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LEAVING CERTIFICATE EXAMINATION, 1938.

PASS.

APPLIED MATHEMATICS.

THURSDAY, 23rd JUNE.—AFTERNOON 4 TO 6 P.M.

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. In the case of a body travelling in a straight line with a constant acceleration, prove the relation $s=\frac{1}{2}at^2$. "s" represents the distance travelled in time "t" from the start of the motion and "a" the acceleration.

The following table gives the number of feet, s, travelled in time t seconds by a body in a laboratory experiment :—

s	0	·25	1	2·25	4	6·25
t	0	1	2	3	4	5

Show that this body is travelling with a uniform acceleration and find the acceleration.

2. A body is allowed to fall freely from a height of 4 feet inside a railway coach. The train is travelling on a straight level track at a speed of 30 miles per hour. When it just reaches the floor of the coach, calculate the magnitude and direction of the body's velocity :—

(*a*) relative to the floor of the coach, and

(*b*) relative to the railway track.

3. State Newton's second law of motion.

The speed of a motor car weighing 30 cwt. decreases from 45 miles per hour to 30 miles per hour while the car travels a distance of 50 yards.

Calculate the loss in momentum and the value of the force (supposed constant) resisting the motion.

4. A point P is travelling in a horizontal circle $3\frac{1}{2}$ feet in diameter. If the point makes 300 revolutions per minute, calculate its linear speed in feet per second. Find the change in velocity of the point in $\frac{1}{4}$ of a revolution and the value of the average acceleration during this time.

5. A body weighing 5 lb. is hung on the end of a light string whose upper end is tied to a fixed support. The body is pulled aside until the string makes an angle of 30° with the vertical.

Find the value of the horizontal force which would be required in order to keep the body in this position, and the tension in the string.

Prove, in general, that the horizontal force required to keep the string inclined at $\theta°$ to the vertical is proportional to $\tan \theta$.

6. A uniform beam AB 16 feet long weighs 60 lb. Loads of 30 lb. and 90 lb. respectively are hung at two points C and D on the beam. AC=4 feet, and AD=14 feet.

The beam is hinged at A, and is kept horizontal by a light chain BE attached to B. The chain is inclined so that the angle ABE is 30°. The points A and E are in the same vertical line.

Calculate (*a*) the size and position of the resultant of the loads (including the weight of the beam)

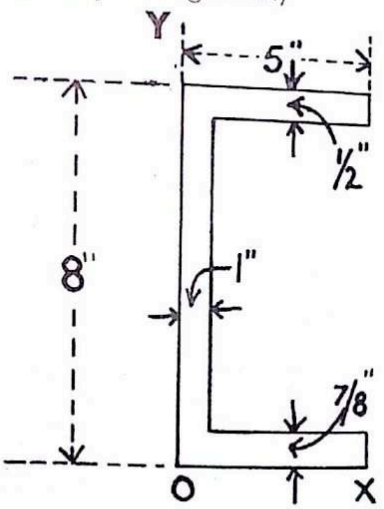
(*b*) the tension in the chain,

(*c*) the vertical and horizontal components of the reaction at the hinge.

(The friction of the hinge may be neglected.)

7. The cross section of a steel girder is shown in the sketch.

Find the position of the centre of gravity of the cross-section relative to the lines OX and OY.



8. A certain pulley system employs two separate pulley blocks. The upper block contains four pulleys and the lower one three pulleys and one single rope passes round all the pulleys.

Sketch the arrangement.

Neglecting the weight of the lower block and all frictional resistances, calculate the effort required to raise a load of 2 cwt. and the distance it must move in order to lift this load 6 inches.

9. A 40 ton cannon fires horizontally a shot weighing 14 cwt. If the velocity of recoil is destroyed in 2 feet, 9 inches, by an average force of 70 tons, calculate the velocity of projection of the shot.

10. Two bodies A and B each weighing 100 grm. are connected by a light, inextensible string passing round a small pulley at the top of a plane inclined at 30° to the horizontal.

A rests on the incline and B hangs vertically. If the bodies are allowed to move, calculate the acceleration of the system and the tension in the string.

(Neglect all frictional resistances.)