UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0499528389

PHYSICS **5054/22**

Paper 2 Theory **May/June 2013**

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 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. Question 8 has a choice of parts to answer.
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.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **18** printed pages and **2** blank pages.

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Section A

For Examiner's Use

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

Answer only one of the two alternative parts in **Question 8**.

1 A ball rolls down a slope, as shown in Fig. 1.1.

The metre rule shows the position of the ball at times $t = 0$, 1.0 s, 2.0 s and 3.0 s.

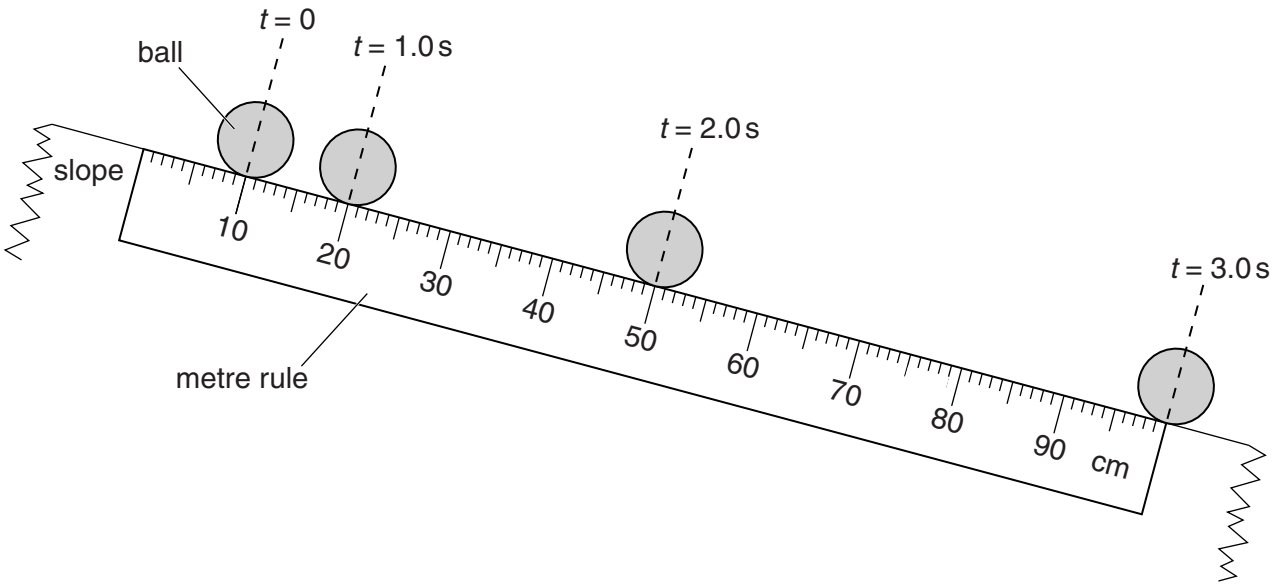


Fig. 1.1

(a) Explain how Fig. 1.1 shows that the ball is accelerating.

.....

..... [1]

(b) Calculate the average speed of the ball between $t = 1.0$ s and 3.0 s.

average speed = ... [2]

(c) Two of the forces that act on the ball are air resistance and weight.

State what, if anything, happens to these forces as the ball accelerates.

air resistance: .....

weight: .....
[2]

(d) Explain why, if the slope is long enough, the ball eventually reaches a constant speed.

.....

..... [1]

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2 **(a)** Explain what is meant by the *moment of a force*.

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.....

.....

..... [2]

(b) Fig. 2.1 shows a system for raising a heavy piece of metal into a vertical position.

