O 54—I

OXFORD LOCAL EXAMINATIONS

General Certificate of Education

Summer Examination, 1964

Ordinary Level

PHYSICS, PAPER I

Tuesday, 23 June. Time allowed: 1¾ hours

Write the number of the paper, **O 54/I,** *on the left at the head of each sheet of your answers in the space provided.*

Answer **four** *questions, including* **at least one** *from each of the three Sections A, B, and C.*

Illustrate your answers by diagrams wherever these will make your answers clearer.

Mathematical tables and squared paper are provided.

SECTION A. MECHANICS AND HYDROSTATICS

1. Define *velocity* and *acceleration.*

Explain how you would use a velocity-time graph to find (*a*) the acceleration at any instant, (*b*) the distance travelled during any interval of time.

A car, initially travelling at 40 ft./sec., accelerates uniformly to 60 ft./sec. in 6 sec., travels at this speed for 8 sec., and then slows down uniformly to 50 ft./sec. in the next 6 sec. Draw a velocity-time graph for the whole 20 sec., and from this graph (or otherwise) find the total distance travelled during this period.

What is the average speed of the car during the period?

2. What is meant by the *tension* in a stretched cord or spring? State Hooke's law, and describe the experiment you would perform in order to demonstrate the truth of this law.

A non-uniform bar 50 cm. long is suspended by two vertical springs attached to its ends A and B. The natural length of each spring is 15 cm. and each extends by 1 cm. when loaded by 40 gm. wt. When the positions of the upper ends of the springs are adjusted so that the bar is horizontal, the spring at A is 18 cm. long and that at B is 22 cm. long. Find the mass of the bar, and the distance of its centre of gravity from the end A.

3. Define the *mechanical advantage* and the *velocity ratio* of a machine, and explain why the quotient

$$\frac{\text{mechanical advantage}}{\text{velocity ratio}}$$

is always less than 1.

Draw a clearly-labelled diagram of a sheaved pulley system. Explain briefly the mode of operation of the system you have drawn, and write down its velocity ratio.

The velocity ratio of a machine is 4 and the efficiency 60 per cent. Find the effort required to raise a load of 72 lb. wt., and the work done by the effort in raising this load 3 feet.

4. Define *pressure*. How would you show experimentally that a liquid transmits pressure equally in all directions, and that the pressure is the same at all points at the same horizontal depth below the free surface of a liquid at rest?

Obtain a formula for the pressure due to a column of liquid of vertical height h and density ρ.

When the height of the mercury barometer is 75 cm., find the pressure at a depth of 20 metres below the surface of the sea. [Take the density of mercury to be 13·6 gm. per c.c., and the density of sea-water to be 1·03 gm. per c.c.]

Section B. Heat and Light

5. Describe the procedure used to make and graduate a mercury thermometer.

Draw a labelled diagram of a clinical thermometer. Explain the features that make it sensitive, quick in action, and self-registering.

What temperature on the Fahrenheit scale is equivalent to 110° on the Centigrade scale?

6. Define *calorie*, *specific heat*, and *latent heat of vaporisation*.

Describe how you would determine the latent heat of vaporisation of water (latent heat of steam).

A copper calorimeter, mass 80 gm., contains 136 gm. of water at 15° C. Find the mass of steam at 100° C. which must be condensed in order to raise the temperature of the calorimeter and its contents to 40° C. [Take the specific heat of copper to be 0·1 cal per gm. per C. degree, the latent heat of steam to be 540 cal. per gm., and neglect heat losses.]

7. By drawing ray diagrams carefully to full scale, find the position and length of the image (*a*) of an object 3 cm. long lying parallel to the surface of a plane mirror at a distance of 5 cm. from it, (*b*) of an object 3 cm. high standing on the axis of a convex lens of focal length 5 cm., and at a distance of 10 cm. from the lens. In each case, give a brief account of the construction of your ray diagram.

Explain, with reference to your diagrams, the meaning of the terms *real image* and *virtual image*.

8. Why are the shadows cast by objects much sharper if the source of light is small than if it is large? In the case of a large source, why is the shadow of a given object always sharper when the screen is close to the object than when it is some distance away?

Explain how eclipses of the sun occur. Under what circumstances would you expect the eclipse to be (*a*) total, (*b*) partial?

Section C. Electricity and Magnetism

9. Describe the gold leaf electroscope, and show how it can be used to determine the sign of an electric charge.

If you were provided only with a rod bearing a negative charge, how would you charge the electroscope (*a*) negatively, (*b*) positively?

Describe an experiment which shows that, when charges are separated by friction (as, for example, when an ebonite rod is rubbed with fur), equal quantities of electricity of opposite signs are obtained.

10. State Faraday's laws of electrolysis. Define *electrochemical equivalent*.

Describe how you would determine the electrochemical equivalent of copper.

Explain very briefly the principle of the process for the electrolytic refining of copper. If power is supplied at 12 volts and the charge is 2*d*. per kilowatt-hour, calculate to the nearest penny the cost of producing one kilogram of pure copper.

[Take the electrochemical equivalent of copper to be 0·00033 gm. per coulomb.]

11. State Ohm's law, and describe an experiment you would perform in order to demonstrate its validity.

Two cells A and B, each of e.m.f. 1·5 volts and internal resistance 3 ohms, are connected in series with one another and with an external resistance of 4 ohms. Find the current in the circuit, and the potential difference across the 4 ohm resistance. Also calculate what the values of these become if B is taken away, leaving A as the only cell in the circuit.

12. Draw diagrams to show the patterns of the magnetic fields due to a steady current flowing in (*a*) a long straight wire, (*b*) a plane circular coil, (*c*) a solenoid.

Explain how a solenoid can be used to magnetise a bar of iron or steel. What are the chief differences between the magnetic properties of soft iron and steel?

Give an account of one practical application of an electromagnet.