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(Department of Education).

BRAINNSE AN MHEADHON-OIDEACHAIS
(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1941.

HONOURS.

APPLIED MATHEMATICS.

FRIDAY, 20th 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. Prove the formula $v=\omega r$ for uniform motion in a circle.

A particle moving uniformly in a circle of radius 3 inches makes 2 revolutions per second. Find its linear velocity at any instant. Find also the change in the direction of its linear velocity one-twentieth of a second after that instant. Hence find the change in its linear velocity in that interval. Calculate the average acceleration during the interval and compare with the acceleration of the particle at any instant.

2. What is meant by (i) a *couple*, and (ii) the *moment of a couple*? Prove that a single force and a couple acting in the same plane on a rigid body can be reduced to a single force of the same magnitude and direction. If the single force is P and the moment of the couple is m, how far must the line of action of P be moved?

3. Masses of 2, 3, 5 ounces are at rest in that order in a straight line. A velocity of 20 feet per second is given to the first and when the masses collide they do not separate. Find the final velocity of the combined masses.

If a fourth mass of 8 ounces is then introduced into the same straight line, what velocity must be imparted to it so that after colliding and coalescing with the others it may bring the system to rest?

4. An express train travelling at 60 miles per hour is 340 yards behind a goods train travelling at 15 miles per hour in the same direction on the same track when the latter increases its speed uniformly at the rate of $1\frac{1}{2}$ ft./sec.^{2} Find the time that will elapse before there is a collision. Find also the least uniform increase of speed which the goods train should have effected in order to have avoided a collision altogether.

5. What is the principle of Conservation of Energy ?

As a body slides down a rough inclined plane, show that the sum of the potential and kinetic energies is reduced. How is this reduction explained ?

6. What is a conical pendulum ?

If a particle suspended by a string from a fixed point is moving uniformly in a horizontal circle, show that the time of revolution varies as the square root of the depth of the particle below the fixed point.

7. A curve on a railway line has a radius of a quarter of a mile and the rails are 5 feet apart. Find the difference in level of the rails so that there may be no lateral pressure on the wheels of a train running round the curve at 30 miles per hour.

8. What is *simple harmonic motion* ?

The extension in a light spiral spring is directly proportional to the load and is 3 cms. for a load of 5 grammes. Show that when this load is pulled down a little further and then released it will describe simple harmonic motion. Calculate the time of a complete oscillation.

9. The greatest height that a boy can project a stone vertically by means of a catapult is 30 feet. If he is standing 40 feet from a vertical wall, what is the highest point on the wall that he can strike with the stone ?