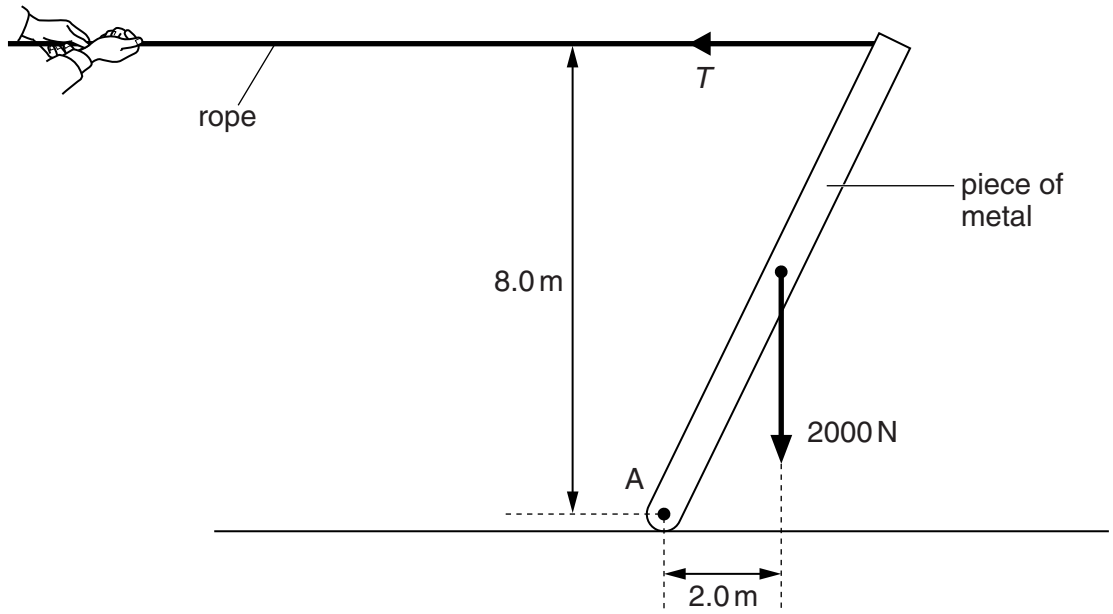


Fig. 2.1 (not to scale)

A man pulls on the rope with a horizontal force *T*. The piece of metal has a weight of 2000 N and is freely pivoted at A. The system is in equilibrium.

(i) By taking moments about A, calculate *T*.

T = ... [2]

(ii) The force *T* and the force that the rope exerts on the man are related by Newton's third law. State the relationship between these forces.

.....

.....

..... [2]

3 Fig. 3.1 shows a man using a chest expander to increase the strength of his arms.

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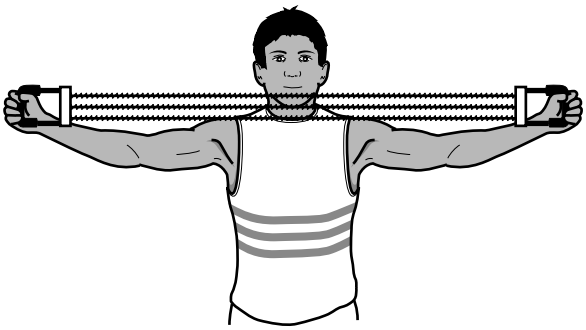


Fig. 3.1

The chest expander may be considered to be a single spring.

Fig. 3.2 shows the force needed to produce different extensions of the spring.

force / N	extension / cm
0	0
60	10
120	20
180	30

Fig. 3.2

(a) The man increases the force on the spring from 0 to 180 N.
The spring extends by 30 cm and the average force exerted during this process is 90 N.

(i) Calculate the work done on the spring.

work = ... [2]

(ii) Twenty extensions are made in 1.0 minute.

Calculate the power used to extend the spring.

power = ... [2]

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(b) The force at the limit of proportionality of the spring is 800 N.

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(i) Calculate the extension of the spring when the force is 800 N.

extension = ... [2]

(ii) The force on the spring is increased from 800 N to 860 N.

Suggest what happens to the extension.

.....

..... [1]

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[Turn over

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4 **(a)** The list below contains three components of the electromagnetic spectrum.

infra-red **gamma rays** **visible light**

Arrange the components in order of increasing wavelength.

