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ET-202(A)

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B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering)

BTCLEVI/BTMEVI/BTELVI/BTECVI/BTCSVI

Term-End Examination

December, 2012

ET-202(A) : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any seven** questions. Use of **scientific** calculator is **permitted**.*

1. (a) To move a boat uniformly along a canal at a given speed requires a resultant force R = 1780 N. This is accomplished by two horses pulling with forces P and Q on two ropes as shown in figure 1. If the angles that the two ropes make with the axis of the canal are $\beta = 35°$, and $\gamma = 25°$, what are the corresponding tensions in the ropes. **5+5**

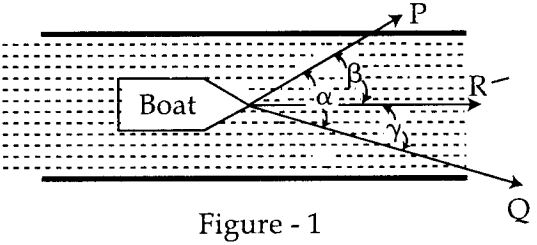

Figure - 1

(b) A ball of weight Q = 53.4 N rests in a right angled trough as shown in figure 2. Determine the forces exerted on the sides of the trough at D and E and if all surfaces are perfectly, smooth.

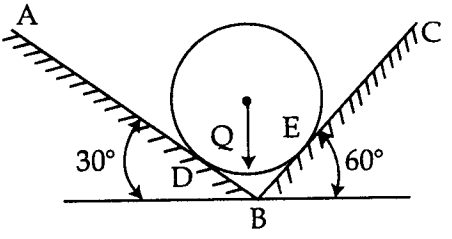

Figure - 2

2. (a) Find the magnitude and direction of the force F to be added to the system of coplanar concurrent forces as shown in figure 3 to maintain equilibrium. 5+5

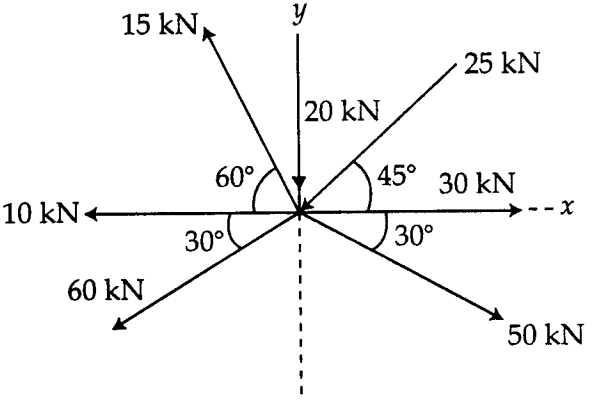

Figure - 3

(b) A ball of weight Q and radius r is attached by a string AD to a vertical wall AB, as shown in figure 4. Determine the tensile force S in the string and the reaction R_b against the wall at B, if Q = 35.6 N, r = 75 mm, AB = 100 mm, Neglect friction at wall.

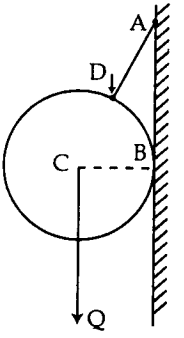

Figure - 4

3. (a) A roller of radius r = 304.8 mm, and weight Q = 2225 N is to be pulled over a curb of height h = 152.4 mm by a horizontal force P applied to the end of a string wound around the circumference of the roller as shown in figure-5. Find the magnitude of P required to start the roller over the curb. 5+5

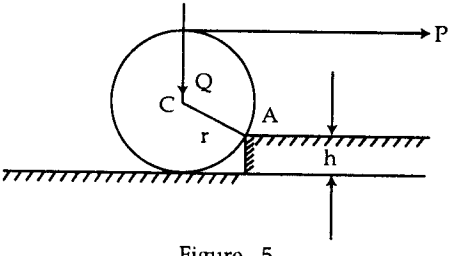

Figure - 5

(b) Two blocks of weights W_1 and W_2 rest on a rough inclined plane and are connected by a short piece of string as shown in figure 6. If the co-efficient of fricition are $\mu_1 = 0.2$ and $\mu_2 = 0.3$ respectively. Find the angle of inclination of the plane for which sliding will impend.

Assume $W_1 = W_2 = 22.25$ N

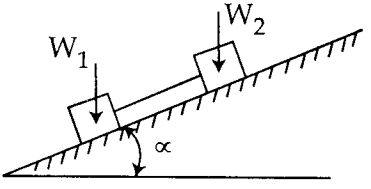

Figure - 6

4. (a) Two identical blocks A and B are connected by a rod and rest against vertical and horizontal planes respectively, as shown in figure 7. If sliding impends when $\theta = 45°$, determine the co-efficient of friction μ_1 assuming it to be the same at both floor and wall. 5+5

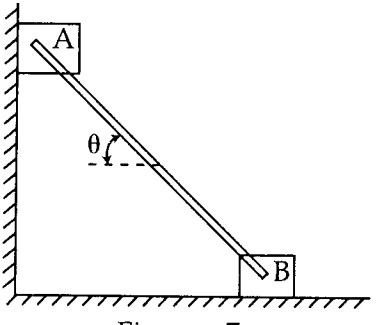

Figure - 7

(b) Find the axial force in each of the bars 1, 2, 3 of the plane truss as shown in figure 8.

