NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR
ENGINEERING MECHANICS (ME 1101)
Second Semester (All Branch)
ASSIGNMENT – 16

1. A body starts to move vertically upward under the influence of gravity with an initial velocity $u = 20\ \frac{m}{sec}$. Find (a) the maximum height to which it will rise and (b) the time required for it to return to its initial position. Take the starting point as the origin and neglect air resistance. *Ans.* $(a)\ h_{max} = 20.387\ m\ (b)\ t = 4.077\ sec$

2. A train is moving down a slope of 0.008 with a velocity of 36 *kph*. 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 will the train travel before stopping? *Ans.* $55.43\ m$

3. An elevator weighing $500\ kg$ is moving upward with a uniform velocity of $4\ m/sec$. In what distance will it stop after the power is shunt off if the friction force opposing the motion is 100 *N*. *Ans.* $0.8\ m$

4. To determine experimentally the coefficient of friction between two materials, a small block of weight $W = 10\ kg$ is projected with initial velocity $v_o = 10\ m/sec$ along a horizontal plane covered with the same material. If the block travels a total distance $x = 15\ m$ before coming to rest, what is the coefficient of friction? *Ans.* $\mu = 0.34$

5. Referring to Fig. A, find the acceleration a of the falling weight $P = 10\ kg$ if the coefficient of friction between the block $Q = 12\ kg$ and the horizontal plane on which it slides is $\mu = \frac{1}{3}$. Neglect inertia of the pulley and friction on its axle. *Ans.* $a = \frac{3g}{11}$

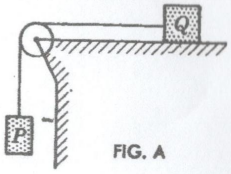

FIG. A

[Turn over]

6. A train moves with a uniform speed of $10\ m/s$ along a straight level track. At a certain instant the engineer moves the throttle so as to increase the traction by 20 percent. What distance will the train cover before acquiring a speed of $15\ m/s$ if the resistance to motion is constant and equal to $\frac{1}{200}$ of the weight of the train? *Ans.* $6371\ m$

7. A police investigation of tire marks shows that a car travelling along a straight level street had skidded for a total distance of $50\ m$ after the brakes were applied. The coefficient of friction between tires and pavement is estimated to be $\mu = 0.6$. What was the probable speed of the car when the brakes were applied? *Ans.* $24.261\ m/sec$

8. A small block of weight W rests on an adjustable inclined plane as shown in Fig. B. Friction is such that sliding of the block impends when $\alpha = 30°$. What acceleration will the block have when $\alpha = 45°$? Neglect any difference between static and kinetic frictions. *Ans.* $2.93\ m/s^2$

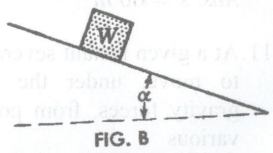

FIG. B

9. Two small cars of weights $W_1 = 200\ N$ and $W_2 = 100\ N$ are connected by a flexible but inextensible string overrunning a pulley C and are free to roll on an inclined plane as shown in Fig. C. If the cars are released from rest in the positions shown, find the time t required for them to exchange positions. Neglect rolling resistance and friction in the pulley. *Ans.* $t = 11.06\ sec$

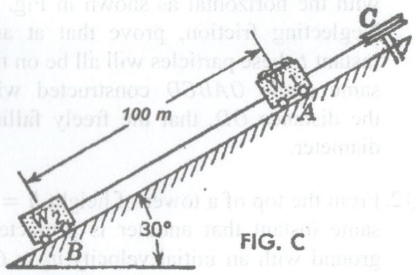

FIG. C

10. A small block starts from rest at a point A and slides down the inclined plane AB in Fig. D. What distance s 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. *Ans.* $s = 60\ m$

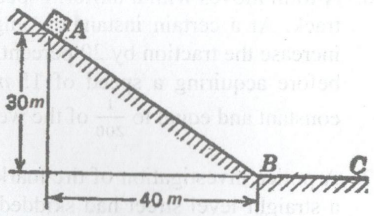

FIG. D

11. At a given instant several particles starts to move, under the action of their gravity forces, from point O along the various inclined planeOA, OB, OC and OD, which make the angles α, β, γ and $\frac{\pi}{2}$, respectively, with the horizontal as shown in Fig. E. Neglecting friction, prove that at any instant t these particles will all be on the same circle $OABCD$ constructed with the distance OD, that the freely falling particle has travelled, as a diameter.

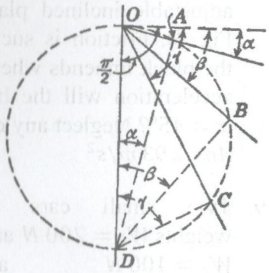

FIG. E

12. From the top of a tower of height $h = 120\ m$ a ball is dropped at the same instant that another is projected vertically upward from the ground with an initial velocity $v_0 = 60\ m/s$. How far from the top do they pass and with what relative velocity? *Ans.* $19.6\ m, 60\ m/sec$

13. A particle projected vertically upward is at a height h after t_1 *sec* and again after t_2 *sec*. Find this height h and also the initial velocity v_0 with which the particle was projected. *Ans.* $h = \frac{1}{2}gt_1t_2, v_0 = \frac{g}{2}(t_1 + t_2)$

14. A small block of weight W is placed on an inclined plane as shown in Fig. F. What time interval t will be required for the block to traverse the distance AB if it is released from rest at A and the coefficient of kinetic friction on the plane is $\mu = 0.3$? What is the velocity at B? *Ans.* $5.32\ sec, 18.78\ m/sec$

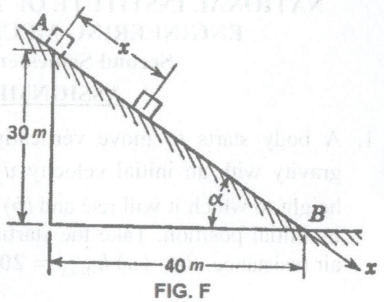

FIG. F

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