..... [1]

(b) Satellites are used in the transmission of some television signals.

Fig. 4.1 shows a satellite above the television station where a television signal is generated.

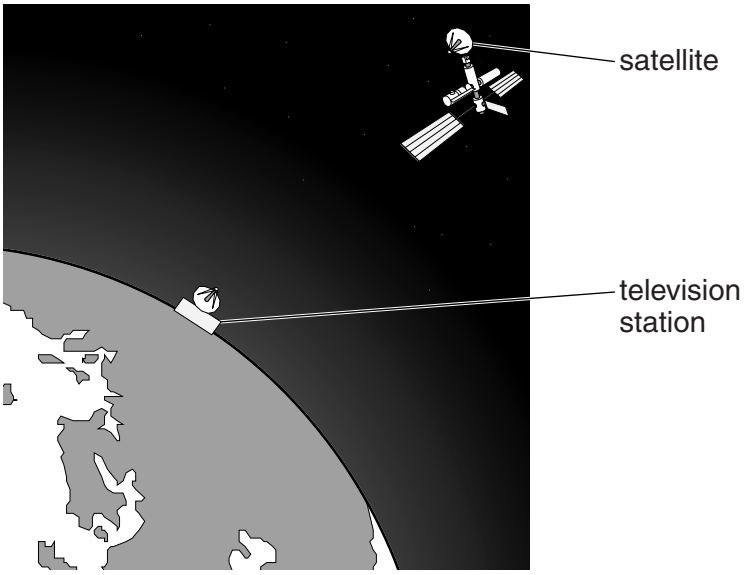


Fig. 4.1 (not to scale)

(i) State which component of the electromagnetic spectrum is used to transmit the television signal to the satellite.

..... [1]

(ii) Explain how the satellite is used.

.....

..... [1]

(iii) Suggest one advantage of using a satellite to transmit television signals.

.....

..... [1]

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5 A student rubs a polythene rod with a dry cloth. The polythene rod becomes negatively charged and the cloth becomes positively charged.

(a) Describe, in terms of the movement of electrons, what happens during the charging process.

.....

..... [2]

(b) There is an electric field around the charged rod.

Explain what is meant by an *electric field*.

.....

..... [1]

(c) The charged rod is placed near a stream of water from a tap, as shown in Fig. 5.1.

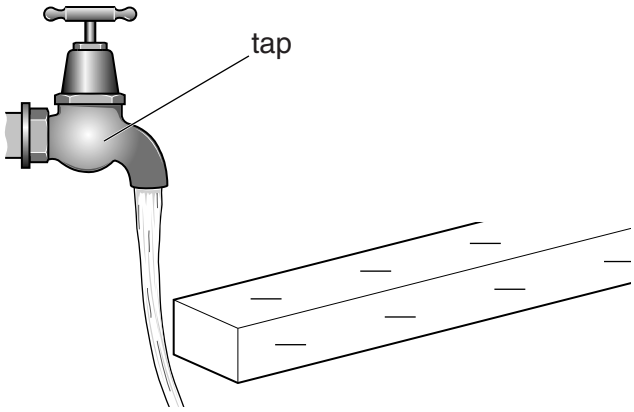


Fig. 5.1

The stream of water bends because the rod is charged.

(i) Explain how the charge on the rod causes positive and negative particles in the water to move.

.....

.....

