AN ROINN OIDEACHAIS

(Department of Education).

BRAINNSE AN MHEADHON-OIDEACHAIS
(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1935.

HONOURS.

APPLIED MATHEMATICS.

FRIDAY, 21st 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.

1. A particle moves along a straight line and its distance in feet s from a fixed point in the line is given by the formula $s=at^3+bt^2+ct$ where a, b, c are constants and t denotes the time in seconds. The distance is 16 when $t=1$ and the velocity is zero when $t=2$ and $t=4$. Find the values of a, b, c and verify that the acceleration is zero when $t=3$. Draw rough diagrams showing how (a) the acceleration, (b) the velocity varies between $t=0$ and $t=6$.

2. A body weighing 1 lb. is moving in a straight line with Simple Harmonic Motion. If the greatest velocity is 8π ft. per second and the amplitude of the oscillation is $\frac{1}{2}$ ft., find the period of oscillation and the force of attraction towards the centre when the body is at its greatest distance from the centre.

3. A body is projected with velocity u, at an inclination α to the horizon, from the foot of a plane inclined at angle β to the horizon. Determine its range up the plane. Show that for a given value of u, the range is a maximum when the direction of projection bisects the angle between the inclined plane and the vertical. Determine the least velocity with which a ball can be thrown to reach the top of a cliff 64 ft. high and $64\sqrt{3}$ ft. away from the thrower, neglecting air resistance.

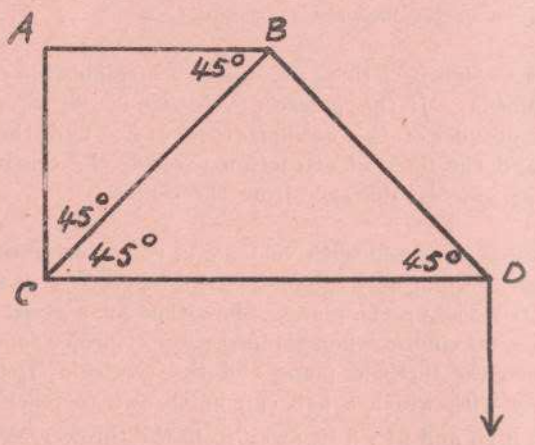
4. If the velocities and accelerations of a number of particles be known, how may the velocity and acceleration of their centre of gravity be found ?

A 4 lb. weight is placed on a smooth table and is attached to a 3 lb. weight, which hangs vertically by a light inextensible string passing over a smooth pulley at the edge of the table. Show that the acceleration of the centre of gravity of the two weights is constant in magnitude and direction, and that the centre of gravity moves in a straight line.

5. A car weighing one ton is rounding a curve of 160 yards radius on a level road. What is the greatest speed at which this is possible without causing the car to overturn, if the wheel gauge is $4\frac{1}{2}$ ft. and the C. G. is mid-way between the wheels transversely and at a height of 3 ft. from the ground ? What is the frictional force between the road and tyres at this speed ?

6. An engine pumps one ton of water per minute to a height of 120 ft. and delivers it through a pipe whose cross-sectional area is 3 square inches. Find (i) the work done against gravity per minute in ft. lbs. ; (ii) the kinetic energy of the water delivered in one minute in ft. lbs. ; (iii) the Horse Power of the engine, neglecting all losses due to friction. (A cubic foot of water weighs $62\frac{1}{2}$ lbs.)

7. A pin-jointed framework of the form shown in diagram, is pin-jointed to a vertical wall at A and C and carries a vertical load of 1 ton at D. Find the forces exerted by the frame on the wall, and determine the stresses in the bars, indicating whether the bar is in thrust or in tension in each case.



8. A weight of half-a-ton is allowed to fall freely through a height of 12 ft. to drive a pile weighing 5 cwt. into the ground. Find the average resistance to the motion of the pile if it is driven 2 inches by the blow, assuming that the weight moves on with the pile.

9. A body, weighing 12 lbs., is kept in equilibrium on a rough plane inclined at 30° to the horizontal by a cord inclined at 30° to the plane. Find the frictional force between the body and the plane and indicate its direction when the tension in the cord is 6 lbs. Find the work done in dragging the body slowly through a distance of one foot up the plane, assuming the coefficient of friction to be $\frac{1}{2}$ and the cord to remain constantly at an angle of 30° to the plane.

10. The two balls, A and B, of a governor, weigh 10 lbs. each; the arms AB and AC are each inclined at 30° to the vertical and are 1 ft. long. Find the number of revolutions per minute they are making, and the tension in each rod; the weights of the rods, AB, AB, may be neglected.