532/2
ORD. LEVEL
PHYSICS 2
Friday
21 JUNE 1974
$2\frac{1}{2}$ *hours*
Morning

UNIVERSITY OF CAMBRIDGE
LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education

PHYSICS

ORDINARY LEVEL

PAPER 2

(*Two hours and a half*)

Answer **five** *questions, including at least* **one** *from each of the Sections* A *and* B, *and at least* **two** *from Section* C.

Mathematical tables and squared paper are provided.

The marks shown indicate the relative credit given for the various parts of the questions.

SECTION A

1 A motor car moves from rest with a constant acceleration of 2·5 m/s^2 for the first 4·0 s. It then changes gear and the acceleration becomes 1·5 m/s^2 for the next 6·0 s.

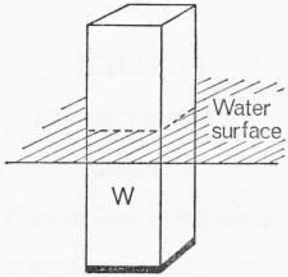
Draw a graph of *speed* against *time* to illustrate the motion during the 10 seconds, and deduce the total distance travelled in this time. **[7]**

Calculate the resultant force required to produce the acceleration of 2·5 m/s^2 when the car has a mass of 1200 kg. How much work is done by this force in the first 4 seconds? **[6]**

If you were travelling in a motor-car, how would you (i) test whether the acceleration in the first half-minute of the journey were uniform and (ii) obtain an estimate of the average acceleration in the first half-minute? **[7]**

This Question Paper consists of 11 printed pages and 1 blank page.

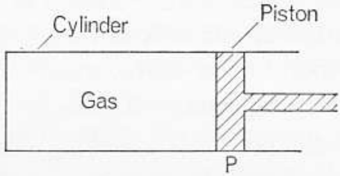
2 The diagram shows a loaded block W floating in water. The block has a weight of 1·20 N and an area of cross-section of 5·0 cm^2. Describe in detail how it could be used in an experiment to measure the pressure due to the water at various depths below the surface. [8]



How would the fluid pressure in a liquid of density 1·5 g/cm^3 compare with that in water (density 1·0 g/cm^3) at the same depth? [2]

Explain how liquid pressure is used in a mercury barometer for the measurement of atmospheric pressure. Explain, with reference to any **two** of its properties, why mercury is a suitable liquid for use in a barometer. [10]

3



The diagram shows a gas enclosed in a cylinder by a piston P. Account for the pressure exerted on the piston P by the molecules of the gas.

State the changes which occur in this pressure when

(*a*) the piston is pushed to the left, so that the gas now occupies only half the volume it occupied originally, but the temperature of the gas remains unaltered,

(*b*) the piston remains fixed in position, but the temperature of the gas is increased.

Account for these changes in the pressure exerted by the molecules of the gas. **[11]**

Draw a fully labelled diagram of an apparatus which could be used to investigate how the volume of a mass of gas changes with temperature at constant pressure. Indicate clearly how the constancy of pressure is achieved. **[6]**

A mass of gas which is initially at a pressure of 760 mmHg has its volume halved, and at the same time its temperature increases from 300 K to 400 K. What does the pressure become? **[3]**

4 What do you understand by *specific latent heat*? **[4]**

By considering the molecular nature of matter, explain what happens to the latent heat of fusion of ice and to the latent heat of evaporation of water, when each is supplied to cause the corresponding change of state. **[6]**

A jet of dry steam (at 100 °C), flowing at the rate of 0·30 g per second, is directed on to crushed ice at 0 °C in a copper can which has a hole in its base. 2·80 g of water at 0 °C flows out through the hole per second. If the specific latent heat of condensation of steam is 2260 J/g and the specific heat capacity of water is 4·20 J/g °C, calculate the heat per second given out by the steam in condensing and cooling to 0 °C. Use this result to estimate a value for the specific latent heat of fusion of ice, and explain whether you would expect this value to be larger or smaller than the correct value. **[10]**

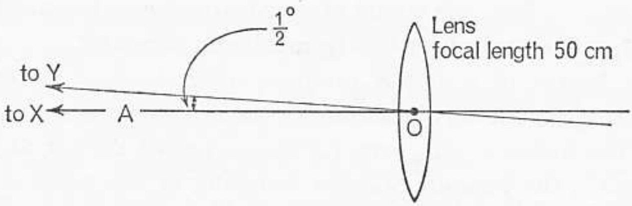
Section B

5 Describe how you would attempt to show that a material medium is essential for the transmission of sound. [7]

A source of sound S produces vibrations of constant frequency in the air. Describe for some point in the air, e.g. A in the following diagram, (i) the *motion* of the air at the point, (ii) the *pressure changes* occurring at the point. How would the pressure changes at that point alter if the source of sound were (*a*) louder, (*b*) of higher pitch? [10]

In the above diagram, B is the point nearest to A at which the motion and pressure changes are at all instants identical with those at A when the frequency of the source is 1360 Hz. Given that AB = 25·0 cm, calculate the speed of sound in the air. [3]

6 (i)



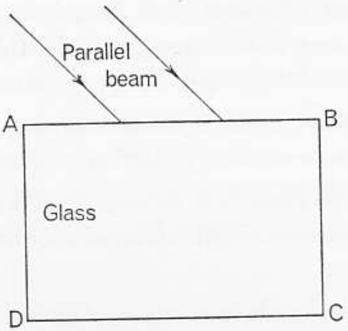
Rays of light from a point X on the edge of the sun's disc are effectively parallel. The lens in the diagram, which has a focal length of 50 cm, is arranged so that its principal axis OA points towards X. Where will the rays from X come to a focus after passing through the lens? **[2]**