..... [2]

(ii) On Fig. 5.1, draw the charge present on the stream of water. [1]

6 Fig. 6.1 shows the current-voltage graph for a filament lamp.

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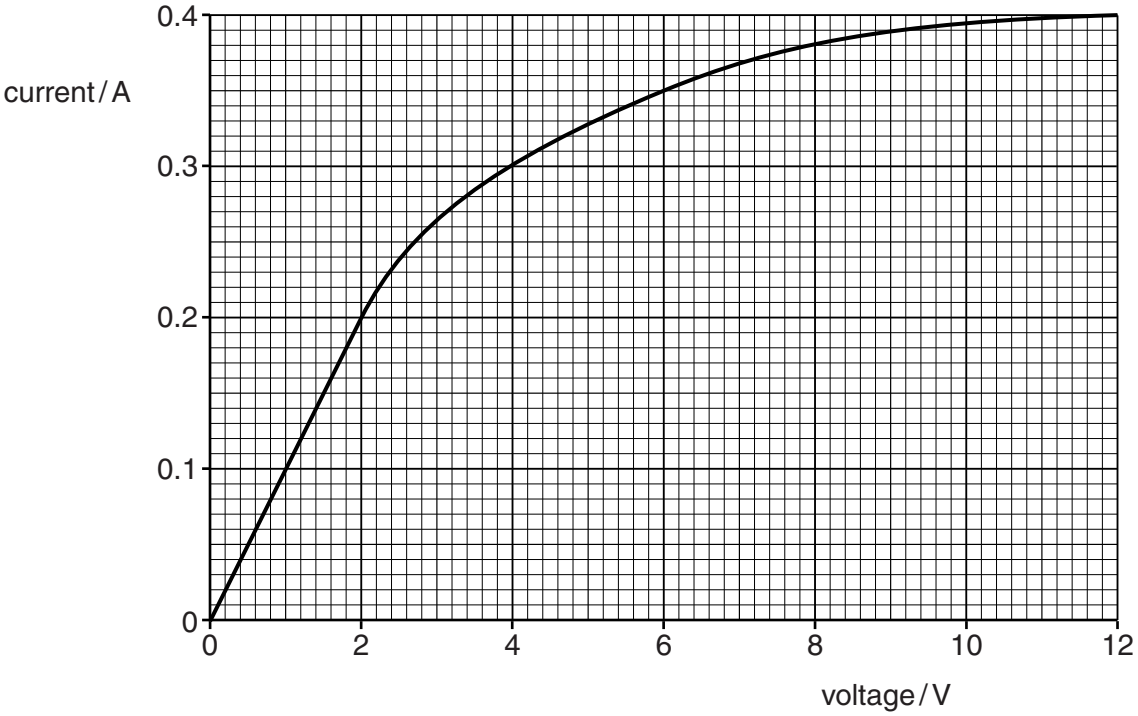


Fig. 6.1

(a) (i) State the range of voltages where the resistance increases.

..... [1]

(ii) State why the resistance of the lamp increases as the voltage increases.

.....

..... [1]

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(b) The filament lamp is connected in the circuit shown in Fig. 6.2.

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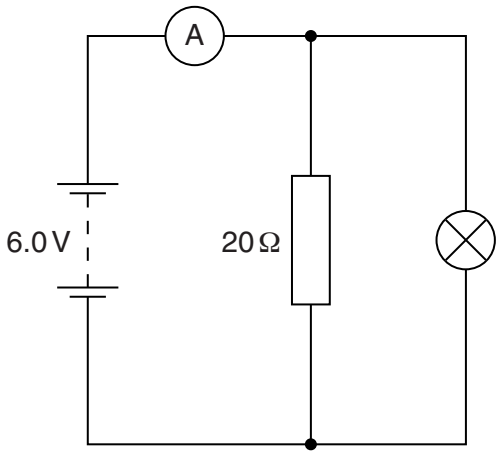


Fig. 6.2

There are currents in the lamp, the 20 Ω resistor and the ammeter.

(i) State what is meant by an *electric current*.

.....

..... [1]

(ii) Use Fig. 6.1 to determine the current in the filament lamp.

current = ... [1]

(iii) Determine the current in the ammeter.

current = ... [3]

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7 Fig. 7.1 shows a view, from above, of two wires X and Y. These wires carry equal currents vertically downwards through a piece of card.

