May - June - 2011

[3961] – 114

F.E. (Semester – II) Examination, 2011
ENGINEERING MECHANICS
(For Students Admitted during the Academic Year 2009-2010 and Onwards)
(2008 Pattern)

Time : 2 Hours | Max. Marks : 50

Instructions : *1) **Attempt** Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6.*
*2) Answer should be written in **one** answer book.*
*3) **Neat** diagram must be drawn **wherever** necessary.*
*4) Figure to the **right** indicates **full** marks.*
*5) **Assume** suitable data, **if necessary** and clearly state.*
*6) **Use** of cell phone is **prohibited** in the examination hall.*
*7) **Use** of electronic pocket calculator is **allowed**.*

1. a) Two forces are shown in Fig. 1a. Knowing that the magnitude of P is 600 N, determine (a) the required angle θ if the resultant R of the two forces is to be vertical, (b) the corresponding value of R. **6**

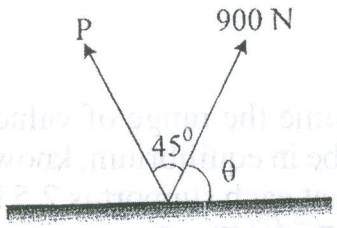

Fig. 1 a

b) A base ball is thrown downward from a 15 m tower with an initial speed of 5 m/s. Determine the speed at which it hits the ground and the time of travel. **6**

OR

2. a) Determine the position of centroid of the shaded area as shown in Fig. 2 a with respect to origin O. **6**

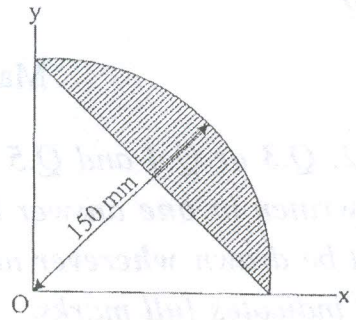

Fig. 2 a

b) The conveyor belt is designed to transport packages of various weights. Each 10 kg package has a coefficient of kinetic friction $\mu_k = 0.15$. If the speed of the conveyor is 5 m/s, and then it suddenly stop, determine the distance the package will slide on the belt before coming to rest. Refer Fig. 2 b. **6**

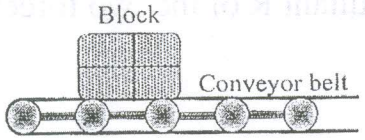

Fig. 2 b

3. a) For the given loading of the beam AB, determine the range of values of the mass 'm' of the crate for which the system will be in equilibrium, knowing that the maximum allowable value of the reactions at each support is 2.5 kN and the reaction at E must be directed downward. Refer Fig. 3 a. **6**

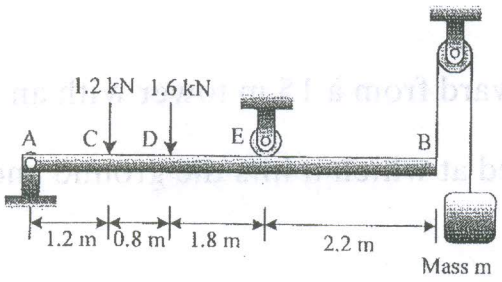

Fig. 3 a

b) A vertical load of 50 kg is supported by three rods as shown in Fig. 3 b. Determine the force in each rod for the co-ordinates of points as below.
A(– 4, – 1, 0), B (3, 3, 0), C(3, – 2, 0) and D(0, 0, 6). **7**

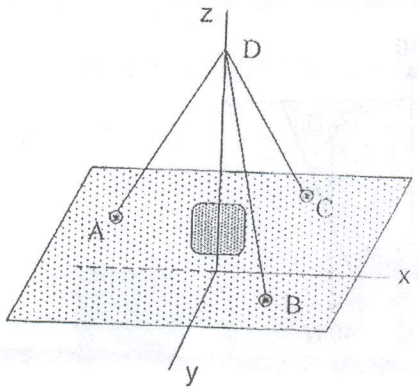

Fig. 3 b

c) A particle position is describe by the co-ordinates r = (2sin 2θ) m and θ = (4t)rad, where t is in seconds. Determine the radial and transverse components of its velocity and acceleration when t = 1s. **6**

OR

4. a) The L-shaped member ACB is supported by a pin support at C and by an inextensible cord attached at A and B and passing over a frictionless pulley at D. Determine the tension in the cord and the reaction at C. Refer Fig.4 a. **7**

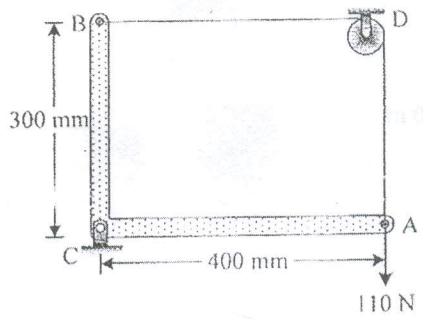

Fig. 4 a

b) Determine the magnitude of the resultant and its location with respect to origin O as shown in Fig.4 b. **6**

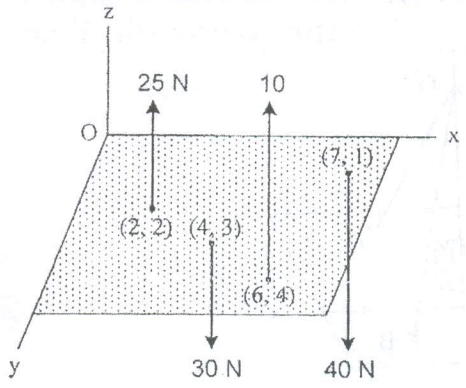

Fig. 4 b

c) 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 experiences a maximum acceleration $a_n = 8g = 78.5$ m-s^2. If he has a mass of 70 kg, determine the normal force he exerts on the seat of the airplane when the plane is traveling at this speed and is at the lowest point. Refer Fig. 4 c. **6**

