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(Department of Education).

LEAVING CERTIFICATE EXAMINATION, 1947.

APPLIED MATHEMATICS.—Honours.

THURSDAY, 19*th 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. A body moving in a straight line travels distances AB, BC, CD of 104 ft., 264 ft., 240 ft. respectively in three successive intervals of 2 secs., 6 secs., and 8 secs. Show that these facts are not inconsistent with the hypothesis that the body is moving with uniform retardation. On this hypothesis find the distance from D to the point where the velocity vanishes and the time occupied in describing this distance.

2. A body weighing 20 lb. is placed on a rough plane inclined at 27° to the horizontal. The angle of friction is 20°. Find (*a*) the least force parallel to a line of greatest slope ; (*b*) the least horizontal force, that will move the body up the plane.

3. A uniform rod AB, of weight W lbs., is suspended in a vertical position by a string attached to it at A. It is now drawn from the vertical by a force acting horizontally on B, and equal to one-third the weight of the rod. Find the tension of the string and the angle it makes with the vertical when the rod is in the position of equilibrium. Find also the inclination of the rod to the vertical.

4. The parallel sides of a trapezium are of lengths a and b respectively and are a distance h apart. Find the distance of the centroid from the side a.

A trapezium PQRS is part of a rectangle ABCD. The co-ordinates of P, Q, R, S are respectively $(1\frac{1}{2}, 1)$; $(6\frac{1}{2}, 1)$; $(7, 6)$; $(1, 6)$ and those of A, B. C, D are respectively $(0, 0)$; $(8, 0)$; $(8, 6)$; $(0, 6)$. Find the centroid of the figure obtained when the trapezium PQRS is removed from the rectangle ABCD.

5. A place B is situated 200 miles north-west of A. An aeroplane has a maximum speed of 240 miles per hour in still air and a south-west wind of 60 m.p.h. is blowing at the level at which the plane is flying. Find the shortest time needed to fly from A to B and the compass course which the navigator must steer.

6. An engine weighs 60 tons, of which 25 tons is borne by the driving wheels. The engine is coupled to a carriage weighing 40 tons. The resistance to the motion of the engine is 16 lb. per ton and to the motion of the carriage 12 lb. per ton. If the coefficient of friction between the driving wheels and the rails is 0·2, find the maximum acceleration (i.e., when the driving wheels are on the point of slipping), and the tension in the coupling between the engine and the carriage.

7. A metal cube of side 8 cm. is suspended in a liquid of density 0·82 grm. per c.c. so that a pair of faces are horizontal and the upper face 6 cm. below the surface of the liquid. The atmospheric pressure is 76 cm. of mercury (density of mercury 13·6 grm. per c.c.). Find the resultant upward thrust on the cube due to the liquid and the total thrust on a vertical face of the cube.

8. Two small blocks, of weights 2 lb., and 1 lb., are suspended from the same point by equal strings each 4 ft. long. The 2 lb. block has a small spike in it so that when it collides with the 1 lb. block the two adhere together. The 2 lb. block is raised till the string to which it is attached is horizontal, and then let go.

Find its velocity (i) just before, (ii) immediately after it strikes the 1 lb. block. Find in foot-pounds the decrease in kinetic energy due to the collision and the sum of the tensions in the strings immediately after the collision.

9. Prove the formula

$$T=2\pi\sqrt{\frac{\text{Displacement}}{\text{Acceleration}}}$$

for a point moving in a straight line with simple harmonic motion.

If the period is 2·5 sec. find the amplitude if the acceleration is not greater than 0·12 g.