AN ROINN OIDEACHAIS

(Department of Education)

BRAINSE AN MHEAN-OIDEACHAIS

(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1960.

APPLIED MATHEMATICS.—Honours.

TUESDAY, 21*st JUNE*.—MORNING, 10 TO 12.30.

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 mass of 21 gm. is supported at O by two light strings OA, OB which are attached to fixed pegs at A, B, respectively, the straight line AB being horizontal. If AB=7 ins., AO=3 ins., BO=5 ins., find the tensions in the strings.

2. Explain the terms "limiting friction", "coefficient of friction."
A uniform ladder of weight W rests with one end in contact with a rough horizontal plane (coefficient of friction 0·6) and the other end in contact with a rough vertical wall. The ladder makes an angle $\tan^{-1}\frac{1}{3}$ with the horizontal. When a man of weight 6W is one-third the way up the ladder, the ladder is on the point of slipping. Find the coefficient of friction between the ladder and the wall.

3. State the theorem of the Triangle of Forces and its converse.
The perpendicular bisectors of the sides of a triangle are the lines of action of three forces. Each force acts outwards and is proportional in magnitude to the length of the side to which it is perpendicular. Prove that the three forces are in equilibrium.

4. ABCD is a quadrilateral lamina. $AB = BC = 5''$ and $CD = DA = AC = 6''$. Find the perpendicular distance from AC of the centre of gravity of ABCD.
If X is a point on AD such that the centre of gravity of ABCX is on AC, find the perpendicular distance from AC of the centre of gravity of CDX.

5. Derive an expression for the greatest height reached by a projectile in terms of the angle of projection and the initial velocity.
A projectile, fired from ground level, just clears a vertical wall which is 210 feet from the point of projection and is 84 feet high, and the greatest height the projectile reaches is 100 feet. Show that $\tan^{-1}\frac{4}{3}$ is one possible angle of projection, and find the other possible angle.

6. A car of mass 15 cwt. is travelling with a uniform acceleration of 2 ft. per sec.^{2} The frictional resistances to motion being equivalent to 35 lb. wt., find the horse-power at which the car is working at the instant that its speed is 30 m.p.h.

(i) if it is travelling on a horizontal road,

(ii) if it is travelling down an incline of 1 in 224.

7. Define simple harmonic motion.

A particle is moving with simple harmonic motion. Its velocity is 4 cm. per sec. when it is 1 cm. from its mean position, and its maximum acceleration is 6 cm. per sec.^{2} Find the amplitude and the period of the motion.

Find how far the particle will be from its mean position one second after it passes through its mean position.

8. If two bodies are moving freely under gravity in the same straight line, show that the velocity of one body relative to the other is constant.

A mass of 10 oz. is projected vertically upwards with an initial velocity of 70 ft. per sec. and one second later a mass of 8 oz. is projected vertically upwards from the same point with an initial velocity of 74 ft. per sec. How many seconds later again will the masses collide ?

If the masses coalesce on colliding, find in ft. lbs., the kinetic energy lost by the collision.

9. In the case of a vertical surface immersed in a liquid at rest, prove that the total thrust on the surface due to the liquid is equal to the area of the surface multiplied by the pressure at its centre of gravity.

A rectangular swimming-pool is 100 feet long and 40 feet wide. The walls are vertical and the floor of the pool slopes uniformly so that the water is 4 feet deep at one end and 16 feet deep at the other end. Find in tons, correct to the nearest ton in each case, the total thrust of the water (i) on the wall at the shallow end, (ii) on one of the side-walls.

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