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(Department of Education)

BRAINSE AN MHEÁN-OIDEACHAIS

(Secondary Education Branch)

LEAVING CERTIFICATE EXAMINATION, 1959.

APPLIED MATHEMATICS—PASS.

WEDNESDAY, 10th JUNE.—AFTERNOON, 2.30 TO 5.

Not more than *six* questions may be answered. All questions are of equal value.

Mathematical Tables may be obtained from the Superintendent.

1. A uniform bar AB which weighs 8 lb. is smoothly hinged at the end A. A horizontal force P acting on the bar at the end B keeps it inclined at 45° to the vertical, B being above the horizontal through A. Find the magnitude of P.

Draw a diagram to indicate clearly the directions in which P and R act, where R is the reaction of the hinge at A.

2. Forces of 2, 6, 4 lb. wt. act respectively along AX, AY and ZA, where $\angle YAX=60^\circ$, $\angle ZAY=30^\circ$, $\angle ZAX=90^\circ$. Find the components of their resultant along AX and along AZ.

Find, correct to the nearest degree, the angle which the line of action of the resultant makes with AX.

3. A particle travels in a straight line from A to B with a uniform acceleration of 2 ft. per sec.² and from B to C with a uniform retardation. Its velocity at A is 10 ft. per sec. and its velocity at C is 4 ft. per sec. If $BC=40$ feet and the particle takes 4 seconds to travel from B to C, find the uniform retardation and the length of AB.

4. If two particles are dropped from the top of a tower, one after the other, show that the velocity of one particle relative to the other will be constant while they are falling freely.

Two stones are thrown vertically upwards from a point at ground level, the first with an initial velocity of 80 ft. per sec. and the other, half a second later, with an initial velocity of 76 ft. per sec. At what height will the stones collide ?

5. A train weighing 300 tons is travelling at a steady speed of 20 m.p.h., the frictional resistances to motion being equivalent to 40 lb. wt. per ton. Calculate the horse-power at which the train is working

- (i) if it is travelling on a horizontal track,
- (ii) if it is ascending an incline of 1 in 160.

6. ABCD is a rectangular lamina in which $AB=24$ cms. and $BC=18$ cms. E, F are the mid-points of CD, CB, respectively. If the triangular portion CEF is removed, find the centre of gravity of the remainder.

7. State the main laws of friction, explaining the terms "limiting friction," "coefficient of friction."

A 5 lb. block is placed on a rough plane inclined to the horizontal at an angle of 30° . If the block remains at rest on the plane, find the force of friction acting on it.

Explain how the coefficient of friction between a block and a plane may be found by experiment.

8. What is meant by saying that velocity is a vector?

A man who can swim at $1\frac{1}{4}$ m.p.h. in still water wishes to swim across a river which is $\frac{1}{2}$ mile wide and which is flowing at $\frac{3}{4}$ m.p.h. In what direction must he head and how long will it take him (i) to cross by the shortest route, (ii) to cross by the quickest route?

9. A piece of metal, of mass 100 grams, is partially immersed in water, 10 c.c. of it being below the surface of the water. It is supported by two strings which make angles of 30° and 45° , respectively, with the vertical. Find the tension in each of the strings, correct to the nearest gram weight.

[1 c.c. of water weighs 1 gram.]