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ET-202(A)

02745

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

BTCLEVI/BTMEVI/BTELVI/BTECVI/BTCSVI

Term-End Examination

June, 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) A boat is moved uniformly along a canal by two horses pulling with forces P = 890 N and Q = 1068 N acting under an angle $\alpha = 60°$ as shown in figure 1. Determine the magnitude of the resultant pull on the boat and the angles β and γ as shown in the figure. **5+5**

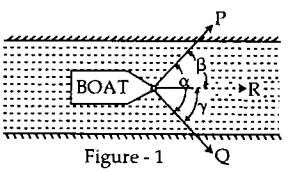

Figure - 1

(b) An electric-light fixture of weight Q = 178 N is supported as shown in figure-2. Determine the tensile forces S_1 and

S_2 in the wires BA and BC if their angles of inclination are as shown.

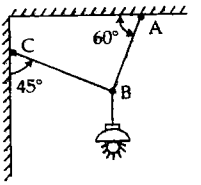

Figure - 2

2. (a) A circular roller of weight Q = 445 N and radius r = 152 mm hangs by a tie rod AC = 304 mm and rests against a smooth vertical wall at B as shown in figure 3. Determine the tension S in the tie rod and the force R_b exerted against the wall at B. 5+5

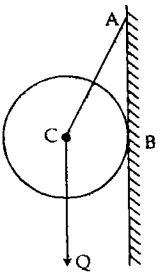

Figure - 3

(b) Find the magnitude and direction of the resultant R of the four concurrent forces as shown in figure 4 and having the magnitudes $F_1 = 1500$ N; $F_2 = 2000$ N, $F_3 = 3500$ N, and $F_4 = 1000$ N.

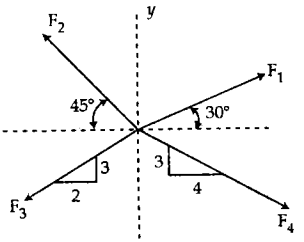

Figure - 4

3. (a) Two blocks having weights W_1 and W_2 are connected by a string and rest on horizontal planes as shown in figure 5. If the angle of friction for each block is ψ, find the magnitude and direction of the least force P applied to the upper block that will induce sliding. **5+5**

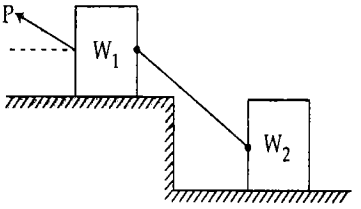

Figure - 5

(b) Two blocks connected by a horizontal link AB are supported on two rough planes as shown in figure 6. The coefficient of friction for block A on the horizontal plane is $\mu = 0.40$. The angle of friction for block B on the inclined plane is $\psi = 15°$. What is the smallest weight W of block A for which equilibrium of the system can exist ?

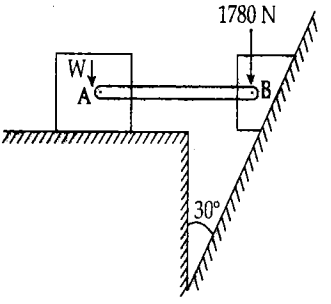

Figure - 6

4. (a) A block of weight $W_1 = 890$ N rests on a horizontal surface and supports on top of it another block of weight $W_2 = 222.5$ N as shown in figure 7. The block W_2 is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force P, applied to the lower block as shown, that will be necessary to cause slipping to impend. The co-efficient of static friction for all contiguous surfaces is $\mu = 0.3$. **5+5**

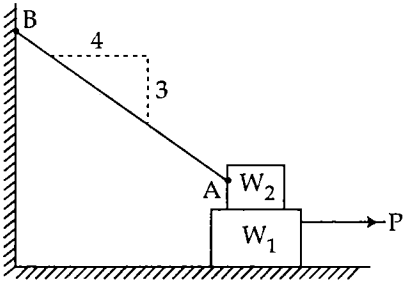

Figure - 7

(b) A prismatic bar AB of weight $Q = 44.5$ N is supported by two vertical wires at its ends and carries at D a load $P = 89$ N as shown in figure 8. Determine the forces S_a and S_b in the two wires.

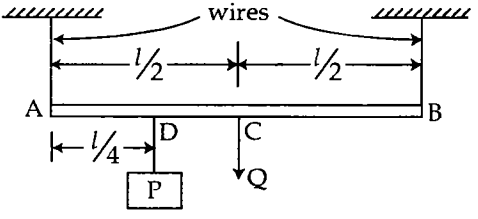

Figure - 8

5. (a) The rectilinear motion of a particle is defined by the displacement-time equation 5+5

$$S = x_0 + v_0 t + \frac{1}{2} a t^2,$$

Find the displacement, and velocity at time $t_2 = 2$ sec. The following numerical data are given $x_0 = 250$ mm, $v_0 = 125$ mm/sec. and $a_0 = 0.5$ m/sec^2.

