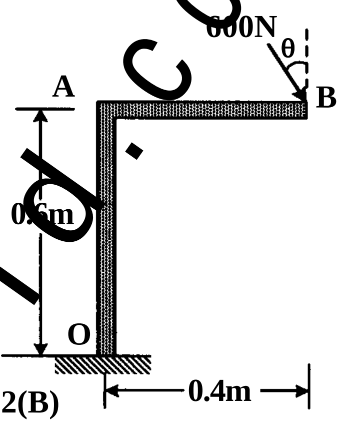


Fig. 2(B)

Q.3) (A) Two identical prismatic bars each of weight 5N, AB and CD are welded together in the form of T as shown in **Fig. 3(A).** Find angle θ that the CD will make with vertical when vertical load P = 10N is applied at B. **[08]**

(B) The tower is held in place by three cables. If the force of each cable acting on the tower is shown in **Fig. 3(B),** determine the resultant. **[10]**

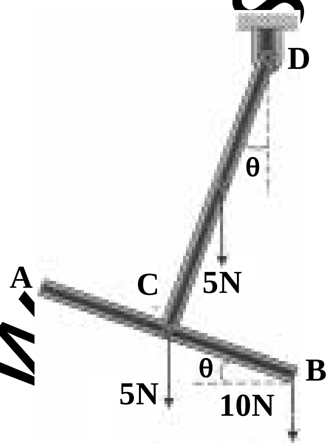


Fig. 3(A)

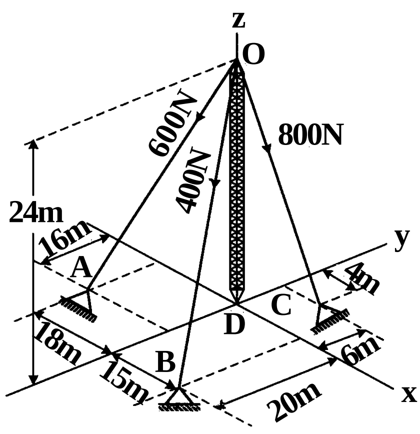


Fig. 3(B)

OR

Q.4) (A) Determine the support reactions for beam AB loaded and supported as shown in **Fig. 4(A)**. **[08]**

(B) A uniform rod of weight W is bent into a circular ring of radius R and is supported by three wires as shown in **Fig. 4(B)**. Determine the tension in each wire. **[10]**

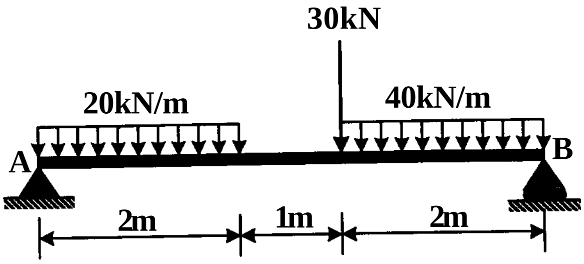


Fig. 4(A)

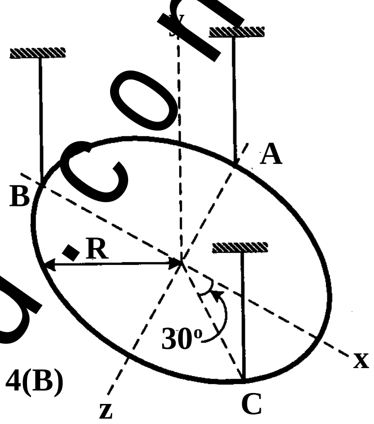


Fig. 4(B)

Q.5) (A) Determine the forces in each member of the truss loaded and supported as shown in **Fig. 5(A).** **[08]**

(B) A 120 kg block is supported by a rope which is wrapped one and half times around a horizontal rod. The coefficient of static friction between the rod and the rope is μ_s = 0.15, determine the range of values of P for which equilibrium is maintained. Refer **Fig. 5(B)**. **[08]**

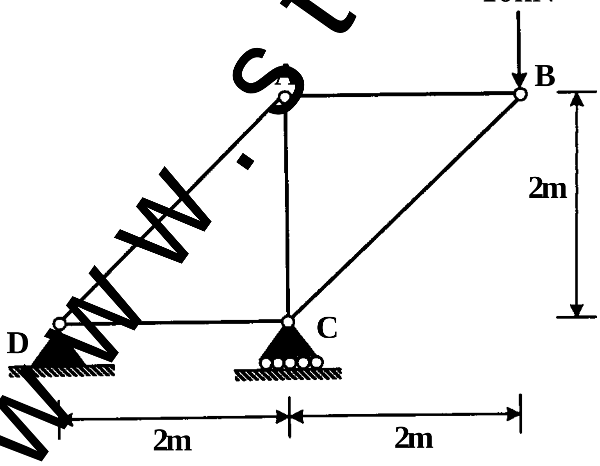
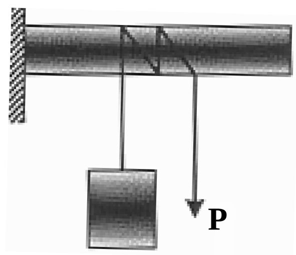


