UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7018231122

PHYSICS **5054/22**

Paper 2 Theory **October/November 2010**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Q9	
Q10	
Q11	
Total	

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Section A

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Answer **all** the questions in this section. Answer in the spaces provided.

1 Fig. 1.1 shows a cricket ball as it comes into contact with a cricket bat.



Fig. 1.1

The cricket ball has a mass of 0.16 kg and it hits the bat with a speed of 25 m/s. After being in contact with the bat for 0.0013 s, the ball rebounds with a speed of 22 m/s in the direction exactly opposite to its original direction.

(a) State the difference between *speed* and *velocity*.

.....

.....[1]

(b) Calculate

(i) the change in velocity of the cricket ball,

velocity change = ...[1]

(ii) the average acceleration of the ball whilst it is in contact with the bat,

acceleration = ...[2]

(iii) the average force exerted on the ball by the bat.

force = ...[2]

2 A U-shaped tube, of constant cross-sectional area, contains some water of density 1000 kg/m^3. Oil that does not mix with water is then poured into the right-hand side of the tube. Fig. 2.1 shows the levels of the water and the oil when equilibrium is reached.

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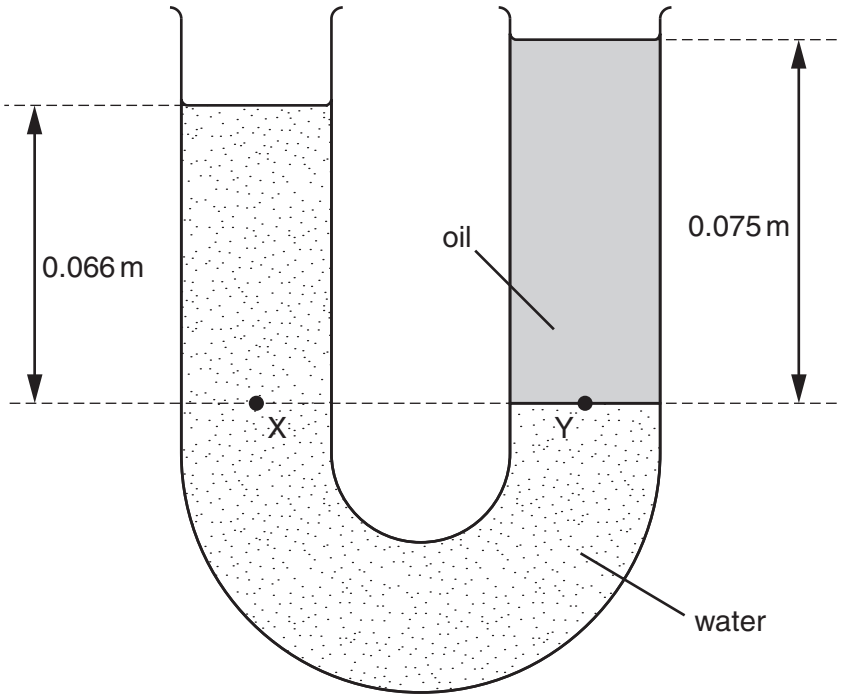


Fig. 2.1

Points X and Y are at the same horizontal level. X is 0.066 m below the top surface of the water. Y is 0.075 m below the top surface of the oil.

(a) State two quantities that influence the pressure beneath the surface of a liquid.

1. .....

2. .....

[2]

(b) The cross-sectional area of the tube is 5.0×10^{-4} m^2.

(i) Calculate the mass of water above the level of X.

mass = ...[2]

(ii) The pressure caused by 0.066 m of water at X is equal to that caused by 0.075 m of the oil at Y.

Determine the density of the oil.

density = ...[2]

