Exam. Code : 103205
Subject Code : 1189

B.A./B.Sc. 5th Semester

MATHEMATICS

Paper—I (Dynamics)

Time Allowed—3 Hours] [Maximum Marks—50

Note :—There are **EIGHT** questions. Candidates are required to attempt any **FIVE** questions. All questions carry equal marks.

SECTION—A

I. (a) Two cars start off the race with velocities u and v and travel in a straight line with uniform acceleration s and t. If the cars reach the destination at the same time, prove that the length of the course is $\frac{2(u-v)(ut-vs)}{(s-t)^2}$.

(b) A stone is thrown vertically upwards with a velocity of 96 m/sec. Find the interval of time between the two instants when it is 80 m from the ground.

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II. Two masses, m_1 and m_2 ($m_1 > m_2$) are suspended by a light inextensible and flexible string over a smooth, fixed, small and light pulley. Find the tension in the string and pressure on the pulley. Also find the condition, under which the tension in the string is maximum.

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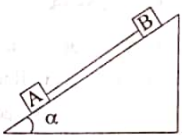
SECTION—B

III. (a) Two blocks A and B connected by a light inextensible string are placed on a smooth inclined plane (as shown in figure) and are in motion down the plane. If $W_A = 40$ kg and $W_B = 20$ kg, find the tension in the string.



(b) Two smooth inclined planes of inclination 30° and 60° respectively are placed back and a string, passing over a smooth pulley at the top, joins masses of 0.4 kg and 0.6 kg lying on the planes. Find the acceleration of either mass, the tension in the string and the reactions of the planes.

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IV. (a) A particle m is attached to a light wire which is stretched tightly between two fixed points under tension T. If a, b be the distances of the particle from the two ends, prove that the period of transverse oscillation is $2\pi\sqrt{\frac{mab}{T(a+b)}}$.

(b) A particle starts from A and moves in a straight line AO (= a) with an acceleration which is directed towards O and varies inversely as the square of the distance from O. Show that the particle arrives at O with an infinite velocity after time $\frac{\pi}{2}\frac{a^{3/2}}{\sqrt{2\mu}}$, μ being the constant of variation.

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SECTION—C

V. Define Projectile. A particle of mass m is projected from a fixed point with velocity u in a direction making an angle $\alpha\left(\neq\frac{\pi}{2}\right)$ with horizontal. Neglecting air resistance, find its motion and show that its path is a parabola. 10

VI. (a) If the greatest height of a projectile above a horizontal plane through the point of projection be a and θ be the angle of projection, find the time between the instants at which the height of projectile is $a \sin^2 \theta$.

(b) An elastic string of natural length l is extended by an amount a, when it supports a mass M at rest, and is extended by an amount b when it is rotating as a conical pendulum, carrying a particle of the same mass, with angular velocity ω, prove that

$$gb = \omega^2 a(l + b).$$ 5,5

SECTION—D

VII. (a) Define work, power and energy. What are their units in F.P.S. system ?

(b) A train of mass M kg is ascending a smooth incline of 1 in n and when the velocity of train is v m/sec, its acceleration if f m/sec square, prove that the effective horse power of the engine is $\frac{Mv(nf + g)}{550\, ng}$ watts. 4,6

VIII. State and prove Principle of Conservation of Energy. 10