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LEAVING CERTIFICATE EXAMINATION, 1933.

HONOURS.

APPLIED MATHEMATICS.

THURSDAY, 22nd 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. The following table gives the speed v of a train t seconds after leaving a station A for portion of the journey between two stations A and B, 4800 ft. apart.

Speed in feet per second ..	0	18	34	40	44	45·5	45·5	42	35
Time in seconds	0	10	20	30	40	50	60	70	80

Estimate the acceleration after 15 seconds and the distance travelled in the 80 seconds. If the train continues to move with the uniform speed of 35 ft. per second until the brakes are applied, producing a uniform retardation of 2 ft. per sec. per sec., find the total time taken in going from A to B.

2. (*a*) A particle describes simple harmonic motion of amplitude a, the period being T. Prove that at distance x from its mean position its speed v is given by $\frac{2\pi}{T}\sqrt{a^2-x^2}$.

(*b*) If the amplitude of the motion of the bob of a simple pendulum is 1 foot and the period 3 seconds, find the time occupied by the bob in passing between points which are distant 8″ and 4″ from the mean position and are on the same side of it.

3. Prove that two bodies moving in different straight lines with uniform velocities will meet if their relative velocity is in the straight line joining them.

A ship steaming in a direction 17° North of East is seen by a submarine which is in a direction 10° East of South from the ship. Find in what direction a torpedo travelling at 20 miles per hour must be fired in order to strike the ship.

4. A bullet of mass 1 oz. travelling horizontally with a speed of 1,200 ft. per second becomes embedded in a block of wood of mass 4 lb. suspended by a light steel wire, the C.G. of the block being 4 ft. below the point of suspension. Find the vertical distance through which the block rises.

5. When the motors of an electric train of effective weight 100 tons are working at the rate of 80 H.P., a uniform speed of 30 miles per hour is attained on the level. Assuming the frictional resistances to remain the same, what is the maximum speed attainable with 150 H.P. when ascending an incline of 1 in 250 ?

6. Show that the centre of gravity of 3 equal particles placed at the three vertices of a triangle respectively coincide with the centre of gravity of the area of the triangle. The parallel sides of a trapezium are of lengths a and b and the perpendicular distance between them is h. Find the distance of the C.G. from the side a.

7. What are the laws of solid friction ?

A body of weight w is dragged along a horizontal plane, coefficient of friction μ, by a cord inclined at an angle θ to the horizontal ; find the tension in the cord. For what value of θ is the tension a minimum ? A body is placed on a plane, coefficient of friction ·15, inclined at 50° to the horizontal ; find the velocity acquired in one second.

8. A triangular roof-truss ABC has a horizontal span AC of 36 feet and the angle ABC is 120°, AB and BC being of equal length. The roof-truss is hinged at A and simply supported on rollers at C (so that the supporting force at C is vertical). It is loaded as follows : $1\frac{1}{2}$ tons perpendicular to AB at its mid-point, 1 ton vertically through B, and $\frac{1}{2}$ ton vertically through the mid-point of BC. Find the reactions of the supporting forces at A and C and the tension in AC.

9. A body of weight 20 lb. is moving due East with a velocity of 12 ft. per second, and forty seconds later it is moving North-East with a velocity of 20 ft. per second. What is the change in velocity ? What constant force acting during the interval would produce the change ? Show that in the latter case the hodograph is a straight line.

10. Assuming that the wheels of a motor-car are $2\frac{1}{2}$ feet in diameter, what is the angular velocity of a wheel when the car is travelling at the rate of 50 miles per hour ? What is the velocity of a point on the surface of a tyre (a) when vertically above the centre, (b) when the radius from the point to the centre is inclined at an angle of 60° to the upward vertical ? What would be the force acting on a stud of mass $\frac{1}{2}$ oz. embedded in the tyre when at its greatest height ?