AN ROINN OIDEACHAIS

(Department of Education).

BRAINSE AN MHEÁN-OIDEACHAIS

(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1958.

APPLIED MATHEMATICS.—Honours.

WEDNESDAY, 18th 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.

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1. ABC is a triangle in which BC=5 cm., $\angle BCA=30°$, and $\cos ABC = \frac{3}{5}$. Forces of 10, 8, 6 lb. wt. act along BA, BC, CA, respectively. If their resultant acts along the straight line DE, cutting BC in D, calculate the length of BD and the size of the angle CDE.

2. Show that the centre of gravity of a triangular lamina is the same as that of three equal masses situated at the vertices of the triangle.

A lamina is in the shape of a trapezium ABCD in which AB and CD are parallel. AB=12, CD=3, AD=8 and $\angle DAB=30°$. Find the perpendicular distance of the centre of gravity of the lamina (i) from AB, and (ii) from AD.

3. Explain the terms "limiting friction", "angle of friction".

A horizontal force of 3 lb. wt. would just keep a block of mass 5 lb. from sliding down a rough plane which is inclined to the horizontal at an angle of 60°. Calculate the coefficient of friction between the block and the plane.

Find the direction and magnitude of the least force that would keep the block from sliding down the plane.

4. A, B, C are three ships at sea. To an observer on A, B appears to be travelling South-East at 6 knots. To an observer on B, C appears to be travelling due North at 5 knots. Find the velocity of C relative to A in magnitude and direction.

5. A car travelling on a level road was uniformly accelerated for 12 seconds and was then uniformly retarded for 2 seconds. In that 14 seconds it travelled from A to B, a distance of 180 yards. Its velocity at A was 15 m.p.h. and its velocity at B was 30 m.p.h. Find the uniform acceleration and the uniform retardation, in feet per sec.^{2}

Calculate the horse-power at which the car was working when its velocity was 20 m.p.h., given that the car weighed one ton and that the frictional resistances to motion were equivalent to 50 lb. wt.

6. A 70 gm. mass is projected vertically upwards with an initial velocity of 52 ft. per sec. and half a second later a 40 gm. mass is projected vertically upwards from the same point with an initial velocity of 80 ft. per sec. Calculate the height at which the masses will collide.

If the masses coalesce on colliding, find the greatest height which the combined mass will reach and the velocity it will have on returning to the point of projection.

7. If a body is describing a circle of radius r with constant angular velocity w, show that its acceleration is w^2r $\left(=\frac{v^2}{r}\right)$ directed towards the centre of the circle.

A particle of mass m, suspended from a fixed point by a string of length l, is describing a horizontal circle with uniform angular velocity w. Express in terms of m, l, w (i) the tension in the string, (ii) the cosine of the angle which the string makes with the vertical.

Show that the time taken by the particle in making one revolution is less than the time of oscillation of a simple pendulum of length l.

8. Define simple harmonic motion.

A particle is moving along a straight line. At time t (secs.) its distance x (cms.) from its mean position is given by the formula

$$x=3\sin 2t.$$

Show that the motion is simple harmonic and find the periodic time.

Calculate the velocity of the particle (i) when it is in its mean position, (ii) half a second later.

9. There are 10 feet of water on one side of a lock-gate and 6 feet of water on the other. The gate is rectangular and is 12 feet wide. Calculate the resultant thrust of the water on the gate, in tons.

By how much should the level of the water on the deeper side be lowered so that the resultant thrust would be 7,125 lb. less ?

[A cubic foot of water weighs 62½ lb.]