

# AN ROINN OIDEACHAIS

(Department of Education).

## BRAINSE AN MHEÁN-OIDEACHAIS

(Secondary Education Branch).

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LEAVING CERTIFICATE EXAMINATION, 1955.

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### APPLIED MATHEMATICS.—Honours.

THURSDAY, 16th JUNE.—AFTERNOON, 2.30 TO 4.30.

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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 and D are two fixed pegs in the same horizontal line. One end of a light string is attached to A and the other end to D. The string carries a weight of 5 lb. at B and a weight of X lb. at C. The angles ABC, BCD, CDA are  $135^\circ$ ,  $150^\circ$ ,  $45^\circ$  respectively. Find the value of X.

2. Explain the terms "coefficient of friction," "angle of friction."  
A block weighing 5 lb. is resting on a rough plane which is inclined to the horizontal at an angle of  $20^\circ$ , the coefficient of friction between the block and the plane being 0.4. Find the direction and the magnitude of the least force that will just cause the block to move up the plane.

3. A car descending an incline of 1 in 140 accelerates uniformly from 30 m.p.h. to 45 m.p.h. in a distance of 200 yards. Find the uniform acceleration in ft. per sec.<sup>2</sup>

If the car weighs 25 cwt. and if the frictional resistances to motion are equivalent to 40 lb. wt. per ton, find the horse-power at which the car was working when its speed was 35 m.p.h.

4. A and B are two points 20 feet apart in the same horizontal plane. A particle is projected from A with an initial velocity of  $u$  feet per second at an angle of  $\tan^{-1} \frac{1}{2}$  to the horizontal. At the same instant a balloon is released at B and rises vertically with a uniform velocity of 6ft. per sec. If the particle strikes the balloon, find the value of  $u$ .

5. Two bodies, weighing 1 lb. and 3 lb. respectively, are lying on a smooth horizontal table which is 4 feet high. The 1 lb. body is at the edge of the table and the 3 lb. body is 2 feet away in a direction perpendicular to the edge, the bodies being connected by a light inextensible string which is 3 feet long. If the 1 lb. body is pushed gently over the edge, how long will it take to reach the ground?

6. A bullet weighing  $\frac{1}{2}$  ounce, moving horizontally with a velocity of 1040 feet per second, strikes a wooden block weighing 2 lb. which is resting on a smooth horizontal plane. If the bullet becomes embedded in the block, find the velocity of the block after the impact.

What fraction of the kinetic energy is lost by the impact?

What constant resisting force would bring the block to rest in 9 inches?

7. A and B are two fixed pegs, one 4 feet vertically above the other. A mass  $m$ , connected to A and B by two light inextensible strings of equal length, is describing a horizontal circle with uniform angular velocity  $w$ .

(i) Show that  $w$  must exceed  $\sqrt{\frac{3}{2}g}$  in order that the lower string will be taut.

(ii) For what value of  $w$  will the tension in the upper string be double the tension in the lower?

8. What is Simple Harmonic Motion?

A particle is moving in a straight line with Simple Harmonic Motion. Its greatest velocity is 5 feet per second and its greatest acceleration is  $6\frac{1}{4}$  feet per second<sup>2</sup>. Find the amplitude and the periodic time.

How long does the particle take to travel from its mean position to a point half-way towards its extreme position?

9. A triangular lamina is immersed in a vertical position in water. The base, which is at the surface, is 3 inches in length, and the vertex of the triangle is 4 inches below the surface. Find the total thrust (F) of the water on the lamina.

The lamina is then drawn vertically upwards so that it is partly out of the water, the base being parallel to the surface. If the thrust on the portion immersed is now  $\frac{1}{2}F$ , how far is the vertex below the surface in the new position?

[One cubic foot of water weighs 62.5 lb.]