AN ROINN OIDEACHAIS

(Department of Education).

LEAVING CERTIFICATE EXAMINATION, 1951.

APPLIED MATHEMATICS.—Honours.

SATURDAY, 9th JUNE.—MORNING, 10 TO 12.

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

Mathematical Tables may be obtained from the Superintendent.

---

1. Two pegs A and B are at the same height above the ground, and are 7 feet apart. One end of an inextensible string 8 feet in length is attached to A, and the other end is attached to B. A 28 lb. weight is suspended from the string at a point 3 feet from A and 5 feet from B. Find the tension in each part of the string.

2. Two roads cross at right angles at O. Two men, A and B, are walking towards O. A is walking at 4 m.p.h. on one road, B at 3 m.p.h. on the other road. When A is 100 yards from O, B is 200 yards from O. Find the velocity of A relative to B.

Find the distance of B from O and from A, when A and B are nearest to each other.

3. Prove that the centre of gravity of any triangular lamina is the same as that of three equal masses situated at the vertices of the triangle.

ABCD is a quadrilateral lamina. A mass equal to one-third the mass of the lamina is placed at the intersection of the diagonals AC and BD. Show that the centre of gravity of the lamina and the mass together is the same as that of four equal masses situated at the vertices of the quadrilateral.

4. Two masses of 3 lb. and 5 lb. connected by a light inextensible string 9 feet long, are lying on a smooth horizontal table 6 feet high. The 5 lb. mass is at the edge of the table and the other mass is 8 feet away in a direction perpendicular to the edge. If the 5 lb. mass is pushed gently over the edge of the table, find how long it takes to reach the ground, and how much longer the 3 lb. mass takes to reach the edge of the table.

Find also the change in kinetic energy when the 3 lb. mass is jerked into motion.

5. A train ascending an incline of 1 in 100 accelerates uniformly from 20 m.p.h. to 40 m.p.h. in a distance of 2 miles. Find this acceleration. If the train and the engine together weigh 200 tons, and if the frictional resistances to motion are equivalent to 7 lb. wt. per ton, find the horse-power at which the engine was working when the speed of the train was 30 m.p.h.

6. A point P is describing a circle, centre O, with uniform speed. If Q is the foot of the perpendicular from P to a fixed diameter, show that Q moves with simple harmonic motion.

When Q is 4 feet from O its velocity is $1\frac{1}{2}$ feet per second, and when it is 3 feet from O its velocity is 2 feet per second towards O. Find how long Q takes to reach O from the latter position.

7. A gun is fixed at a point P at the top of a vertical cliff 400 feet high. Q is the foot of the perpendicular from P to the sea. A ship is travelling away from the cliff at 20 feet per second along a straight line that passes through Q. When the ship is 1000 feet from Q a shell is fired from the gun at an angle of 45° and strikes the ship. Find the initial velocity of the shell.

8. A mass of one ounce attached to a fixed point by an inextensible string 3 feet long, describes a horizontal circle at a uniform rate of 40 revolutions per minute. Find the tension in the string and the vertical distance from the fixed point to the plane of the circle.

What vertical distance will the mass rise if its speed is increased to 60 revolutions per minute?

9. Prove that if a plane surface is immersed in a liquid the total thrust on it due to the liquid is equal to the area of the surface multiplied by the pressure at its centre of gravity.

A triangular lamina ABC is totally immersed in water so that the plane of the lamina makes an angle of 30° with the horizontal plane. The base BC is 6 inches in length and the height of the triangle is 3 inches. Find the total thrust of the water on ABC

(i) when its vertex A is at the surface of the water and its base BC is horizontal;

(ii) when its base BC is at the surface of the water.

[1 cubic foot of water weighs $62\frac{1}{4}$ lbs.]