Fig. 5(A)



120 kg Block

Fig. 5(B)

OR

Q.6) (A) Knowing that W_A = 25N and θ = 30°, determine the range of values of W_B for which the system is in equilibrium. Refer **Fig. 6(A)**. **[08]**

(B) Determine the horizontal and vertical components of force that pins A and C exert on the frame. Refer **Fig. 6(B)**. **[08]**

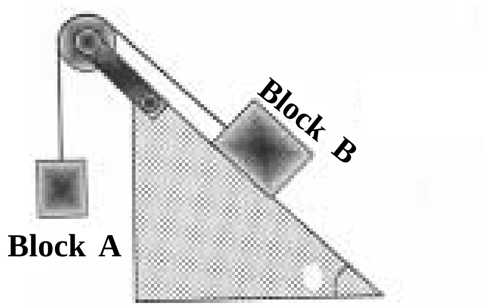


Fig. 6(A)

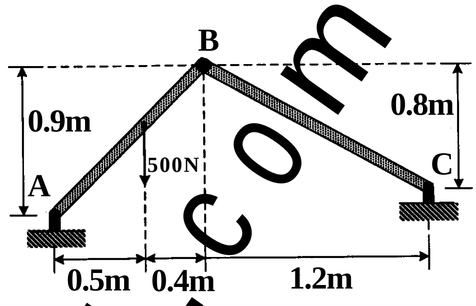


Fig. 6(B)

SECTION - II

Q.7) (A) The v-t diagram for the motion of the train as it moves from station A to station B is shown in **Fig. 7(A)**. Determine the average speed for the train and the distance between the stations. Also draw the a-t curve. **[08]**

(B) Determine the constant force F which must be applied to the cord in order to cause the 150N block A to have a speed of 3.6 m/s when it has been displaced 1 m upward starting from rest. Neglect the weight of the pulleys and cord. Refer **Fig. 7(B)**. **[10]**

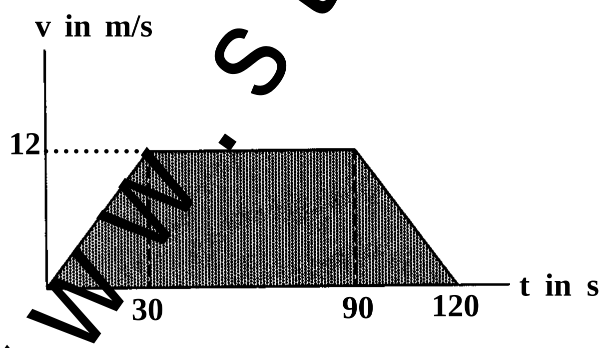


Fig. 7(A)

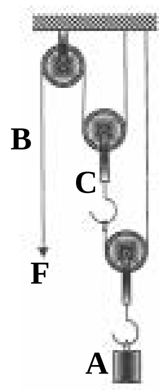


Fig. 7(B)

OR

Q.8) (A) A car attained a speed of 24 m/s after traveling 150 m along a straight road. Determine the constant acceleration and the time of travel when a car (a) starts from rest, (b) starts with initial velocity of 12 m/s. **[08]**

(B) The 50 kg crate shown in **Fig. 8(B)**, rest on horizontal plane for which the coefficient of kinetic friction is $\mu_k = 0.3$. If the crate does not tip over when it is subjected to a 400N force, determine the velocity of the crate in 5 s starting from rest. **[10]**

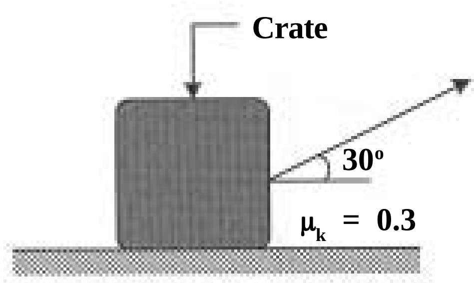


Fig. 8(B)

Q.9) (A) A particle moves along the path $r = \{ (8\,t^2)i + (t^3 + 5)j \}$ m, where t is in seconds. Determine the magnitudes of particle velocity and acceleration when t = 3s. **[08]**