(b) A particle starts from rest and moves along a straight line with constant acceleration a. If it acquires a velocity $v = 3$ m/sec. after having travelled a distance $s = 7.5$ m, find the magnitude of the acceleration.

6. (a) A mine case of weight $W = 8.9$ kN starts from rest and moves downward with constant acceleration, travelling a distance $s = 30$ m in 10 sec. Find the tensile force in the cable during this time. 5+5

(b) Find the acceleration of the falling weight P as shown in figure 9, if the coefficient of friction between the block Q and the horizontal plane on which it slides is μ. Neglect inertia of the pulley and friction on its axle. The following numerical data are given $P = 44.5$ N, $Q = 53.4$ N, $\mu = 1/3$.

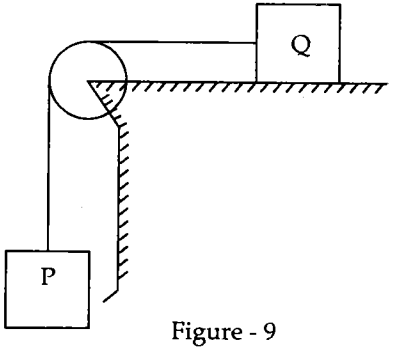

Figure - 9

7. (a) A small block starts from rest at point A and slides down the inclined plane AB in figure 10. What distance along the horizontal plane BC will it travel before coming to rest ? The coefficient of kinetic friction between the block and either plane is $\mu = 0.3$. Assume that the initial velocity with which it starts to move along BC is of the same magnitude as that gained in sliding from A to B. **5+5**

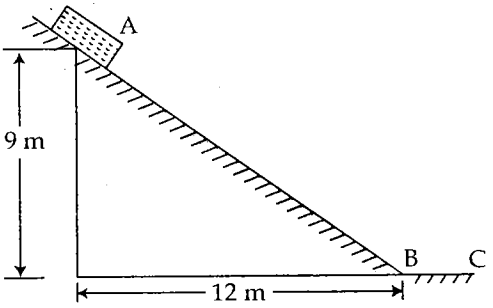

Figure - 10

(b) A 31.15 N weight produces a static elongation of 30 mm in a given spring. Determine the period of vibration of a weight $W = 44.5$ N suspended by the same spring.

8. (a) A locomotive weighing 534 kN has a velocity of 16 kmph and backs into a freight car weighing 86 kN that is at rest on a level track. After coupling is made, with what velocity v will the entire system continue to move ? Neglect all friction. **5+5**

(b) A man weighing 667.5 N runs and jumps from a pier into a boat with a horizontal velocity $v_1 = 3$ m/sec. Assuming that the impact is entirely plastic, find the velocity with which the man and boat will move away from the pier if the boat weighs 890 N.

9. (a) A locomotive of weight $W = 534$ N goes around a curve of radius $r = 300$ m at a uniform speed of 72 kmph. Determine the total lateral thrust on the rails. 5+5

(b) In figure 11, the pilot of an airplane flying horizontally with constant speed $v = 480$ kmph at the elevation $h = 600$ m above a level plain wishes to bomb a target B on the ground. At what angle θ below the horizontal should be see the target at the instant of releasing the bomb in order to score a hit ? Neglect air resistance.

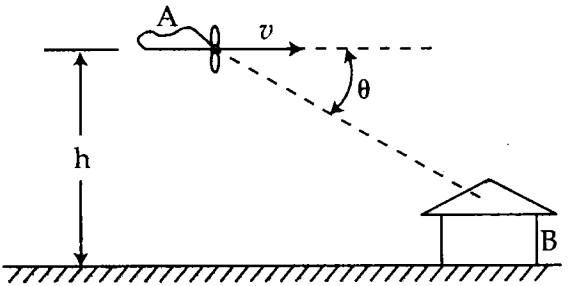

Figure - 11

10. (a) The armature of an electric motor has angular speed $n = 1800$ rpm at the instant when the power is cut off 5+5

(i) If it comes to rest in 6 sec. calculate the angular deceleration α assuming that it is constant.

(ii) How many complete revolutions does the armature make during this period ?

(b) A beam AB, 6 m long, simply supported at ends carries 6 kN and 12 kN loads at distances of 2 m and 4 m from A as shown in figure 12. Draw the SF and BM diagrams of the beam.

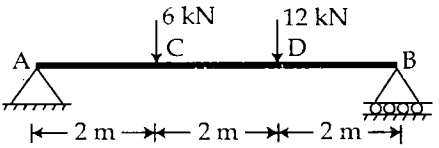

Figure - 12