

AN ROINN OIDEACHAIS

(Department of Education).

BRAINSE AN MHEÁN-OIDEACHAIS

(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1956.

APPLIED MATHEMATICS.—Honours.

WEDNESDAY. 13th 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 warship is travelling on a course 30° East of North. To an observer on a liner travelling due East at 15 knots the warship appears to be moving due North. Find the speed of the warship.

In what direction should the warship travel at that speed so that it would appear to the observer to be moving North-Eastwards?

2. ABC is an equilateral triangle. Forces of 13, 3, 7 lb. wt. act along the lines BA, BC, AC respectively. Find the magnitude of their resultant.

Show that the line of action of their resultant cuts BA and AC internally and CB externally, and find the angle which it makes with CB produced.

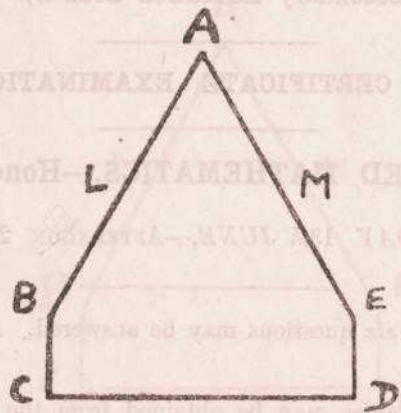
3. A uniform ladder is 10 feet long and weighs 30 lb. It rests with one end in contact with a rough horizontal plane (coefficient of friction 0.5) and the other end in contact with a rough vertical wall (coefficient of friction 0.4). If the bottom of the ladder is 8 feet out from the wall, how far can a man who weighs 150 lb. go up the ladder without causing it to slip?

How far in must the bottom of the ladder be moved to enable him to go 6 feet up the ladder?

4. A 3 lb. mass is held at rest on a smooth plane inclined to the horizontal at an angle of 30° . A light string passing over a smooth pulley at the top of the plane connects the 3 lb. mass to a 2 lb. mass which is hanging freely and which is $2\frac{1}{2}$ feet from the ground. The system is released and after t_1 seconds the 2 lb. mass is brought to rest on hitting the ground; after a further t_2 seconds it is jerked into motion again. Find the values of t_1 and t_2 .

What fraction of the kinetic energy is lost when the 2 lb. mass is jerked into motion?

5. A lamina is in the shape ABCDE (see diagram) in which ABE is an equilateral triangle of side 4 cms. and BCDE is a rectangle in which BC=1 cm. Find the distance of the centre of gravity of the lamina from the line CD.



If the triangular portion ALM is removed ($AL=AM=2$ cms.), find the distance from CD of the centre of gravity of the remainder.

6. An engine raises water from a depth of 18 feet and delivers it at the rate of 300 gallons per minute with a velocity of v feet per second. If the engine is working at $2\frac{1}{2}$ horse-power, find the value of v .

[One gallon of water weighs 10 lb.]

7. A ball is lying on the ground at C, a point 15 feet away from B, the base of a vertical pole. The ball is to be kicked from C with an initial velocity of $20\sqrt{2}$ feet per second so as to strike the pole at a point h feet above B.

- (i) If $h=6$, find the two possible angles of projection.
- (ii) Find the value of h for which there is only one angle of projection.

8. Define Simple Harmonic Motion.

A particle is moving in a straight line. Its distance, x (cms.), from a fixed point in the line at time t (seconds) is given by the formula $x=5 \sin\frac{1}{2}t$.

Show that its motion is simple harmonic ; find its maximum velocity and the periodic time.

Find how far it is from its mean position when its velocity is half its maximum velocity.

9. A lamina is in the shape of a trapezium ABCD in which $AD=6$ in., $AB=5$ in., $CD=11$ in., and the angle $\hat{B}AD=\hat{C}DA=90^\circ$. The lamina is immersed in a vertical position in water, AD being at the surface. Find the total thrust of the water on the lamina.

When the lamina is pushed down vertically so that AD is x inches below the surface and parallel to it, a horizontal line through B will divide the lamina into two parts the thrusts on which are equal. Find the value of x .

[One cubic foot of water weighs 62.5 lb.]