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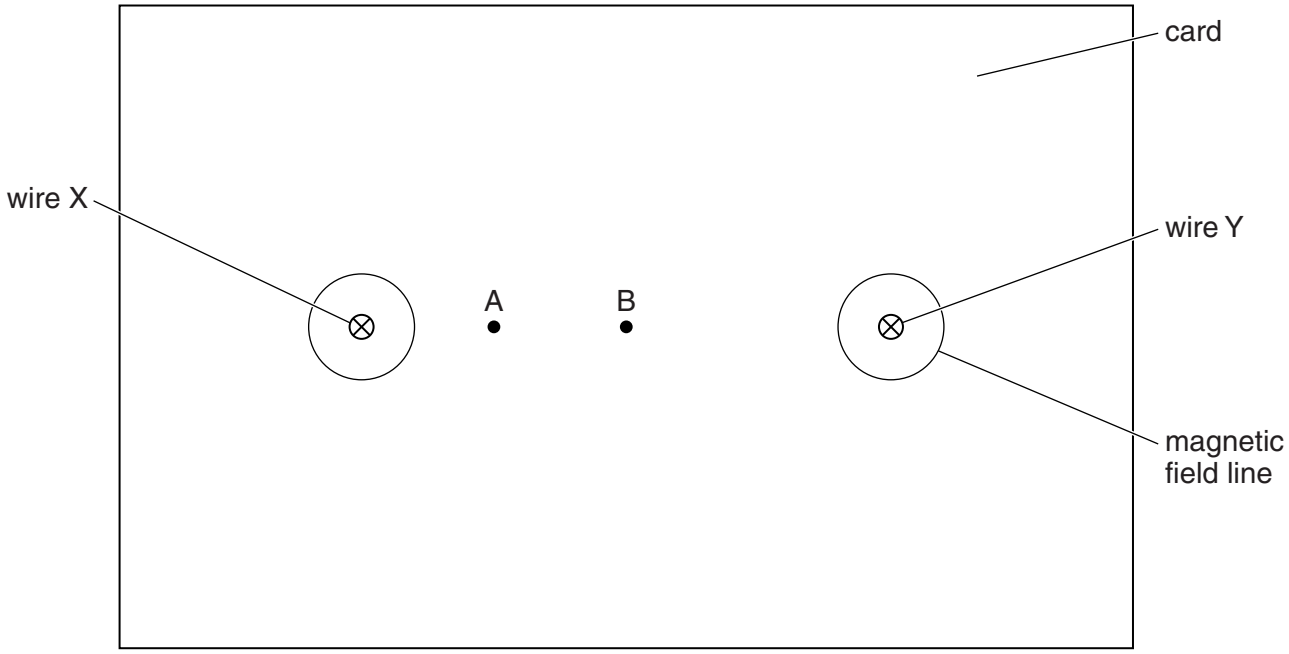


Fig. 7.1

One complete magnetic field line is drawn around each wire.

In this question, ignore the effects of the Earth's magnetic field.

(a) On Fig. 7.1, draw the complete magnetic field line due to the current in wire X that passes through point A.
Mark the direction of this field line. [2]

(b) Point B is midway between the two wires. Explain why the magnetic field at B is zero.

.....

..... [1]

(c) There is a force on wire Y due to the current in wire X.

(i) State the direction of the force on wire Y.

..... [1]

(ii) Explain why there is a force on wire Y.

.....

..... [1]

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8 EITHER

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Fig. 8.1 shows a simple a.c. generator. The coil is turning and an e.m.f. is induced in the coil.