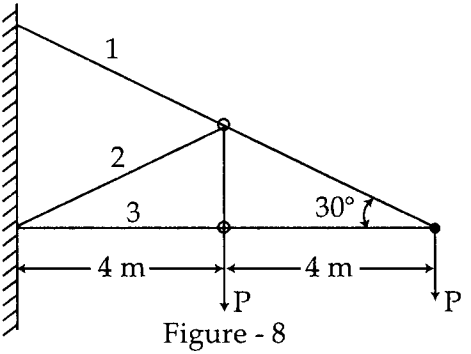

Figure - 8

5. (a) The velocity - time relationship of a moving particle is given by the equation. 5+5

$$v = \frac{1}{2} ct^2$$

where $c = 2.5 m/s^2$. Determine the displacement of the particle at the instant $t_3 = 3sec$, if there was no initial displacement.

(b) An elevator of gross weight $W = 4450$ N starts to move upward with constant acceleration and acquires a velocity $v = 18 m/sec$, after travelling a distance $= 1.8$ m. Find the tensile force S in the cable during this accelerated motion. Neglect friction.

6. (a) A body starts to move vertically upward under the influence of gravity with an initial velocity $\dot{x} = 6 m/s$. 5+5

Find :

(i) the maximum height to which it will rise, and

(ii) the time required for it to return to its initial position. Take the starting point as the the origin so that $x_0 = 0$, and neglect air resistance.

(b) A train is moving down a slope of 0.008 with a velocity of 48 kmph. At a certain instant, the engineer applies the brakes and produces a total resistance to motion equal to one - tenth of the weight of the train. What distance x will the train travel before stopping ?

7. (a) A 44.5 N weight is suspended by a helical spring having a constant K = 890 N/m. Neglecting the mass of the spring. Find the period t for small amplitudes of vertical vibration. 5+5

(b) Two blocks of weights P and Q are connected by a flexible but inextensible cord and supported as shown in figure-9. If the co-efficient of friction between the block P and the horizontal surface is μ and all other friction is neglisible, find :

(i) the acceleration of the system, and

(ii) the tensile force S in the cord.

The following numerical data are given

$P = 53.4$ N $Q = 26.7$ N, $\mu = \frac{1}{3}$.

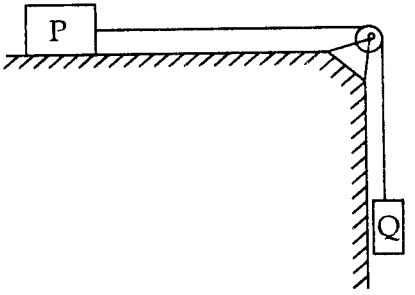

Figure - 9

8. (a) A wood block weighing 22.25 N rests on a smooth horizontal surface. A revolver bullet weighing 0.14 N is shot horizontally into the size of the block. If the block attains a velocity of 3 m/s, what was the muzzle velocity v of the bullet ? 5+5

(b) A wood block weighing 44.3 N rests on a rough horizontal plane, the co-efficient of friction between the two being $\mu = 0.4$. If a bullet weighing 0.23 N is fired horizontally into the block with muzzle velocity $v = 600$ m/sec, how far will the block be displaced from its initial position ? Assume that the bullet remains inside the block.

9. (a) A projectile is fired horizontally from point A with initial velocity $v_0 = 108$ m/sec. Find the range R to the target. B, as shown in figure 10. 5+5

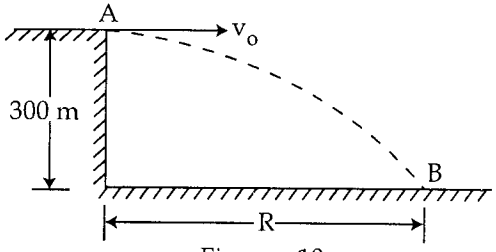

Figure - 10

(b) A mortar having muzzle velocity $v_o = 212.1$m/sec. Fires for maximum range across a level plain. Neglecting air resistance, calculate the time of flight of the shell.

10. (a) A fly wheel having moment of inertia $I = 66.75\ \mu g/m^2$ with respect to its axis of rotation and making 100 rpm, left alone, comes to rest with constant angular declaration in 52 sec, owing to friction in the bearing. Determine the friction couple that produces this angular deceleration. **5+5**

(b) A beam AB = 9m long is simply supported at ends. It carries loads of 6 kN at C and 9 kN at D as shown in figure 11. Determine support reactions. Draw SF and BM diagrams of the beam. What is the shear force in portion CD ?

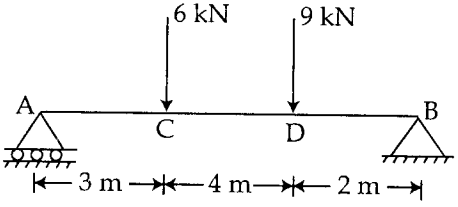

Figure - 11