AN ROINN OIDEACHAIS

(Department of Education).

LEAVING CERTIFICATE EXAMINATION, 1949.

APPLIED MATHEMATICS.—Honours.

SATURDAY, 18th JUNE.—AFTERNOON, 4 TO 6.

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. ABC is a triangle in which AB=8 cm., BC=10 cm., and CA=11 cm. Forces of 4, 5, 6 lb. wt. act along the sides AB, CA, CB, respectively. Find the magnitude of their resultant and find how far from C it cuts CA and the angle it makes with CA.

2. (*a*) Three coplanar forces P, Q, R act along the straight lines OA, OB, OC, respectively, and are in equilibrium. Prove that P : Q : R = sinBOC : sinCOA : sinAOB.

(*b*) The ends of a light string are attached to two points A, B respectively in the same horizontal line. A 5 lb. wt. and a body of unknown weight are suspended from the string at two points C, D respectively. In the position of equilibrium the angles BAC, ACD, CDB are found to be 60°, 135°, 90°, respectively. Calculate the weight of the body.

3. A cylindrical glass jar of internal diameter 7 cm. and internal depth 12 cm. weighs 600 gm. and is open at the top. The bottom is 2 cm. thick and its weight is one-half of that of the whole jar. Find the depth of the centre of gravity from the top when the jar contains water to a depth of 8 cm.

[1 c.c. of water weighs 1 gm.]

4. A 7 ounce mass is projected vertically upwards with an initial velocity of 160 ft./sec. and 2 seconds later a 17 ounce mass is projected vertically upwards from the same place and with the same initial velocity. Assuming that the masses coalesce when they collide, find the total time that elapses before the combined mass returns to the point of projection. What kinetic energy is lost by the collision?

5. A circular racing-track of 10 laps to the mile is banked at an angle of 30° to the horizontal. At what speed on the track will a cyclist have no tendency to skid?

If the coefficient of friction is 0·15, what is the greatest speed at which a cyclist could travel on the track without skidding?

6. A particle is projected at an angle of 30° to the horizontal with a velocity of 100 ft./sec. from the top of a tower 56 feet high. Find at what horizontal distance from the foot of the tower it will strike the ground and its velocity, in magnitude and direction, when it reaches the ground.

7. A train of mass 240 tons is travelling at a uniform speed of 30 miles per hour on a horizontal track. Half a mile from a station a coach of mass 30 tons is slipped and the rest of the train proceeds under the same tractive force as before. If the resistance to motion is always 20 lb. wt. per ton, find (*a*) the H.P. at which the engine is working, (*b*) the uniform force with which the coach must be braked after it is slipped so that it may come to rest at the station, (*c*) the distance the train is past the station when the coach arrives.

8. A particle starts from rest and moves with simple harmonic motion. Its velocity after covering a distance of 2 feet from rest is 2 ft./sec. and its maximum velocity is $2\frac{1}{2}$ ft./sec. Find its maximum acceleration and the periodic time.

9. A rectangular trough with vertical sides and a square base of 1 ft. edge is filled with mercury (sp. gr. 13·6) to a depth of 9 inches. Find the total thrust on the base and the total thrust on a vertical side.

If water to a depth of 6 inches is poured on top of the mercury, find the increase in the total thrust on a vertical side.

[1 c. ft. water weighs $62\frac{1}{2}$ lbs.]