3 Fig. 3.1 shows a firefighter of total weight 840 N in equilibrium at the top of a ladder that is pivoted at point P.

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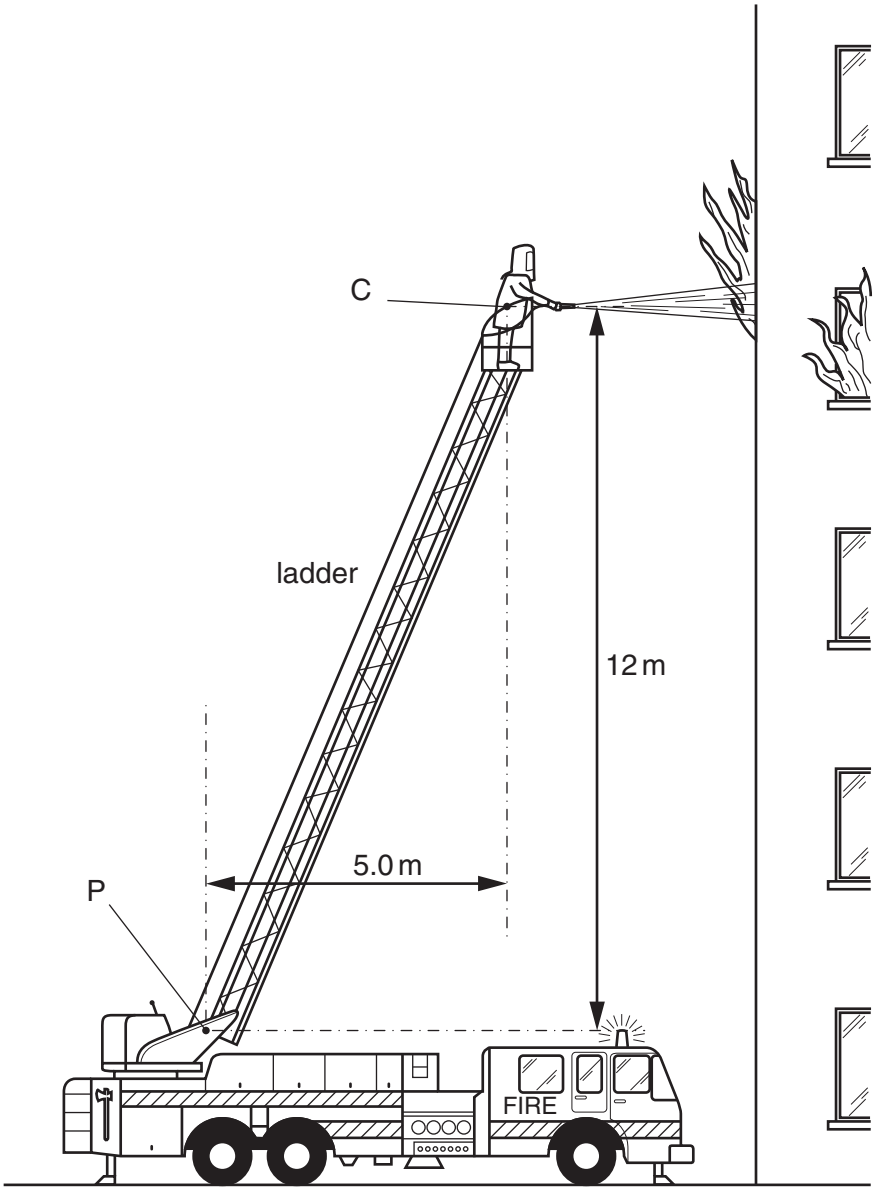


Fig. 3.1

The ladder leans towards a burning building at an angle such that the centre of gravity C of the firefighter is 12 m above and 5.0 m to the right of P. The firefighter holds a hose that directs a high-speed jet of water horizontally into a burning building.

(a) (i) Calculate the moment *M* of the firefighter's weight about P.

moment = ...[2]

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(ii) The jet of water causes a horizontal force *R* on the firefighter that acts towards the left, through C. This opposes the turning effect of his weight. Calculate the size of *R* that, on its own, ensures that *M* is exactly cancelled.

force = ...[1]

(iii) Suggest a third force that has a turning effect about P on the ladder.

.....

.....[1]

(b) Fig. 3.2 shows the firefighter.

