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LEAVING CERTIFICATE EXAMINATION, 1938.

HONOURS.

APPLIED MATHEMATICS.

THURSDAY, 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.

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1. A body travels in a straight line so that the distance s feet travelled in time t seconds from a fixed point in the line of motion is shown by the following equation :—

$$s = 5{\cdot}5 + 17{\cdot}5t - 5t^2.$$

Show that the body is travelling with uniform acceleration, find the value of the acceleration, and calculate the maximum distance from the fixed point reached by the body in the initial direction of motion.

2. A simple pendulum hanging vertically inside a railway carriage, inclines at 4° to the vertical while the train is travelling round a circular curve on a horizontal track at a speed of 30 miles per hour. Calculate the radius of the curve.

3. Prove that in the case of a body moving in a straight line with simple harmonic motion the acceleration is proportional to the distance of the body from its mean position.

If the acceleration of such a body is 300 feet per sec., per sec., when it is at a distance of 3 feet from the mean position, find the period of vibration.

4. The vertical load which is carried by one wheel of a railway truck is 3 tons. The wheel itself weighs 500 lb. and is $2\frac{1}{2}$ feet in diameter.

If the centre of gravity of the wheel is $\frac{1}{5}$ inch from its geometric centre calculate the greatest and least pressures of the wheel on the track when the train is travelling at 45 miles per hour.

5. A force P inclined at $\theta°$ to the horizontal is just able to drag a body of weight W slowly and uniformly along a rough horizontal surface.

Show that P is equal to $\frac{\mu W.}{\text{Cos } \theta + \mu \text{ sin } \theta.}$

(μ represents the coefficient of friction.)

If the coefficient of friction is ·6, prove that P is a minimum when θ is equal to $\tan.^{-1}.6$.

6. What time will be required to accelerate the speed of a 2 ton motor car from 30 miles per hour to 45 miles per hour, if the motion is resisted by a constant force of 30 lb. per ton ? It is assumed that the engine is working at the rate of 20 horse-power at the beginning of this period and that it exerts a constant tractive effort on the wheels.

7. A uniform pole leans against a vertical wall, the upper end touching the wall and the lower end resting on horizontal ground. The coefficient of friction at each end is $\frac{1}{3}$. If the pole is on the point of slipping, find the value of the angle it makes with the horizontal.

8. In the case of a group of particles whose individual masses, velocities, and accelerations are known, show how the velocity and acceleration of the centre of gravity of the system may be calculated.

Two particles of mass 22 grm. and 11 grm. respectively are connected by a light, inextensible string passing over the edge of a horizontal table. The heavier mass rests on the table and the other hangs vertically. Neglecting frictional resistances find the tension in the string and the acceleration of the centre of gravity of the system.

9. A body is projected from a height of 4 feet so that it passes horizontally over the top of a building 68 feet high. The centre line of the building is 100 feet from the point of projection of the body.

Calculate the magnitude and direction of the velocity of projection of the body. How far horizontally from the point of projection will the body hit the ground !

10. Explain how the velocity of one body relative to another is obtained.

Two ships are sailing along straight courses with such constant, different velocities that they will collide unless their velocities are altered. Show that it would appear to a person on either of the ships, as if the other were always moving directly towards him.