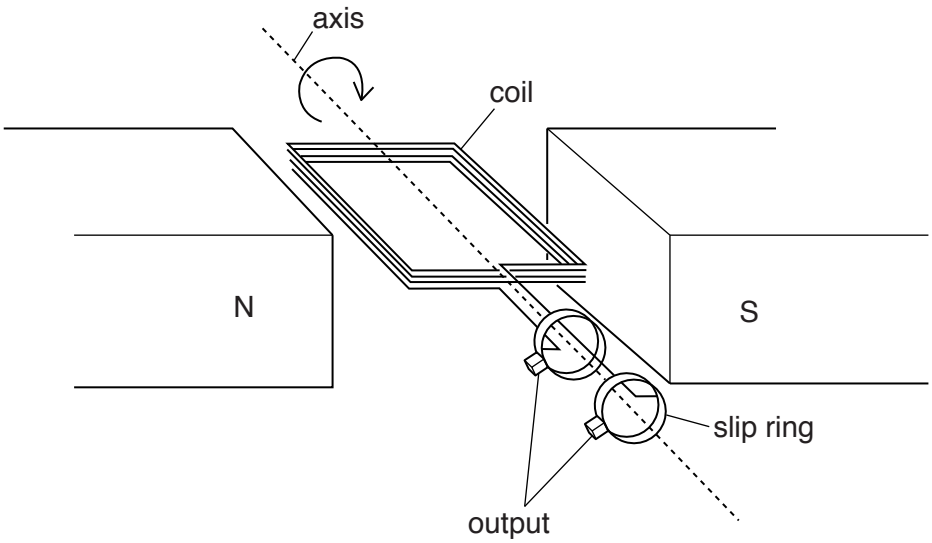


Fig. 8.1

(a) The generator contains a permanent magnet. State the name of a metal used in a permanent magnet.

..... [1]

(b) At the instant shown in Fig. 8.1, the induced e.m.f. is a maximum.

(i) Explain why the induced e.m.f. is a maximum.

.....

.....

.....

..... [2]

(ii) State the position of the coil where there is no induced e.m.f.

.....

..... [1]

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Fig. 8.2 shows an astable circuit (pulse generator) that contains two capacitors C_1 and C_2, two resistors R_1 and R_2, and two components labelled Y.

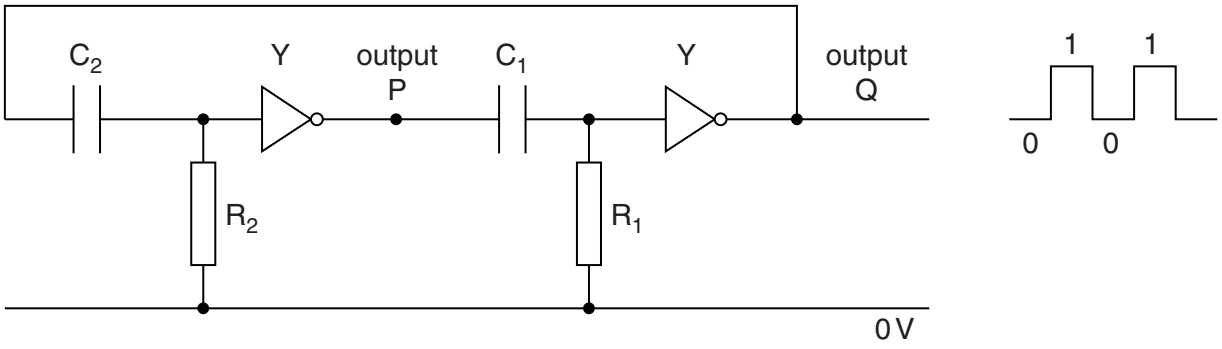


Fig. 8.2

(a) State the name of component Y.

..... [1]

(b) Complete Fig. 8.3 to show the truth table for component Y.

A high voltage is shown as 1 and a low voltage as 0.

input	output
0	
1	

[1]

Fig. 8.3

(c) The astable circuit produces a series of pulses at output Q.

(i) At one instant, capacitor C_1 is uncharged, output P is 1 and output Q is 0.

Describe how the voltage across resistor R_1 changes until Q becomes 1.

.....

..... [1]

(ii) Describe one change to the circuit that increases the frequency of the astable circuit.

