S 45

OXFORD LOCAL EXAMINATIONS

SCHOOL CERTIFICATE

TUESDAY, JULY 12, 1949

TIME ALLOWED—$1\frac{3}{4}$ HOURS

Physics I

[Write PHYSICS I at the head of each sheet of your answers.

Answer FIVE questions; of these, at least TWO MUST BE from the section on Mechanics.

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

[*Mathematical tables and squared paper are provided.*]

Mechanics

1. State *Boyle's Law*. Explain how it is involved in the process of inflating a bicycle tyre.

In an experiment with the usual form of Boyle's law apparatus, dry air is trapped in the closed limb A while the pressure is altered by moving the reservoir B up and down. When the mercury level in B is 27·6 cm. above that in A, the volume of the air in A is 8·7 c.c.; when the level in B is 40·8 cm. below the level in A, the volume of the air in A is 26·1 c.c. What is the height of the barometer?

2. What do you understand by *the moment of a force about an axis*?

Explain why it is that a cardboard sheet pivoted on a needle passing through its centre of gravity will balance at rest in any position, while there is only one stable position of equilibrium if the needle is placed anywhere else.

A metre stick weighing 110 gm. is pivoted at its mid-point, but it is found that in order to make it balance properly a piece of wax weighing 0·5 gm. has to be attached at one end. How far is the centre of gravity of the stick from its mid-point?

3. Describe carefully how you would determine the specific gravity of a powdered solid which is known to be soluble in water.

A common hydrometer weighs 35·0 gm. The volume of the whole instrument (including the stem) is 40·0 c.c., and that of the stem itself is 6·0 c.c. What is the density of a liquid in which it floats with half the stem immersed?

4. Define *work*, *potential energy*, *kinetic energy*. Explain why, in any given system of measurement, the same units are used for all three quantities.

A body of mass 55 gm. is raised vertically until it is 20 cm. above the bench. Find the work done in raising it. It is then released and falls freely through a distance of 12 cm. What is (*a*) its kinetic energy then, (*b*) the difference between its potential energy then and its potential energy in its original position on the bench? Give your results in ergs.

[Take g as 981 cm. per sec. per sec.]

Heat and Light

5. Explain the general principles of the 'method of mixtures' in calorimetry. Illustrate your answer by referring to any calorimetry experiment that you have performed yourself.

A copper calorimeter of mass 51·7 gm. contains 82·0 gm. of oil, and is initially at 22·0° C. To it are added 7·5 gm. of ice. The ice melts and the final temperature of the mixture is 7·0° C. Find the specific heat of the oil.

[Take the specific heat of copper as 0·1, and the latent heat of fusion of ice as 80 cal. per gm.]

6. Describe an experiment to investigate the expansion of a fixed mass of gas heated at constant pressure.

What do you understand by the terms *absolute temperature* and *absolute zero*?

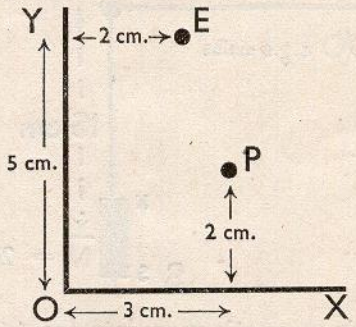
The density of hydrogen at N.T.P. is 0·09 gm. per litre. Find the mass of 3 litres of hydrogen measured at 27° C. at a pressure of 76 cm. of mercury.

7. Explain what is meant by the *magnification* given by a lens, and show how it can be calculated in terms of the distances of the object and the image from the lens.

A convex lens of 21 cm. focal length is used to project an image of a transparent slide on to a screen 168 cm. from the lens. Find where the slide should be placed, and calculate the magnification obtained.

8. State the *laws of reflection* of light, and show how they may be used to find by geometrical construction the position of the image of a point in a plane mirror.

The diagram shows a horizontal section of two vertical plane mirrors, OX and OY, which are set with their reflecting surfaces enclosing a right angle. A small



object P is placed between the mirrors, in the position shown. Find the positions of the images of P formed by the two mirrors, and draw the pencil of rays by which an eye placed at E sees the image that is formed by light that is reflected first at OX and then at OY.

9. Describe some form of photometer, and give a detailed account of the way in which you would use it to compare the candle-powers of two small lamps. Explain how you would work out the result.

A small 40 c.p. lamp is placed 3 ft. from a screen so that light falls perpendicularly on the screen. Find the illumination (intensity of illumination) of the screen. If the lamp is now surrounded by a glass globe which transmits only 75 per cent. of the light falling on it, find where the screen must be placed in order to receive the same illumination as before.

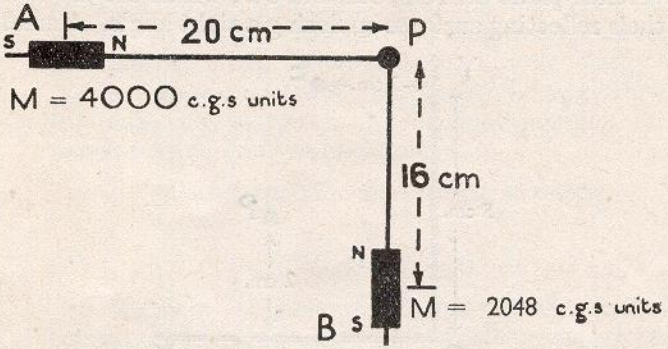
Magnetism and Electricity

10. Describe a simple form of direct-current electric motor, and explain the principles on which it works.

The windings of a 60 watt 12 volt motor have a resistance of 0·12 ohm. Find the current taken by the motor, and the value of the back E.M.F. when it is running.

11. Explain the terms *magnetic moment* of a magnet, *magnetic axis* of a magnet, and *field strength* (or *magnetic intensity*) at a point in a magnetic field.

Two short symmetrically magnetized bar magnets A and B are laid along the edges of a drawing board as



shown. Their magnetic moments are 4,000 and 2,048 c.g.s. units, and the distances from the corner P to their mid-points are 20 cm. and 16 cm. respectively. Calculate the resultant field strength at P.

[You may assume that the field strength due to a short magnet of moment M c.g.s. units at a point on the axis of the magnet at a distance of d cm. from its centre is $2M/d^3$ oersteds.]

12. What do you understand by the *electromotive force* (*E.M.F.*) and *internal resistance* of a cell?

Three Daniell cells, each of E.M.F. 1·1 volts and internal resistance 0·6 ohm, are connected in series with a low resistance ammeter and a resistance X. The cells are then arranged in parallel with one another, the combination being connected across the ammeter and X as before. It is found that the reading of the ammeter is the same in each case. Find the resistance of X and the value of the current.

13. Explain what is meant by *electromagnetic induction*, and describe **two** simple experiments to demonstrate it.

Describe a piece of apparatus which makes use of electromagnetic induction, and explain how it works. Mention briefly **one** important application of the apparatus you describe.