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LEAVING CERTIFICATE EXAMINATION, 1932.

HONOURS.

APPLIED MATHEMATICS.

WEDNESDAY, 8th 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. A particle moves along a straight line and its distance from a fixed point in the straight line is given by $s=9t-12t^3$. Calculate its average speed in the interval $t=2$ to $t=3$; its instantaneous speed at $t=4$. Find when and where its instantaneous speed is zero. Describe in a general way the motion of the particle.

2. (*a*) A particle is projected at an angle θ to the horizontal up an inclined plane of inclination α. Show that its hodograph is represented by a vertical line XY where OX is its initial speed, and OY its speed on striking the plane. Show that if C is the middle point of XY that the angle XOC is $\theta-\alpha$ and that OC multiplied by the time of flight is equal to the range on the inclined plane.

or

2. (*b*) A particle is projected at an inclination θ with a speed u sufficient to enable it to strike a point on a wall which is at a horizontal distance a from the point of projection. Find the height of the point on the wall struck by the particle in terms of $\tan\theta$. Hence find an expression for the maximum height on the wall which can be reached by the particle.

3. A trolley is pulled along a horizontal table by a string passing over a pulley and carrying a scale pan and weights so that the total load on the string is P grams. The acceleration

f in cm. per sec. per sec. for different values of P is given in the following table:—

P	50	60	70	80	90	100
f	15.5	25.5	32.5	39.8	49.1	56.5

Explain how you would treat these observations.

(1) to obtain the value of P required to make the system move with uniform speed.

(2) to exemplify the second law of motion.

(3) to deduce approximately the mass of the trolley.

4. Why is the outer rail of a railway track raised on a curve? If the gauge is 4ft. 8½in. and the radius of the curve is 440yds., find how much the outer rail must be raised for an engine going round the curve at 30 miles an hour. [g=32ft./sec².]

5. A nail B is driven into a wall vertically below a point A to which is attached a pendulum bob by a string of length l (l being greater than AB). The bob is raised to the level of A with the string taut and then released. The string strikes the nail at B, and the bob just makes one complete revolution about B. Find the value of AB in terms of l.

6. An oil-electric coach weighs 45 tons when fully loaded and is equipped with an engine of 250 h.p. Taking the resistance to motion on the level as 30lb. per ton; find the speeds which can be attained (1) on the horizontal, (2) up an incline with a gradient of 1 in 100.

7. A regular hexagon is constructed of rods 16in. long, each weighing 40 grams. Each corner is loaded in the following order going round the hexagon with 40, 50, 60, 80, 90, and 100 grams, respectively. Find the centre of gravity of the whole.

8. The beam of a balance weighs w grams and its centre of gravity is at a distance h cm. below the central knife-edge. When the beam is in equilibruim with the scale pans removed, the outer knife-edges, from which hang the scale-pans, are at a horizontal distance a from the central knife-edge and each x cm. higher than the central knife-edge. If weights of the scale-pans and their loads are p and q respectively, find an expression for the inclination of the beam to the horizontal.

9. A string of length s is fastened to the ends of a uniform rod of length l. Using a suitable length of string it is possible to find a point on it at a distance x from one end so that if the rod is suspended by holding the string at that point the portion x is horizontal. Find an equation for x and show that the length of the string should not exceed $2l\sqrt{3}$.

10. A body of weight w is dragged with uniform speed up a plane inclined at an angle α to the horizontal by a force p applied to it in a direction inclined to the plane at an angle θ. Assuming the ordinary laws of friction, determine the magnitude of the force p and the work done dragging the body up the plane.