A/Q III A

OXFORD LOCAL EXAMINATIONS

GENERAL CERTIFICATE OF EDUCATION

Summer Examination, 1951

Advanced Level

PHYSICS, PAPER III A

FRIDAY, JUNE 29. TIME ALLOWED—3 HOURS

[Write the number of the paper, Q III A, on the left at the head of each sheet of your answers in the space provided.

If you are taking Physics at Scholarship Level you must not work this paper, but you must work Physics III S.

Attempt SIX questions only, including at least ONE question from each of the four sections of the paper.

Mathematical tables are provided.]

(Take g to be 981 cm./sec.^{2})

SECTION A

1. A mass is suspended from the lower end of a light vertical spring, fixed at its upper end. Show that, if the mass is displaced from its equilibrium position through a small vertical distance, and is then released, it will oscillate with simple harmonic motion, provided that Hooke's law is obeyed. Obtain an expression for the period of the motion.

It is found that a certain spring extends by 15 cm. when supporting a steady load of 2 kgm. This load is displaced vertically through 3 cm. and then released. Calculate the period of the resulting oscillations, and the maximum velocity of the load.

2. Describe how you would use the ballistic pendulum to measure the coefficient of restitution between two materials, and explain the theory of the experiment.

A ball A, of mass 200 gm., travelling at 50 cm. per sec., collides directly with another ball B of mass 300 gm., which is at rest. Find the velocity of each ball after the impact, if the coefficient of restitution between them is 0·6.

Section B

3. Describe how you would measure the coefficient of thermal conductivity of either a very good or a very bad conductor. Explain why the method you give is appropriate for the case you choose, and explain how you would calculate the coefficient from your measurements.

The walls of a small building have a total area of 50 sq. metres, of which windows occupy 6 sq. metres. The walls are 24 cm. thick, and the windows are 0·3 cm. thick; the coefficients of thermal conductivity of brick and glass are $1{\cdot}0\times 10^{-3}$ and $2{\cdot}0\times 10^{-3}$ cal. per sec. per °C. per cm. respectively. Find the wattage that must be supplied to an electric heating system in order to maintain the building at a steady temperature of 12° C. above the surroundings.

(Take J as 4·2 joules per calorie.)

4. Describe the constant volume air thermometer, and explain how you would use it to determine the pressure coefficient of a gas heated at constant volume.

500 c.c. of air is collected at 20° C., when the relative humidity is 80 per cent. and the barometric pressure 754·4 mm. of mercury. What volume will it occupy at normal temperature and pressure ?

(The maximum vapour pressure of water is 4 mm. of mercury at 0° C. and 18 mm. of mercury at 20° C.)

5. Distinguish between progressive and stationary waves, and describe how you would use a tuning fork or other device vibrating at constant frequency to maintain a stationary wave system in a stretched string.

Two strings of the same material are stretched side by side on a sonometer to the same tension, and they are adjusted to unison with a fork of frequency 328 per sec. Their lengths between the bridges are 75·0 and 90·0 cm. respectively. Find the ratio of the diameters of the two wires, and also the number of beats per second that will be heard if the length of the longer wire is increased to 90·3 cm.

Section C

6. Explain what is meant by the refractive index of a material, and describe how you would find its value for a liquid.

The refracting angle A of a glass prism of refractive index 1·63 is 70°; the face AB is covered with liquid of refractive index 1·36. Calculate the angle of incidence on the face AC of light which is just totally internally reflected at the face AB.

7. Describe an experiment to measure the wave-length of monochromatic light, and indicate how the result is calculated from the observations.

A diffraction grating with 6,300 lines per centimetre is set on the table of a spectrometer, so that monochromatic light is incident normally on it. The telescope is moved round, and bright images appear on the cross-wires at the following settings:

$80^\circ\ 54'$; $107^\circ\ 28'$; $130^\circ\ 0'$; $152^\circ\ 12'$; $179^\circ\ 6'$.

Explain what is being observed at each of these settings, and calculate the wave-length of the light.

8. Describe the construction of (*a*) a sextant, (*b*) a projection lantern, and explain the action of each instrument as fully as you can.

SECTION D

9. State Faraday's laws of electrolysis, and show how they are explained by the ionic theory.

A potentiometer circuit is set up in the usual way, and a Daniell cell of E.M.F. 1·08 volts just balances the potential fall down 75·6 cm. of wire. In another circuit, a copper voltameter is in series with a battery and a resistance R of 0·5 ohm, and the p.d. across R is balanced by the fall down 67·2 cm. of potentiometer wire. Find the mass of copper deposited in one hour.

(The electrochemical equivalent of copper is 0·00033 grams per coulomb.)

10. Describe some simple device for the production of an alternating E.M.F., and give the theory of its action.

Explain, without going into detailed quantitative calculation, the action of (*a*) a condenser, and (*b*) a coil wound on a soft iron core, when it is included in a circuit to which an alternating E.M.F. is applied.