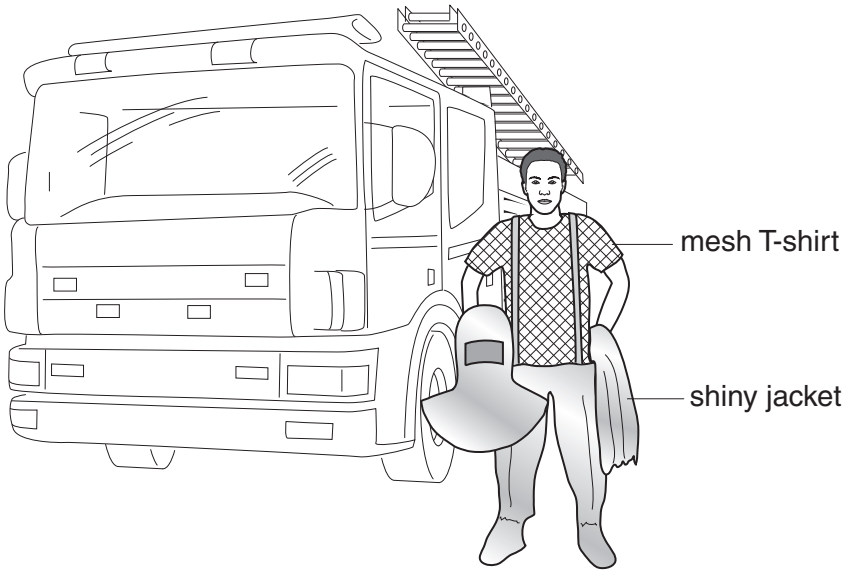


Fig. 3.2

The jacket of his protection suit has a shiny, silver-coloured outer surface. Underneath it he wears a loosely-woven mesh T-shirt (string vest).

Explain how wearing the shiny jacket and the mesh T-shirt helps to keep the firefighter cool when he is close to a source of intense heat.

.....

.....

.....

.....

.....

.....[4]

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4 At night, a bright floodlight is used to illuminate a building. The floodlight is a metal filament lamp. It is connected in series with a variable resistor and a 230 V mains power supply.

When the floodlight is first switched on, the resistance of the variable resistor is at its maximum value. In the following few minutes the variable resistor is adjusted so that its resistance decreases slowly to zero. This causes the brightness of the lamp to increase until it reaches a maximum. At maximum brightness, the current in the lamp is 12 A.

(a) Calculate the resistance of the lamp at maximum brightness.

resistance = ...[2]

(b) State and explain what happens to the resistance of the lamp as its brightness increases.

.....

.....

.....[2]

(c) Suggest how, by using the variable resistor in this way, the filament lamp is protected from damage.

.....

.....

.....[2]

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5 A microphone is connected to a cathode-ray oscilloscope (c.r.o.). A note produced by a musical instrument causes a trace on the screen. The trace is stored electronically in the c.r.o.

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Fig. 5.1 shows the stored trace displayed on the screen.

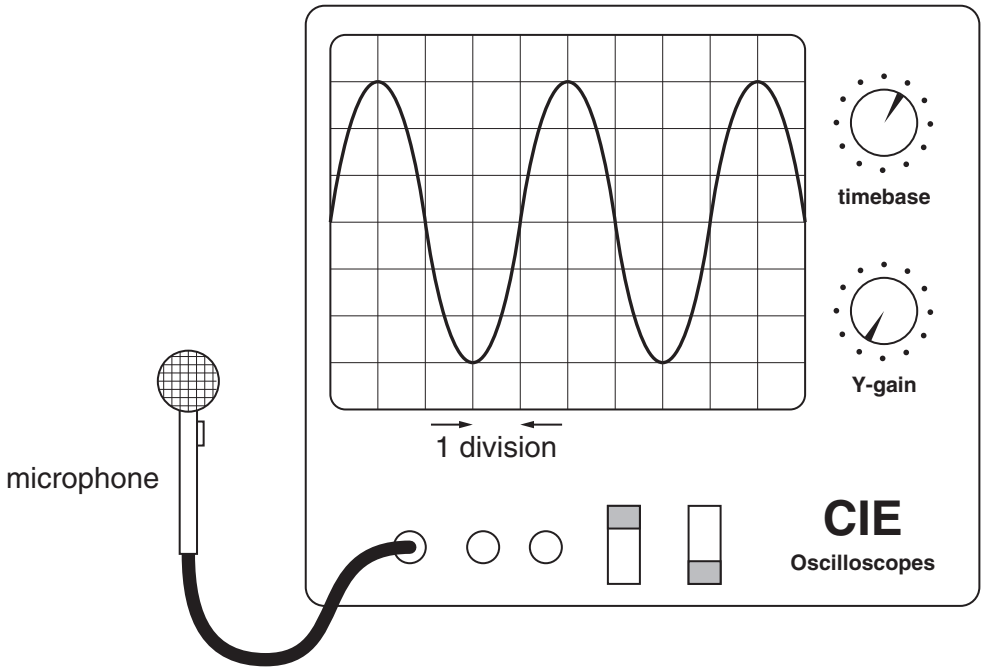


Fig. 5.1

The timebase setting on the oscilloscope is 0.20 ms / division.

(a) Determine the frequency of this note.

frequency = ...[3]

(b) A note from a second musical instrument is played and the trace S produced by the new note is also displayed on the screen. Fig. 5.2 shows the screen displaying both the original trace and S.