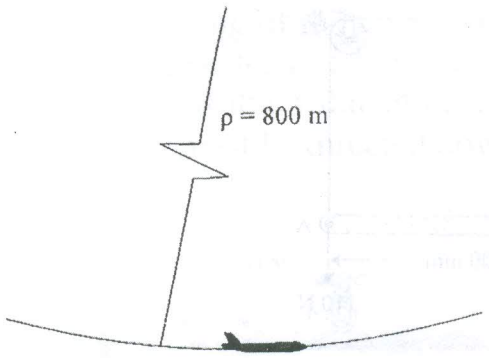

Fig. 4 c

5. a) Blocks A and B have masses of 40 kg and 60 kg respectively. They are placed on a smooth surface and the spring connected between them is stretched 2 m. If they are released from rest, determine the speeds of both blocks the instant the spring becomes unstretched, by work energy method. Refer Fig. 5 a. **6**

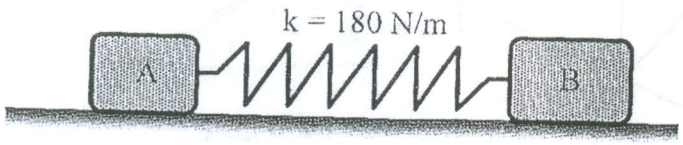

Fig. 5 a

b) A cable passes around three 0.05 m radius pulleys and supports two blocks as shown in Fig. 5 b. Pulleys C and E are locked to prevent rotation and the coefficient of friction between the cable and pulleys are $\mu_s = 0.2$. Determine the range of values of the weight of block A for which equilibrium is maintained, if the pulley D is free to rotate. **7**

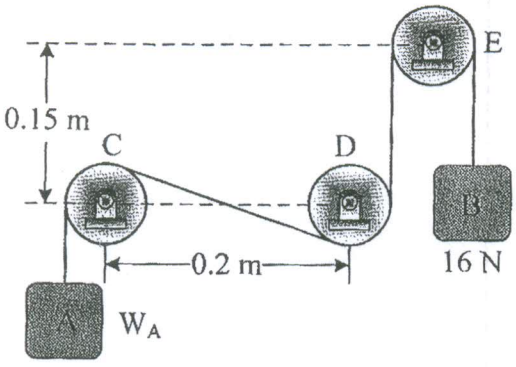

Fig. 5 b

c) Identify zero force members and find magnitude and nature of forces in remaining members of the truss as shown in Fig. 5 c. **6**

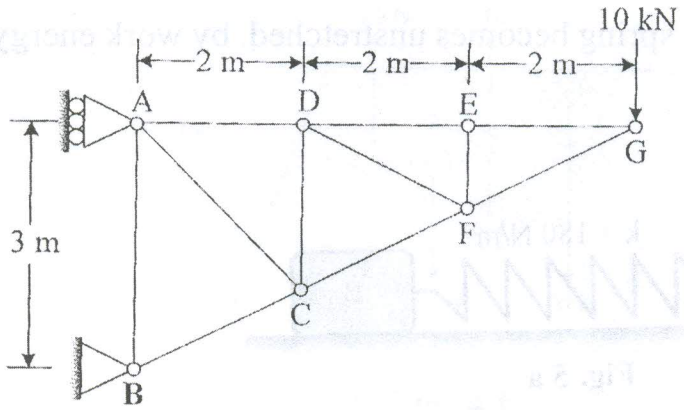

Fig. 5 c

OR

6. a) Cable ABC supports two boxes as shown in Fig. 6 a. Knowing that b = 2.7 m, determine the required magnitude of the horizontal force P and the corresponding distance a. **6**

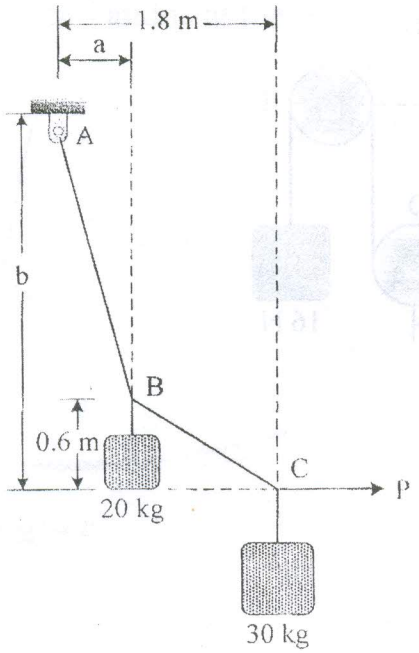

Fig. 6 a

b) Determine whether the block shown in Fig. 6 b, is in equilibrium, and find the magnitude and direction of the friction force when $\theta = 30°$ and $P = 200$ N. **7**

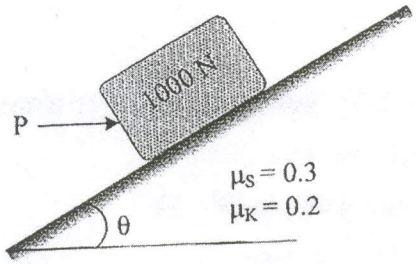

Fig. 6 b

c) A jet plane has a mass of 250 Mg and a horizontal velocity of 100 m/s when $t = 0$. If the engines provide a resultant horizontal thrust $F = (40 + 0.5t)$ kN, where t is in seconds. Using impulse momentum principle determine the time needed for the plane to attain a velocity of 200 m/s. Neglect air resistance and the loss of fuel during the motion. **6**
