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(Department of Education).

LEAVING CERTIFICATE EXAMINATION, 1949.

SATURDAY, 11th JUNE.—MORNING, 10 TO 12.

PHYSICS.—HONOURS.

Not more than *two* questions may be answered from each Section.

All questions are of equal value.

SECTION I.

1. Describe how you would (*a*) use Hare's apparatus to measure the density of a liquid, (*b*) apply the Principle of Archimedes to measure the density of a solid in the form of a long cylinder which floats in water with its axis vertical. Explain the method in each case.

A cylinder of mass 15 grams and of a cross-section 0·5 sq. cms., floats vertically in water with 5 cms. of its length above the surface. What length of the cylinder will be above the surface when it floats vertically in a liquid of specific gravity 1·25?

2. A body of mass m lbs. moves with a velocity of v feet per second. What is the kinetic energy of the body in ft.-lbs.?

Prove that when a force acts on a mass which is free to move the work done by the force is equal to the change in kinetic energy of the mass.

A bullet, of mass 1 oz. moving with a velocity of 1,120 feet per second, passes horizontally through a wooden wall $1\frac{1}{2}$ inches thick and emerges with a velocity of 800 feet per second. Calculate, in ft.-lbs., the average resistance to penetration of the wall.

3. Prove that the centre of gravity of a triangular lamina is the same as that of three equal particles placed at the angular points.

If a quarter of the area of a triangular lamina ABC is removed by cutting along a line DE which is parallel to BC, find the ratio in which the centre of gravity of the remaining portion divides the line joining the middle points of DE and BC.

4. Describe Atwood's machine and explain fully how it may be used to test the relationship between a moving mass, the force causing motion, and the acceleration produced.

Section II.

5. State the laws of Boyle and Charles and describe fully how you would demonstrate the truth of one of them experimentally.

Discuss what is meant by (*a*) absolute zero, (*b*) absolute scale of temperature.

If the pressure, volume and absolute temperature of a mass of a gas are P, V and T, respectively, prove that $\frac{PV}{T}$ is constant.

6. Describe a method of measuring the mechanical equivalent of heat.

A copper vessel weighs 122 grams and contains 1,680 grams of oil. The oil is stirred by a rotating paddle which works at 48 watts and after 10 minutes the temperature of the oil is raised 8°C. If the specific heat of copper is 0·1 and that of the oil is 0·5, calculate the mechanical equivalent of heat.

7. What do you understand by refractive index? Describe how you would measure (*a*) the refracting angle of a prism, (*b*) the angle of minimum deviation of light passing through the prism. Describe how you would use these measurements to calculate the refractive index of the material of the prism.

Prove any formula you use.

8. In the case of a convex lens establish the relationship between u, v and f, where u and v are the distances of the object and image, respectively, from the lens and f is the focal length of the lens.

A compound microscope consists of an eye-piece of focal length 5 cms. and of an object-glass of focal length 1 cm., the distance between the lenses being 20 cms. Find at what distance from the object-glass an object must be placed so that on looking through the eye-piece a clear image of the object may be seen, the minimum distance of distinct vision being 25 cms. Find, also, the magnifying power of the microscope.

Section III.

9. What do you understand by the capacity of a charged conductor? Tell how the capacity of a parallel plate condenser changes (i) as the distance between the plates is varied, (ii) as slabs of different insulating media are placed in turn between the plates, (iii) as the area of the plates is varied. Describe experiments, one in each case, in support of your answer.

Calculate the capacity of a condenser consisting of two metal plates, each of area 500 sq. cms., separated by a slab of mica 0·2 mm. thick, taking the specific inductive capacity of mica to be 6·6.

10. Define the (c.g.s.) units in which (*a*) the strength of a magnetic field, and (*b*) an electric current are measured.

A circular coil of wire of n turns and diameter d cms. is placed with its plane in the magnetic meridian and a short magnet is mounted at the centre of the coil. If H represents the value of the

horizontal component of the earth's magnetic field and x amps. the current in the coil, find from first principles an expression for the deflection of the magnet in terms of n, d, x, H.

Describe a tangent galvanometer and tell briefly how you would use it to measure an electric current.

11. Write a brief account of the theory of electrolysis.

12. Describe a method for measuring the internal resistance of a cell.

A number of similar cells are joined together to form a battery and an external resistance of R ohms is joined to the terminals of the battery. The electromotive force and internal resistance of each cell are e volts and r ohms, respectively, and the number of cells is n. Find an expression for the current flowing in the external resistance when the cells are connected (a) in series, (b) in parallel.

Three similar cells, the E.M.F. and internal resistance of each being 1·4 volt and $\frac{1}{2}$ ohm, respectively, are used to send a current through (a) an external resistance of $\frac{1}{10}$ ohm, (b) an external resistance of 10 ohms. In what way, series or parallel, should the cells be connected in each case in order to send the maximum current through the external resistance?