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LEAVING CERTIFICATE EXAMINATION, 1937.

HONOURS.

APPLIED MATHEMATICS.

WEDNESDAY, 23rd JUNE.—AFTERNOON 4 TO 6 P.M.

Not more than *six* questions may be answered. All questions are of equal value.

Mathematical Tables may be obtained from the Superintendent.

1. A body of mass 10 units moves in a straight line so that its distance s from a fixed point in the line of motion at time t is given by the equation : $s=a+bt+ct^2$.

Derive formulae for its velocity, acceleration and momentum at any time.

Given that when $t=0$ the velocity is 2 units and that the distances travelled when $t=1$, and $t=2$ are 9·5 and 23·5 respectively, determine the values of a, b and c in the above equation.

2. A mass weighing $\frac{1}{4}$ ton drops without rebound from a height of 16 ft. on to the top of a pile weighing 12 cwt., and the pile is driven 8 inches into the ground by the blow.

Calculate in ft.lbs. the energy lost in the impact, and the average resistance offered by the ground to the motion of the pile.

3. Calculate the effective h.p. delivered by the engine of a 2 ton motor vehicle in each of the following cases :—

(*a*) The vehicle is ascending an incline of 1 in 28 with a uniform speed of 30 miles per hour ;

(*b*) the vehicle accelerates uniformly from a speed of 45 miles per hour to a speed of 60 miles per hour while travelling a distance of 550 yards along a level road.

The frictional resistances to motion may be taken as the same in both cases and equal to a force of 60 lbs. wt.

4. State the laws of statical friction.

A uniform ladder 26 feet long and weighing 96 lbs. is on the point of slipping when placed with its upper end against a smooth vertical wall and its lower end on a rough horizontal surface at a distance of 10 feet from the wall.

Calculate the value of the frictional force between the foot of the ladder and the ground and also the value of the coefficient of friction.

5. A point A describes a circular path of radius r with a uniform velocity. P is the foot of the perpendicular from A to a fixed diameter of the circle. Show that the velocity and acceleration of P at any instant are equal to $rw\,Cos\,wt$ and $-w^2x$ respectively, where x is the displacement of P fron the centre of the circle, t is the time for this displacement and w is the angular velocity of A.

(*b*) Show that for small oscillations the bob of a simple pendulum may be regarded as having a similar motion to that of P and that the time of oscillation is $2\pi\sqrt{l/g}$ where l is the length of the pendulum.

6. Through what vertical height will the bob of a conical pendulum drop if its speed falls from 60 to 30 revolutions per minute ?

7. A train is travelling at the rate of 45 miles per hour round a circular track of 660 yards radius. The horizontal distance between the rails is 64 inches. How much must the outer rail be raised above the inner one so that there may be no side thrust on the rails ?

8. The force acting on a body moving in a straight line is given at any instant by the formula

$$F=\frac{320}{x^2}$$

where F is in lbs.-wt. and x is the distance in feet of the body at that instant from a fixed point in the line. If the motion is resisted by a constant force of 3 lbs.-wt., find the kinetic energy stored in the body in moving from $x=10$ to $x=5$.

9. A particle of mass 5 lbs. is placed on a smooth plane inclined at 30° to the horizon and is connected by a light string passing over the top of the plane to a particle weighing 3 lbs. which hangs vertically.

Find (*a*) the common acceleration ;

(*b*) the velocity after 3 seconds of the centre of inertia of the particles.

10. A body is projected up a smooth incline of 30° with an initial velocity of 96 feet per second. If the length of the incline is 160 feet find the greatest height attained by the body and the range on a horizontal plane passing through the foot of the incline.