AN ROINN OIDEACHAIS
(Department of Education).

BRAINNSE AN MHEADHON-OIDEACHAIS
(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1936.

PASS.

APPLIED MATHEMATICS.

WEDNESDAY, 24th 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 train starting from rest leaves a station at 3 p.m. Observations are made of the times taken to reach various mileage posts along the line with the following results:—

Distances travelled in miles	¼	½	1	2	3	4	5	6	7	8
Times taken in minutes	2·2	3·2	4·5	6·3	7·7	8·9	10	11	12	13

What is the average speed of the train during this time?

What do you understand by this statement of average speed?

Plot the distance-time graph and find the speed of the train at 3h. 4m. p.m. and 3h. 11m. p.m.

What information does the graph convey to you regarding the speeds of the train between 3 p.m. and 3.10 p.m. and between 3.10 p.m. and 3.13 p.m.?

2. (*a*) A tramcar travelling at a uniform speed of 12 miles per hour has its direction of motion changed from due N. to N.E. in passing round a circular curve 176 yards long. What is the direction and magnitude of the total change in velocity, and of the average acceleration during this period?

(*b*) What is the velocity of the wind which, blowing due W., appears to a passenger to strike the tramcar at right angles to its new direction of motion?

(Solutions *graphically or by calculation*).

3. A car of mass 1 ton passing a certain point on a straight level road at a speed of 15 miles per hour accelerates at a uniform rate to a speed of 60 miles per hour in 2 minutes; travels at this speed for 6 minutes and then slows uniformly to rest in the next $\frac{1}{2}$ mile. Calculate :—

(*a*) the total distance travelled,

(*b*) the total time taken, and

(*c*) the resultant force acting during each of the three periods.

4. In a laboratory experiment a small steel ball was fired in a horizontal direction from a spring gun placed 4 feet above the floor level.

The ball struck the floor at a horizontal distance of 24 feet from the gun.

Calculate the velocity of projection of the ball. If this gun is fired in a direction inclined upwards at 45° to the horizontal find the greatest height reached, the time of flight and the horizontal range of the projectile.

5. Sliding from rest down a smooth incline a body travels a distance of 88 feet in the 6th second of its motion. What is the inclination of the plane to the horizontal?

6. A mass of 2 kilogrammes is placed on a smooth horizontal table. A light string attached to it and lying parallel to the table passes over a smooth pulley at the edge of the table and then hangs vertically. What mass must be attached to the free end of the string so that it descends with an acceleration of 327 cms. per second, per second and what will be the tension in the string?

If the string breaks what will be the subsequent motion of each body?

7. A bullet of mass 1 oz. is projected horizontally from a gun of mass 10 lbs. with a velocity of 2,000 ft. per sec. into a block of wood of mass 25 lbs. which is free to move.

With what velocity does the block start to move and the gun to recoil?

8. Three ropes all in the same vertical plane meet at a point and there support a block of stone weighing 204 lbs. The ropes are all inclined upwards at angles of 30°, 120°, and θ° to a horizontal line in their common plane. The pulls in the first two ropes are 150 lbs wt. and 120 lbs. wt. respectively.

Calculate the magnitude of the pull in the third rope and the value of θ.

9. Sketch the system of pulleys in which two blocks are used each containing three pulleys—the same rope passing round all pulleys.

Four wires attached to an electric standard 28 feet high run horizontally due W. The lowest wire is 24 feet above the ground and the others are attached above it at 1 foot intervals. The tension in each wire is 96 lbs.

To hold the pole in a vertical position while a permanent stay is being attached this system of pulleys is employed. One block is tied to a stake driven into the ground and the hook of the other block is attached to a stay rope fixed to the top of the pole and inclined at 45° to the horizontal.

The stay rope and pulleys are in the same vertical plane as the overhead wires and directly behind them.

What force must be exerted on the free end of the pulley rope?

10. Five bodies of mass 4, 6, 3, 7 and 5 lbs. respectively lie on the circumference of a horizontal circle 20 feet diameter at the following compass points—N., N.E., S.E., S.W., and N.W. Find the position of their centre of gravity relative to the N—S and E—W lines passing through the centre of the circle.