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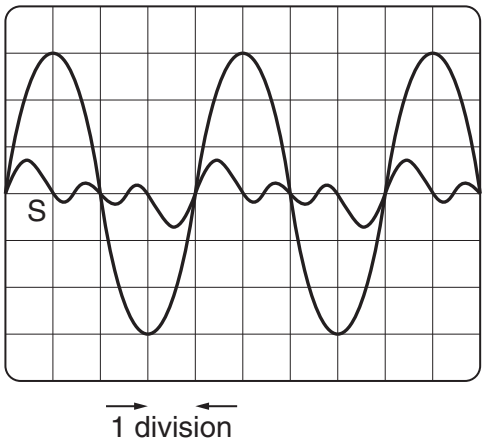


Fig. 5.2

In each of the three spaces below, describe either a similarity or a difference between the **sounds** made by the two notes.

1. .....

2. .....

3. .....

[3]

6 Fig. 6.1 shows a metal bar placed inside a vertical solenoid.

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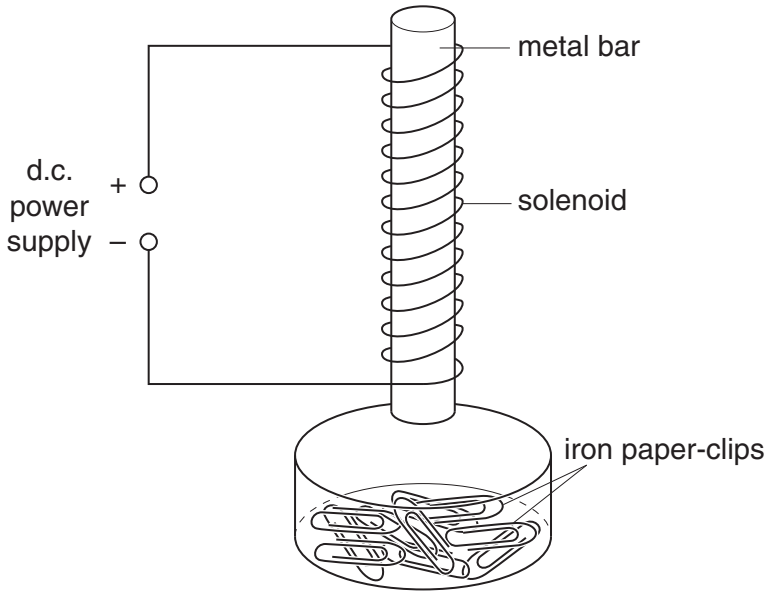


Fig. 6.1

The solenoid is a coil of several turns of insulated wire. A d.c. power supply is connected to the solenoid so that there is a current in it when the supply is switched on. The metal bar is a short distance above a small pile of iron paper-clips in a glass dish.

The power supply is

- switched on,
- left on for several seconds,
- then switched off.

Describe the behaviour of the paper-clips when this procedure is carried out using a metal bar of

(a) aluminium,

.....

.....[1]

(b) iron,

.....

.....[2]

(c) steel.

.....

.....[2]

7 **(a)** Explain what is meant by *background radiation*.

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.....

.....

.....[2]

(b) Describe how one human activity has led to an increase in background radiation.

.....

.....

.....[2]

8 Explain, in outline, how a low-density cloud of hydrogen in space becomes a star.

.....

.....

.....

.....

.....

.....[4]

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Section B

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Answer **two** questions from this section. Answer in the spaces provided.

9 Fig. 9.1 shows a very large plane mirror, inclined at 45° to the horizontal, beneath a pattern on the high ceiling of a hall.

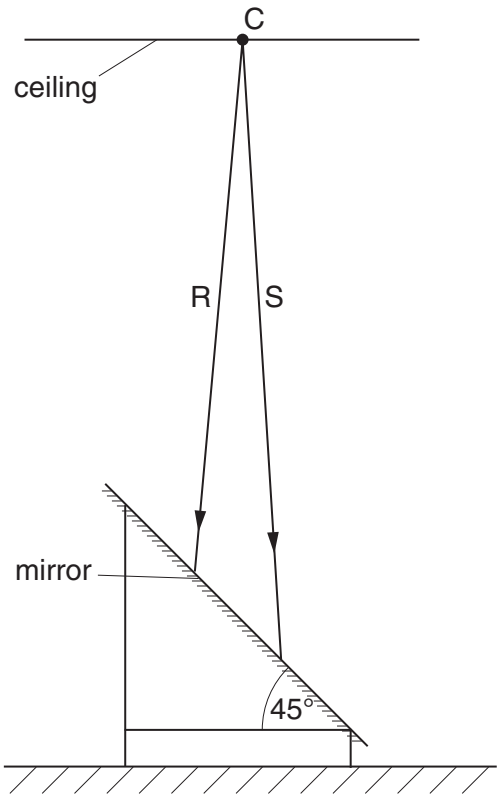


Fig. 9.1

The mirror is set on a stand at head-height immediately below the centre C of the pattern. R and S are two rays of light from C that strike the mirror.

