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LEAVING CERTIFICATE EXAMINATION, 1929.

HONOURS

APPLIED MATHEMATICS.

THURSDAY, 20th JUNE.—Afternoon, 1.30 to 3.30 p.m.

Not more than *five* questions may be answered.

Mathematical Tables may be obtained from the Superintendent.

1. If a particle is moving in a straight line with a constant acceleration f prove that $v^2 = u^2 + 2fs$.

If the brakes of a tram bring it to rest when travelling along a level track at a speed of 12 miles per hour in a distance of 10 yards, find the slope of an incline on which the brakes will keep the tram at rest ($g = 32$ ft./sec^2). [55 marks.]

2. An Attwood machine has a 3 lb. weight on one side and two 2 lb. weights on the other side, 1 foot apart. Motion begins when the lower 2 lb. weight is 1 foot from the floor. Find how near the second 2 lb. weight will approach the floor after the first one has struck. What changes occur in the tension of the cord attached to the 3 lb. weight during this experiment? [55 marks.]

3. Give a definition of "work."

A weight of 10 lbs. is pushed up a smooth inclined plane of inclination 45° along the line of greatest slope by a force acting at an angle of 30° with the plane.

Derive the magnitude of this force and the pressure on the plane from the conditions of equilibrium. Show that the work done by the "effort" is equal to the work done against the "load" in pushing it 1 foot up the plane. [55 marks.]

4. Explain the meaning of the terms "smooth," and "reaction" as used in mechanics.

A plank 8 feet long weighing 20 lb. rests on a rough floor and against the smooth edge of a table 4 feet high, making an angle of $\tan^{-1} 4/3$ with the horizontal. Find the coefficient of friction if the plank is just on the point of slipping.

[60 marks.]

5. Show that the centre of gravity of a triangular lamina coincides with the centre of gravity of three equal particles placed at its vertices.

Hence prove that the centre of gravity of a quadrilateral lamina having a particle whose weight is one-third of the weight of the lamina attached at the intersection of the diagonals coincides with the centre of gravity of four equal particles placed at the corners of the quadrilateral. [60 marks.]

6. What is a hodograph ? Show that for a projectile under gravity where AB is the initial velocity of projection, the hodograph is the vertical line through B. If this vertical meets a line drawn through A making an angle a with the horizontal in C, show that AC multiplied by the time of flight represents the range on a plane of inclination a. What does BC represent ? Prove that the range is a maximum when the triangle ABC has a maximum area ? [60 marks.]

7. Two perfectly elastic spheres of mass m_1 and m_2 collide along their line of centres with velocities u_1 and u_2. Find their velocities $\bar{u}_1$ and $\bar{u}_2$ with respect to their centre of gravity before collision. Show that the velocity of the centre of gravity is unaltered by the collision, and the effect of the collision is simply to reverse the velocity of each sphere with respect to their common centre of gravity. [60 marks.]

8. What connection exists between a simple harmonic motion and a uniform circular motion. Explain how it can be used to find an expression for the period of the former.

A spiral spring AB of natural length 9 inches, whose length would be doubled by a steady pull of 10 lb. is hung up at A and has a 4 lb. weight attached to it and then let go. Find the distance the weight will fall before it comes to rest and the time of a complete oscillation. [60 marks.]