AN ROINN OIDEACHAIS

(Department of Education).

BRAINNSE AN MHEÁN-OIDEACHAIS

(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1934.

HONOURS.

APPLIED MATHEMATICS.

WEDNESDAY, 20th 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.

1. Being given a small nearly frictionless truck of known weight, a weight of 10 lb., 10 small weights of ·05 lb. each, and a horizontal plane fitted with pulley, describe in detail how you would show experimentally that the acceleration of a system of constant mass is proportional to the force producing the acceleration.

2. The amplitude of the vibration of a simple pendulum, of length l ft., making small oscillations is a ft. Find the maximum velocity of the bob.

A bullet weighing 1 oz. is fired horizontally into a block weighing 24 lb. suspended as a ballistic pendulum of length 10 feet and becomes embedded in it. If the block is displaced through a horizontal distance of 8 inches, find (i) the velocity of the block immediately after the impact, (ii) the velocity of the shot immediately before it struck the block.

3. A man standing on a train which is moving at 48 miles per hour shoots at an object which is moving away from the railway track at right angles with a speed of 30 miles per hour. If the bullet, which is supposed to move in a horizontal straight line, has a velocity of 880 ft. per second and if the line connecting the man and object makes an angle of 45° with the direction in which the train is moving, find at what angle to the train he must aim in order to hit the object.

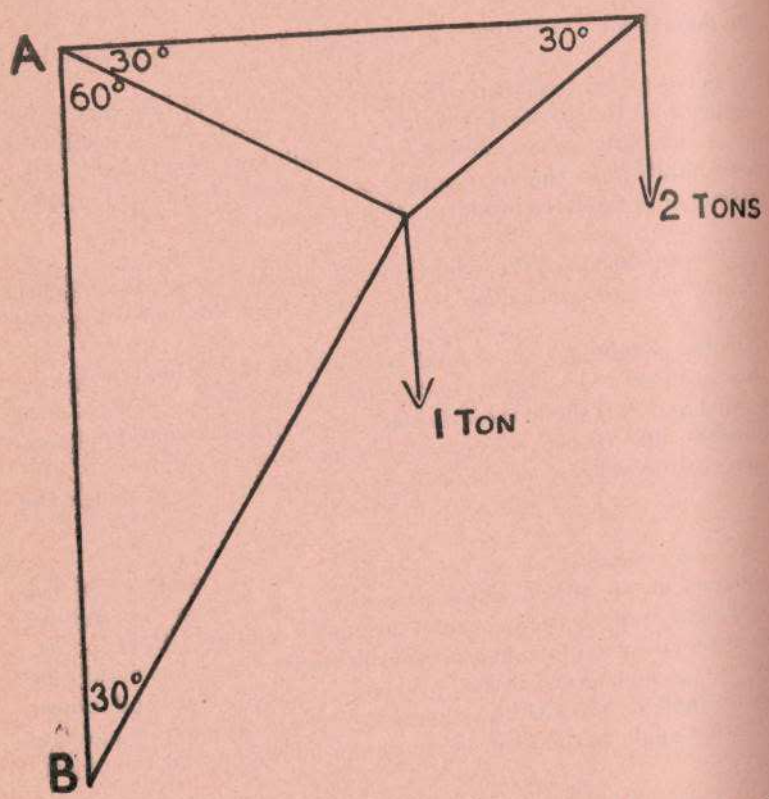
4. A sphere weighing 4 lb. is suspended by a light, inextensible wire so that its c.g. is 4 ft. below the point of support. It is projected

with an initial horizontal velocity v so that the wire ceases to be taut when it makes an angle of 60° with the upward-drawn vertical. Find the velocity of projection and the greatest vertical height attained above the point of projection.

5. A cycle track has a radius of 120 ft. and is to be banked for a speed of 30 miles per hour. Determine the angle which the track surface must make with the horizontal (i) when the friction between the wheels and the surface is entirely neglected, (ii) when the co-efficient of friction is taken as having a value of 0·2.

6. Taking the frictional resistances as 12 lb. per ton, find the Horse Power required to produce a speed of 45 miles per hour in a train weighing 300 tons in 4 minutes (i) on the level, (ii) down an incline of 1 in 200.

7. A pin-jointed framework, of the form shown in the diagram, is loaded as indicated. It is supported by a fixed pin at A and is kept in position with AB vertical by a horizontal force at B. Determine the stresses in the bars, indicating in each case whether the bar is in thrust or in tension.



8. Show that the total work done in raising a body against gravity by any part is equal to the product of the weight and the vertical

height through which the c.g. is raised. Does this principle hold if the body is not rigid ? A chain weighing 12 lb. per foot length and 60 ft. long hangs over a pulley with one end 30 ft. above the other. Find the work done in bringing the lower end to within 10 ft. of the level of the other end.

9. Explain what is meant by "the angle of friction." If a body be placed on a rough horizontal table show that no thrust, however great, applied to the body at an angle with the normal to the plane less than the angle of friction, can push the body along the plane.

A ladder 24 feet long, weighing 56 lb., has one end resting on a concrete floor and the other against a vertical wall. The c.g. is 10 ft. from the lower end, and a man weighing 140 lb. stands on a rung 18 ft. from the same end. If the co-efficient of friction at each end is $\frac{1}{3}$, find the inclination of the ladder if it is just about to slip.

10. A ball weighing 1 lb. describes a horizontal circle, the ball being attached to two cords, the other ends of which are attached to two points in the same vertical line. Each of these points is 3 feet from the centre of the ball and the cords are at right angles. If the ball makes 3 revolutions per second, find the tension of each cord in lbs.