(a) (i) On Fig. 9.1, continue the rays R and S after they strike the mirror. [1]

(ii) On Fig. 9.1, show how these rays are used to locate the image of C and mark and label the position of this image with the letter I. [2]

(iii) State two characteristics of this image.

1. .....

2. .....
[2]

(iv) Suggest how the mirror helps visitors to the hall to see the pattern on the ceiling.

.....

.....[1]

(b) Violet light from C has a wavelength of 4.0×10^{-7} m.

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(i) Calculate the frequency of this light, clearly stating the value of any constant used in the calculation.

frequency = ...[3]

(ii) State two different components of the electromagnetic spectrum that have wavelengths smaller than the wavelength of violet light.

1. .....

2. .....
[2]

(iii) **1.** Discuss a medical application of **one** of these components of the electromagnetic spectrum.

.....

.....

.....

.....

.....[3]

2. State a health risk associated with this component of the electromagnetic spectrum.

.....

.....[1]

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10 A bus breaks down on a road with a 10° upward slope. The passengers get out and push the bus to the top of the slope at a constant speed. Fig. 10.1 shows the passengers exerting a force on the bus parallel to the line of the slope.

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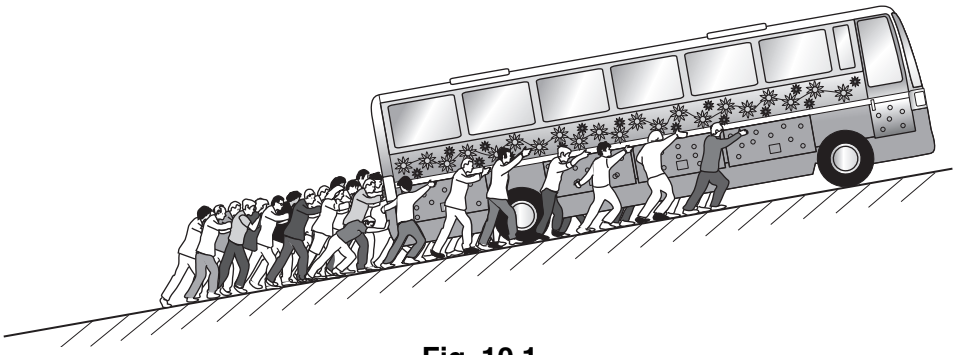


Fig. 10.1

(a) The total mass of the bus is 3200 kg.

(i) Calculate the weight of the bus.

weight = ...[1]

(ii) On Fig. 10.1, draw **two** arrows to show the direction of the weight of the bus and the direction of the force exerted on the bus by the passengers. [1]

(iii) The total force exerted by the passengers on the bus is 17 000 N along the line of the slope. Use a graphical method to determine the size and direction of the resultant of this force and the weight of the bus. State the scale used.

scale = ...

size of resultant = ...

direction of resultant = ...

[4]

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(iv) The bus travels at a constant speed. State the size of the resultant of all the forces acting on the bus.

.....[1]

(b) As the passengers push the bus up the slope, work is done against two forces. State the names of these two forces and, for each force, state the form of energy produced as work is done.

force 1 .....

form of energy 1 .....

force 2 .....

form of energy 2 .....

[4]

(c) When the bus reaches the top of the slope, it stops and the passengers get back in.

(i) On the axes of Fig. 10.2, sketch the distance-time graph for the bus from a time when the passengers are pushing the bus at constant speed until they get back into the stationary bus.

