AN ROINN OIDEACHAIS

(Department of Education).

LEAVING CERTIFICATE EXAMINATION, 1950.

APPLIED MATHEMATICS.—Honours.

FRIDAY, 16th JUNE.—AFTERNOON, 4 TO 6.

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. If the velocities of two bodies A and B are known, indicate by means of a diagram, or otherwise, how the velocity of A relative to B may be found.

When a man is travelling due east at 4 miles per hour, the wind appears to blow from the north, but when he is travelling north east at 16 miles per hour, it appears to blow from a point 30° east of north. Find the velocity of the wind in magnitude and direction.

2. Two masses, A and B, weighing 2 lb. and 1 lb. respectively, are connected by means of a light string passing over a smooth pulley. A is at rest on the floor and B is hanging freely. The mass B is raised a vertical distance of 8 feet and is then allowed to fall freely. Find how long after it has been jerked into motion it will take the mass A to return to the floor. Find, also, the kinetic energy of the system immediately before, and immediately after, the mass A is jerked into motion.

3. An engine is travelling round a curve of radius 480 feet on a horizontal railway track, the rails of which are at the same level and 5 feet apart. If the centre of gravity of the engine is 6 feet above the level of the rails and is in a vertical plane which bisects the distance between them, find the greatest speed at which the engine can travel round the curve without losing contact with one of the rails.

Find, also, the distance which the outside rail must be raised so that there may be no lateral thrust on the rails when the engine is travelling at 30 miles per hour.

4. One end of a uniform ladder, weighing 60 lb., rests on a rough plane inclined at an angle of 20° to the horizontal, and the other end rests against a smooth vertical wall at the top of the plane. The coefficient of friction between the ladder and the plane is $\frac{1}{\sqrt{3}}$. If the ladder is on the point of slipping, find its inclination to the wall, and, also, its total reaction on the plane.

5. A train, starting from rest at the bottom of an incline of 1 in 32 and moving with uniform acceleration, attains a speed of 30 miles per hour when it has travelled one mile up the incline. If the engine weighs 40 tons and the rest of the train 120 tons, and if the resistances to motion are equivalent to 12 lb. wt. per ton, find the tension in the coupling between the engine and the rest of the train. Find, also, the H.P. at which the engine is working when the train attains the speed of 30 miles per hour up the incline.

6. A piece of metal of uniform thickness is in the shape of a square of side 4 inches together with an isosceles triangle whose base is one of the sides of the square. The centre of gravity of the piece of metal is in the base of the isosceles triangle. The top of the triangular portion is removed by cutting along a line which joins the middle points of the equal sides of the isosceles triangle. Find how far the centre of gravity of the remaining piece is from the intersection of the diagonals of the square.

7. The side-wall of a house is 48 feet high, and the roof which is smooth makes an angle of 30° with the horizontal. An object on the roof slides from rest at a point 16 feet from the bottom edge down along the line of greatest slope and then falls freely to the ground. With what velocity, in magnitude and direction, and how far from the bottom of the side-wall, will the object strike the ground ?

8. What do you understand by " simple harmonic motion " ?
When a particle moving with simple harmonic motion is travelling towards its mean position and is at a distance of 5 feet from it, its velocity and acceleration are 15 feet per sec. and 15 feet per sec.^{2}, respectively. Find (*a*) the amplitude, (*b*) the periodic time, (*c*) the least time it will take the particle to reach its mean position.

9. The walls of a rectangular swimming bath are vertical and the floor slopes uniformly so that the water is 6 feet deep at one end and 18 feet deep at the other end. The bath is 150 feet long and 60 feet wide. Find the total thrust of the water (*a*) on the wall at the deep end, (*b*) on one of the side-walls.
A line drawn parallel to the surface of the water on the wall at the deep end divides the wall into two portions, the thrusts on which are equal. Find how far the line is below the surface of the water.
[1 cu. ft. of water weighs 62$\frac{1}{2}$ lb.]