The point Y, at the opposite end of the sun's diameter to X, is in a direction OY where $Y\hat{O}A = \frac{1}{2}°$. At what point will rays from Y come to a focus after passing through the lens? Where should a screen be placed in order to obtain the most clearly focused image of the sun's disc? Calculate the diameter of this image. **[8]**

(ii) Describe how you would determine, experimentally, the focal length of a converging lens. **[6]**

(iii) Explain, with the aid of a ray diagram, how a lens of focal length 5 cm can be used to enable a person to see an erect magnified image of a small object. **[4]**

7 (i)



The diagram shows a parallel beam of monochromatic light incident at 45° on the surface AB of the glass block ABCD. Copy the diagram, about twice the size shown above, and complete it to show some of the *wave-fronts* of the light

(*a*) approaching AB,

(*b*) travelling in the glass,

(*c*) after emergence from CD.

Explain why the direction of travel of a *wave-front* changes on entering the glass.

If the refractive index of the glass is 1·55, what angle do the wave-fronts in the glass make with AB? **[12]**

(ii) Calculate the *critical angle* for light emerging from glass, of refractive index 1·55, into air. Would the critical angle be greater or less than this if the light were emerging from the glass into water? Give your reasoning. **[4]**

Draw a diagram to show how a right-angled isosceles glass prism can be used to turn a ray of light through 90°. What are the advantages of using a prism, rather than a silvered mirror, for this purpose? **[4]**

Section C

8 Given an unmagnetised steel bar, how would you test experimentally that it is unmagnetised? Describe how you would then use a solenoid, a d.c. supply, and other apparatus

(i) to test that there is a limit to the strength of the magnet that can be made by magnetising the steel bar,

(ii) to find a relation between the direction of the current in the turns of the solenoid and the polarity of the magnetised steel. [12]

A steel bar is inside a solenoid which carries a current sufficient to magnetise the steel fully. State the effect, on the magnetism of the bar, of switching off the current and then gradually increasing the current to its previous value but in the opposite direction. [4]

Describe briefly any **one** method of demagnetising a magnetised steel bar. [4]

9 An accumulator battery of electromotive force 24·0 V and internal resistance 4·0 Ω is to be connected to a coil of resistance wire for use as a heater of output about 30 W. Given two such coils A and B, of resistance 4·0 Ω and 8·0 Ω respectively, find by calculation, for each coil separately connected to the accumulator

(*a*) the power provided by the heater,

(*b*) the efficiency (power provided by the heater ÷ power expended by the battery). [7]

Tabulate your answers; give brief comments on the results. [3]

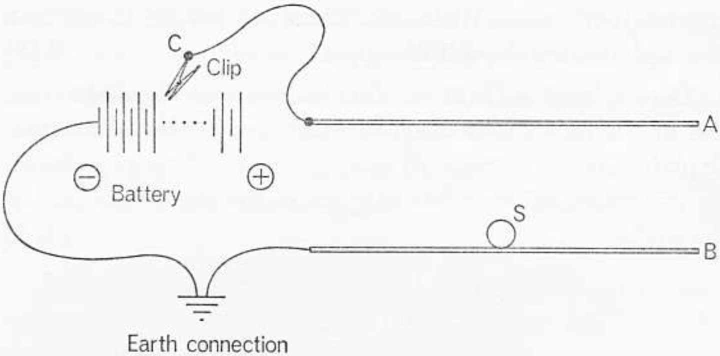
Draw a labelled circuit diagram to show how you would re-charge a 24 V accumulator battery, at 5 A, from a 240 V a.c. main, given a transformer with a turns-ratio of 6:1 and any other necessary accessories. How could you tell when the charging process was complete? [10]

10 Draw a labelled diagram to show the apparatus and the electric circuit you would use for copper-plating a sheet of brass on both sides. What conditions are needed to ensure a firm and uniform deposit of copper? **[8]**

Give a brief account of what happens at the electrodes, and of the movement of electric charges in the electrolyte. Explain how an increase in the potential difference between the electrodes affects what happens in the electrolyte and at the electrodes. [7, 5]

[Turn over

11



The diagram shows a section through two horizontal metal plates A and B; B is earthed, and A can be given a potential V by using the movable clip C to connect it to a terminal on a high-voltage battery. S is a small sphere of conducting material, resting on B.

Give an explanation of each of the following:

(*a*) When C is connected to the battery, S becomes charged. [3]

(*b*) When V is steadily increased, a stage is reached at which S moves upwards. [3]

(*c*) A value of V greater than that in (*b*) results in a continuous movement of S up and down from one plate to the other. [8]

Make reference, in your explanation of this movement, to the differing accelerations of S as it moves up and down.

(*d*) If A becomes isolated from the battery while S is moving between the plates, the up and down motion of S continues, becomes slower, and soon ceases. [6]

12 Name the particles emitted in (i) *thermionic emission*, (ii) *radioactive decay*. **[4]**

How do the processes by which particles are emitted differ in *thermionic emission* and in *radioactive decay*? How, if at all, do the processes affect the atomic structure of the emitter in each case? **[11]**

Thoron is a radioactive gas with a half-life of the order of 1 minute. When some of the gas is put in a cloud chamber, tracks of the emitted particles can be seen. If, on first observing tracks in the chamber, there were 15 tracks visible, what further observations would you make, and how would you use them, in order to determine the half-life of thoron as accurately as you can? **[5]**