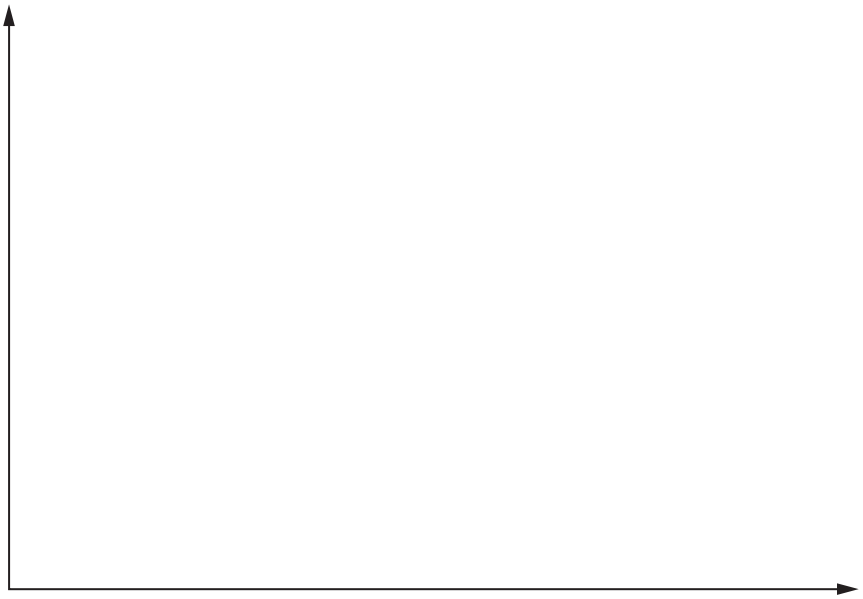


Fig. 10.2

[3]

(ii) State how the speed of a moving object may be obtained from an accurately drawn distance-time graph.

.....

.....[1]

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11 Fig. 11.1 shows a workman using a cordless electric drill.

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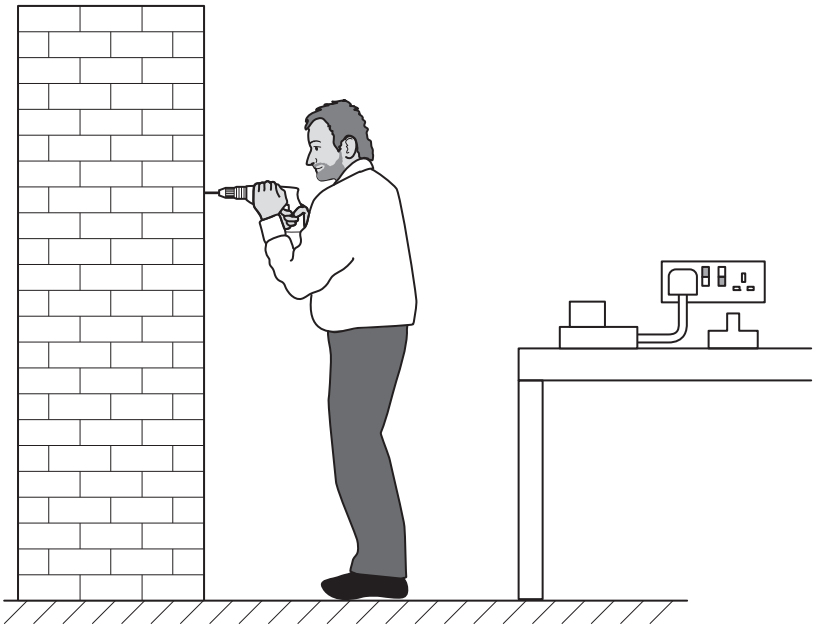


Fig. 11.1

The motor of the drill is powered by a rechargeable battery with an electromotive force (e.m.f.) of 18V. When the drill is used, the power supplied to the motor is 450W.

(a) Explain what is meant by an *e.m.f. of 18V*.

.....

.....

.....[2]

(b) The workman uses the drill for 90 minutes.

Calculate

(i) the electrical energy supplied to the motor,

energy = ...[3]

(ii) the charge that the battery supplies.

charge = ...[2]

(c) After 90 minutes of use, the battery is flat. It is connected to a charger and is recharged. The charger includes a transformer that produces a 23V a.c. output from a 230V a.c. mains supply.

(i) Draw a labelled diagram to show the structure of the transformer.

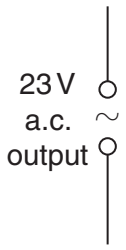
[2]

(ii) State how the transformer ensures that the a.c. output has a value of 23V when the input is the 230V a.c. mains supply.

.....

.....[1]

(iii) The 23V a.c. output of the transformer is used in a rectifying circuit to produce a direct current that recharges the battery. Complete the circuit diagram of the circuit.



[2]

(d) State and explain **one** advantage of using an alternating current (a.c.) for long-distance transmission of electrical power.

.....

.....

.....

.....[3]

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