(B) Determine the maximum constant speed at which the pilot can travel around the vertical curve having a radius of curvature $\rho = 800$ m, so that he experience a maximum acceleration $a_n = 8g = 78.5\ m/s^2$. If he has a mass of 70 kg, determine the normal force he can exerts on the seat of the airplane when the plane is traveling at this speed and is at its lowest point. Refer **Fig. 9(B)**. **[08]**

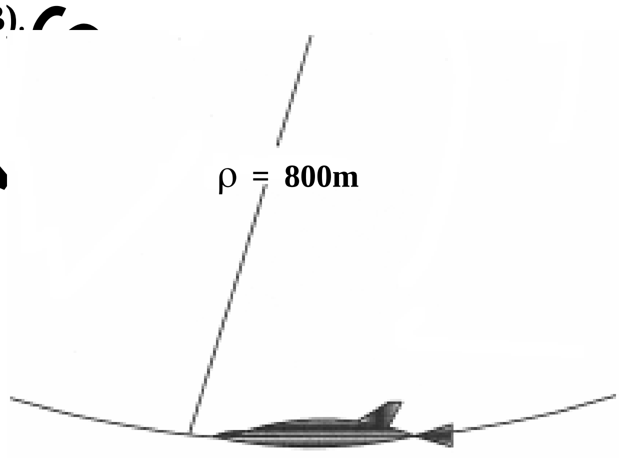


Fig. 9(B)

OR

Q.10) (A) For a short distance the train travels along a track having a shape of spiral, r = (1000/θ) m, where θ is in radians. If it maintains a constant speed ν = 20 m/s, determine the radial and transverse components of its velocity when θ = (9π/4) radian. **[08]**

(B) Determine the constant speed of the passengers on the amusement park ride if it is observed that the supporting cable are at θ = 30° from the vertical. Each chair including its passengers has a mass of 80kg. Refer **Fig. 10(B).** **[08]**

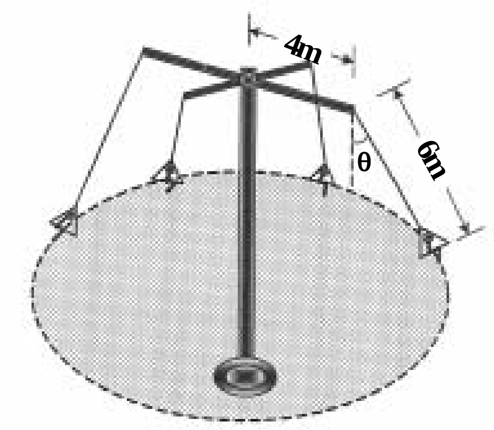


Fig. 10(B)

Q.11)(A) Define Conservative and Non-conservative Forces with example. **[04]**

(B) State the principle of Conservation of Energy and derive an expression for the same. **[04]**

(C) The force acting on the 250N crate has a magnitude of $F = (12t^2)$ N, where t is in seconds. If the crate starts from rest, determine its speed when t = 5s. The coefficient of static and kinetic friction between the floor and crate are 0.3 and 0.2 respectively. Refer **Fig. 11(C)**. **[08]**

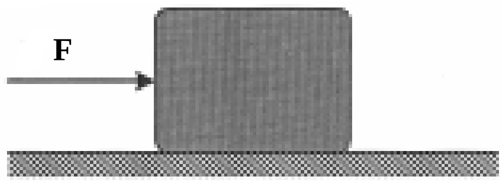


Fig. 11(C)

OR

Q.12)(A) The double spring bumper is used to stop the 7500N steel billet in a rolling mill. Determine the stiffness $k = k_1 = k_2$ of each spring so that no spring is compressed more than 0.06 m after it is struck by the billet travelling with a speed of 2.4 m/s. Neglect the mass of the springs, rollers and the plates A and B. Refer **Fig. 12(A)**. **[08]**

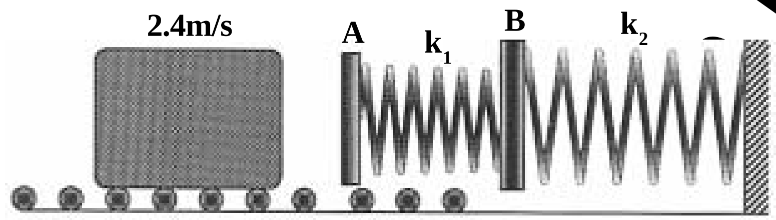


Fig. 12(A)

(B) Block A has a mass of 250 kg and is sliding on a smooth surface with an initial velocity of 2 m/s. It makes a direct impact with block B, which has a mass of 175 kg and is originally at rest. If both blocks are of the same size and the impact is perfectly elastic (e = 1), determine the velocity of each block just after impact. Show that the kinetic energy of the blocks before and after impact is the same. **[08]**
