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(Department of Education)

BRAINSE AN MHEAN-OIDEACHAIS
(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1959.

APPLIED MATHEMATICS.—Honours.

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.

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1. A uniform rod XY, which weighs 12 lbs., is supported by two strings XZ, YZ, attached to a fixed peg Z. If XY=14″, XZ=9″, YZ=7″, calculate the tensions in the strings.

2. ABCD is a quadrilateral lamina. AB=AD=12 cm., AC=15 cm., $\angle$ BAC=30° and $\angle$ ADC=90°. Find the perpendicular distance of the centre of gravity of the lamina (i) from AC, (ii) from AD.

3. A light string passes over a smooth pulley at the top of a smooth plane inclined to the horizontal at an angle whose sine is $\frac{1}{4}$. The string connects a 3 lb. mass which is on the plane to a 1 lb. mass which is hanging freely : find the acceleration of the masses when the system is released.

When it has fallen 4 feet the 1lb. mass is brought to rest on hitting the ground. It remains at rest for t seconds and is then jerked into motion with velocity v : find the values of t and v.

4. A man is walking due east while a steady wind is blowing. When he walks at 2 m.p.h. the wind appears to him to blow from the north, but when he walks at 3 m.p.h. it appears to blow from a direction 30° east of north. Find the velocity of the wind in magnitude and direction.

At what speed must the man walk so that the wind will appear to him to blow from the north-east ?

5. Show that the range of a projectile on a horizontal plane is $\dfrac{u^2\sin2\alpha}{g}$, where u is the initial velocity and α the angle of projection.

A shell is fired from ground level and after 5 seconds it is 500 feet above the ground. If the point at which it returns to ground level is 2700 feet from the point of projection, find the initial velocity of the shell.

6. An engine weighing 100 tons is pulling a train weighing 300 tons up an incline of 1 in 160. The frictional resistances to motion are equivalent to 8 lb. wt. per ton. Find the horse-power at which the engine is working

> (i) when the train is travelling at a steady speed of 18 m.p.h. ;
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> (ii) when the speed of the train is 18 m.p.h. and it is accelerating at the rate of 0·1 feet per second per second.

7. A cyclist is travelling at a steady speed of 30 m.p.h. round a track which is banked at an angle of 15° to the horizontal. If he is describing a horizontal circle of radius 100 feet, find the angle which he makes with the normal to the track.

Find the greatest speed at which he could travel round that circle without slipping sideways, if the coefficient of friction between the track and the tyres is 0·4.

8. Describe how you would investigate experimentally the possible effect of various factors on the time of oscillation of a simple pendulum.

Establish the formula for the time of oscillation of a simple pendulum.

9. A lamina immersed in water is in the shape of a trapezium ABCD in which AD, BC are parallel, $\angle$ABC=60°, AB=10″, BC=12″, AD=4″. Find the thrust of the water on the lamina, to the nearest lb. wt.,

> (i) if it is immersed horizontally 3 inches below the surface ;
> (ii) if it is immersed vertically with AD at the surface.

By how much would the thrust in (ii) be increased if the lamina were pushed down vertically until AD was 2 inches below the surface and parallel to it ?

[*A cubic foot of water weighs* $62\frac{1}{2}$ *lb.*].