DYNAMICS-VI

(Semester-IV)

Time Allowed: Three Hours
Note: Attempt two questions each from Sections A and B carrying 5½ marks each, and the entire Section C consisting of 7 short answer type questions carrying 2 marks each.

SECTION-A

1. (a) A train weight M kg on the level is pulled by a force P kg wt. Against resistance R kg wt. Show that in developing velocity of V_1 from V_0 m/sec the distance described $(v^2 - v^2)M$

by train is $\frac{\left(v_1^2 - v_0^2\right)M}{2(P - R)g}$ metres. (2½)

(b) A string passes over a smooth fixed pulley and to one end mass m, is attached and to other end a smooth pulley over which passes another string with masses m, and m, at the ends. If the system is released from rest then show that m, will not move

if $\frac{4}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$ (2½)

11. (a) A ball is dropped from the top of the tower ? metres high and at the same moment

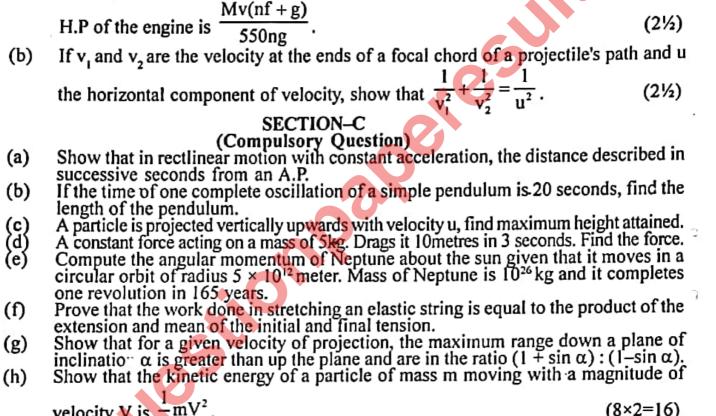
another ball is projected upward from the bottom. They meet when the upper one has described $\frac{1}{n}$ th of the total distance. Show that their speed when they meet are in ratio 2: (n-2) and initial velocity of lower bail is $\frac{1}{2}\sqrt{ng}$? (2½) An aeroplane together with its load weights M kg and is falling with an acceleration (b) of f m/sec², f being less than g. Show that if a part of the load equal to $\frac{2Mf}{f+g}kg$. Be thrown out, the aeroplane will begin to rise with an acceleration of f m/sec2. (21/2) Find the escape velocity of a particle projected from the surface of earth. Where g = 9.8m/s² and R = 6370 km, R being the radius of earth.

A point moving in a straight line with S.H.M. has velocities v₁ and v₂ when its III. (a) (b) distance from the centre are x_1 and x_2 . Show that the period of motion is $2\pi \sqrt{\frac{x_1^2 - x_2^2}{v_2^2 - v_1^2}}$. The motion of a particle in a straight line is given by the differential equation $x'' + n^2x = 0$ with initial condition $x = x_0$, $x' = v_0$ at t = 0. Show that the motion is IV. (a) osciallatory and its amplitude is $\left[x_0^2 + \frac{v_0^2}{n^2}\right]^{1/2}$ and the initial phase is $\frac{\pi}{2} - \tan^{-1}\left(\frac{v_0}{nx_0}\right)$. A simple pendulum has time period T. When the string is lengthened by a small (b) fraction $\frac{1}{n}$ of its length, the period becomes T. Show that $\frac{1}{n} - \frac{2(T-T')}{-T}$. (2½) If t, and t, are two times of flight with which given range R on a horozontal plane can be reached by a particle with velocity u, prove that t_1 and t_2 satisfy the equation $g^2t^2 - 4u^2t^4 + 4R^2 = 0$. (2½) Find latus rectum, vertices, the focus, the height of the directrix of the parabola V. (a) (b) traced out by a projectivel. A uniform string of mass M and length 2a is placed symmetrically over a smooth peg and has particles of masses m andm' attached to its extremities. Show by principle of energy that when the string runs off the peg, its velocity is VI. (a) $(2\frac{1}{2})$ ABC is triangle right-angled at C; a particle P starts from A and moves along AC with uniform velocity u; a second particle Q stats from C at the same time instant and moves along CB with uniform velocity v; show that the shortest distance between (b) P and Q will be $\frac{v.AC}{\sqrt{u^2 + v^2}}$ after a time $\frac{v.AC}{u^2 + v^2}$. (2½) A bullet of mass m kg is fired into a fixed target of mass M kg and penetrates through a distance a metres. If the target was free to move, show that the distance VII. penetrates would be $\frac{Ma}{M+m}$ metres and the K.E. lost would be $\frac{M}{M+m}$ of its initial The mass of three spheres A, B, Care 7m, 7m, m; their co-efficient of restitution is unity, their centrs are in a straight line and C lies betwen A and B. Initially A and B are at rest and C is given a velocity along the line of centres towards A. Show that it strikes A twice and B once and final velocities of A,B,C are proportional to 21, 12, (b)

A train of mass M pounds is ascending a smooth incline of 1 in n and when the

VIII.

(a)



IX.

velocity of the train is v fl/sec, its acceleration is f fl/sec2. Prove that the effective