Physics 1

540

UNIVERSITY OF LONDON

General Certificate of Education Examination

JUNE 1973 **ORDINARY LEVEL**

Physics 1

Two hours

Answer FIVE questions, choosing not more than TWO from any one section. All questions carry equal marks.

All necessary working must be shown.

Candidates are reminded of the necessity for good English and orderly presentation in their answers.

PSE 72/768 9/3/2/100/R42,500

Turn over

Section A

A1. Describe how you would establish experimentally the relationship between the pressure and volume of a fixed mass of dry air maintained at room temperature. Show how you would use your readings to demonstrate this relationship.

A mercury barometer, with a tube of uniform diameter and length 850 millimetres above the mercury level in the reservoir, reads 750 millimetres on a day when the atmospheric pressure is 760 millimetres of mercury. What will be the atmospheric pressure on a day when it reads 730 millimetres?

If the barometer tube had twice the diameter, would you expect to get the same readings? Give a reason for your answer.

(Assume the temperature to be the same throughout.)

A2. Answer any *TWO* of the parts (*a*), (*b*), (*c*).

(*a*) You have about 60 centimetres^3 of a liquid. Describe an experiment you would perform in order to find the relative density of the liquid as accurately as possible, stating clearly any precautions you would take.

(*b*) How long would it take a stone dropped from a height of 10 metres above the ground to reach the ground?

(Assume the acceleration of free fall, $g = 10$ metres per second^2.)

If two large spheres of the same radius and same substance, one solid and the other hollow, are dropped from a great height in air they will not reach the ground at the same time. Account for this in terms of the forces acting on the spheres, stating which will reach the ground first.

(*c*) Describe an experiment which shows that hydrogen diffuses at a different rate from air. State what is observed during your experiment and explain in terms of molecular motion why the effect is produced.

A3. (*a*) Describe how you would investigate experimentally the relationship between the *extension* of a light spring and the *load* which it supports. State what you understand by *elastic limit* and, assuming that the spring is not loaded beyond this point, sketch the graph which you would expect to obtain from your readings. Explain how you would use the apparatus and graph to find the weight of a stone which is less than the maximum load you put on the spring.

(*b*) The surface of a liquid is said to be in a state of tension. Describe *two* simple, but different, observations which support this idea.

A4. (*a*) State what you understand by *diffraction* and describe a simple laboratory experiment which demonstrates the effect.

(*b*) A stationary source of sound is placed some distance from a large wall. When an observer, with a suitable detector, walks from the source directly towards the wall a series of sound maxima and minima are observed. State what these maxima and minima are called. If the average distance between successive minima is 0·2 metre and the velocity of sound in air is 320 metres per second, calculate the frequency of the source.

If the sound from the same source is transmitted through a wooden fence which is perpendicular to the wall and attached to it, will the distance between successive minima in the wood be the same as in the air? Give a reason for your answer.

Section B

B5. Give a detailed account of the experimental determination of the *specific latent heat of vaporisation* of water.

A Liebig condenser consists of a central glass tube surrounded by a jacket through which cold water is passed in order to condense steam flowing through the central tube. When dry steam enters the condenser at 100 °C it is condensed and delivered to the receiver at the other end of the apparatus as water at 80 °C. The steam enters at the rate of 1 gramme per minute and the water (in the cooling jacket) rises in temperature by 2 degrees C on flowing the length of the jacket.

Determine:

(*a*) the heat received each minute by the water flowing through the jacket,

(*b*) the rate in grammes per minute at which cold water is passed through the cooling jacket.

(Assume specific latent heat of steam = 2200 joules per gramme, specific heat capacity of water = 4·0 joules per gramme degree C.)

B6. (*a*) Draw a labelled diagram of a clinical thermometer, naming the liquid used and suggesting why it is suitable. State the reasons for any special features in the design of the thermometer.

Some thermometers have different sized bulbs, but give the same readings. Explain why this is possible.

(*b*) Describe how you would determine experimentally the *linear expansivity* of a metal rod or tube.

B7. Describe fully the apparatus used, how it is set up, and the precautions which are taken, in order to obtain an accurate value for the focal length of a concave spherical mirror. Show how the observations made are used to give the final result.

A concave spherical mirror has a focal length of 10 centimetres. Where must an object be placed in order to produce a *real* magnified image three times as tall as the object? How far, and in what direction, does the object need to be moved to produce a *virtual* image three times as tall as the object?

B8. (*a*) Show by means of a diagram how a pinhole camera can produce an image larger than the object which is viewed. State and explain briefly *one advantage* and *one disadvantage* of this device compared with a lens camera.

(*b*) Explain *why* in most cameras it is possible to adjust the distance between the lens and the film. How is the amount of light energy reaching the film controlled?

(*c*) Describe and explain the appearance of a green apple on a red cloth when it is viewed through (i) a red filter, (ii) a green filter, and (iii) a blue filter.
(All colours referred to may be considered to be pure.)

Section C

C9. (*a*) An insulated, charged metal plate is connected by a wire to a leaf electroscope. Describe and explain what happens to the electroscope when an earthed metal plate similar to and kept parallel to the first is brought up with its area gradually overlapping the charged plate, but with their distance apart kept constant. What, if anything, will be observed if now the distance of separation is increased with the plates kept directly opposite to each other? Give reasons for your answers.

(*b*) A powerful bar magnet is placed horizontally with its poles in line with the magnetic meridian, and two small regions are found on the axis of the magnet where a small plotting compass sets in a random manner. With the aid of a diagram on which the poles of the magnet are marked, account for this effect. On another diagram show how similar regions could be produced on a horizontal line through the mid-point of the magnet and perpendicular to its axis.

C10. Describe, giving a circuit diagram, an experiment which would show whether a particular cell has an appreciable internal resistance. Indicate briefly what readings would be needed in order to estimate its value. (You are not required to derive the equation for this.)

Explain why a check against a short circuit should be made when using secondary cells such as lead plate accumulators, whereas this is not so important when dry cells are used.

Resistances of 2 ohms and 3 ohms are connected in series with a cell. A high resistance voltmeter connected across the 3-ohm resistor reads 1·0 volt, but this increases to 1·2 volt when an extra 2-ohm resistor is connected in parallel with the first 2-ohm resistor. Calculate the *electromotive force* and *internal resistance* of the cell.

C11. Describe, with the aid of a diagram, the structure and mode of action of a transformer which can be used to operate a 12-volt 30-watt lamp from the 250-volt a.c. mains. What would be the cost of running the lamp for 100 hours if the transformer is 75% efficient and electricity costs 2 pence per kilowatt hour?

The lamp could also be operated at its correct rating by connecting a limiting resistor in series with the lamp and connecting directly to the 250-volt a.c. supply. What value would this resistor need to be, and why would this method not usually be chosen? Find the cost of running the lamp for 100 hours using this method.

C12. (*a*) Describe the structure and mode of action of a moving coil meter.

(*b*) The count rate recorded by a Geiger-Müller tube and counter close to an alpha particle source is 400 per minute after allowing for the background count. If the half-life of the source is 4 days,

(i) what would the count rate be 12 days later,

(ii) why would the rate be determined over periods of several minutes rather than over a few seconds,

(iii) why, if the mass of the source was determined many days later, would there be no apparent change?

What is meant by *background count*?