..... [1]

Section B

For Examiner's Use

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

9 Fig. 9.1 shows a flask, partly full of a liquid and partly full of air.

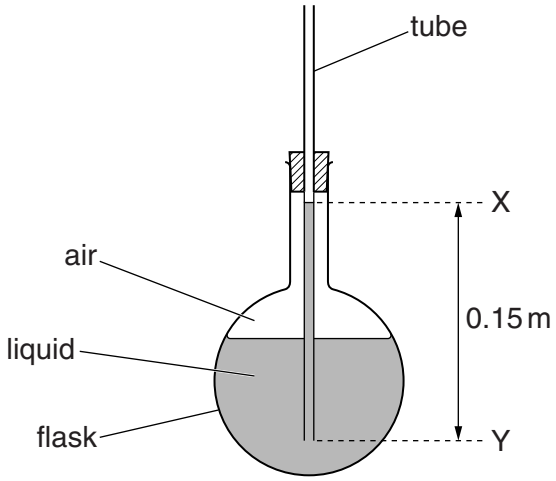


Fig. 9.1

When the flask is heated, the pressure of the air inside the flask increases and the liquid rises up the tube.

(a) Explain, using ideas about molecules, why heating the air inside the flask causes the pressure to increase.

.....

.....

..... [3]

(b) A teacher uses the flask as a thermometer. He marks the liquid level at 0 °C and at 100 °C.

(i) Describe how the teacher obtains these temperatures.

.....

.....

.....

..... [2]

(ii) State two ways in which the thermometer can be made more sensitive.

1. .....

2. .....
[2]

(iii) The thermometer has a non-linear scale.

Explain what is meant by a *non-linear* scale on a thermometer.

.....

.....

..... [2]

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(c) The inner cross-sectional area of the tube is $5.0 \times 10^{-5}\,m^2$.
The density of liquid in the tube is $1200\,kg/m^3$.
The distance between X and Y is 0.15 m.
The gravitational field strength g is 10 N/kg.

Calculate

(i) the mass of liquid in the tube,

mass = ... [2]

(ii) the weight of liquid in the tube,

weight = ... [1]

(iii) the pressure at the bottom of the tube caused by the liquid column between X and Y.

pressure = ... [2]

(d) When the flask is completely full of liquid, the liquid moves up the tube a smaller distance for the same temperature rise. State why.

.....

..... [1]

10 A student traces the path of a ray of blue light as it enters and as it leaves a glass prism. Fig. 10.1 shows the trace obtained by the student.

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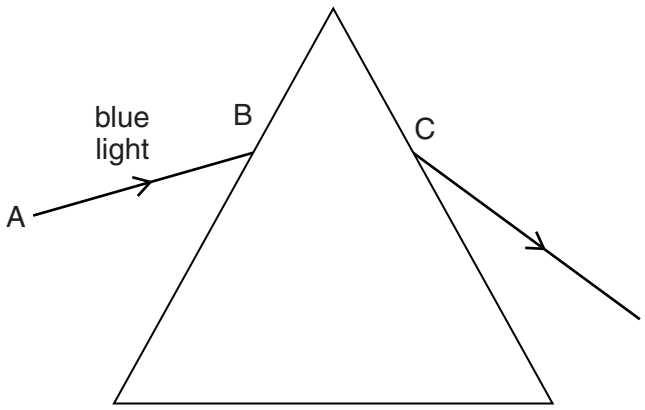


Fig. 10.1

(a) On Fig. 10.1, draw and label, at the point B, the normal, the angle of incidence *i* and the angle of refraction *r*. [3]

(b) State, in terms of the properties of light waves, why the light refracts at B.

.....

..... [1]

(c) The angle of incidence for the ray of blue light at B is 45°. The refractive index of the glass is 1.5. Calculate the angle of refraction at B.

angle of refraction = ... [3]

(d) The student performs another experiment with a ray of red light along the line AB.

On Fig. 10.1, show the path taken by this ray of light as it passes through and leaves the prism. [2]

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(e) The student performs another experiment with a semicircular glass block and a ray of white light. Fig. 10.2 shows the path taken by this ray of light as it enters the glass at P until it hits the straight edge at Q.

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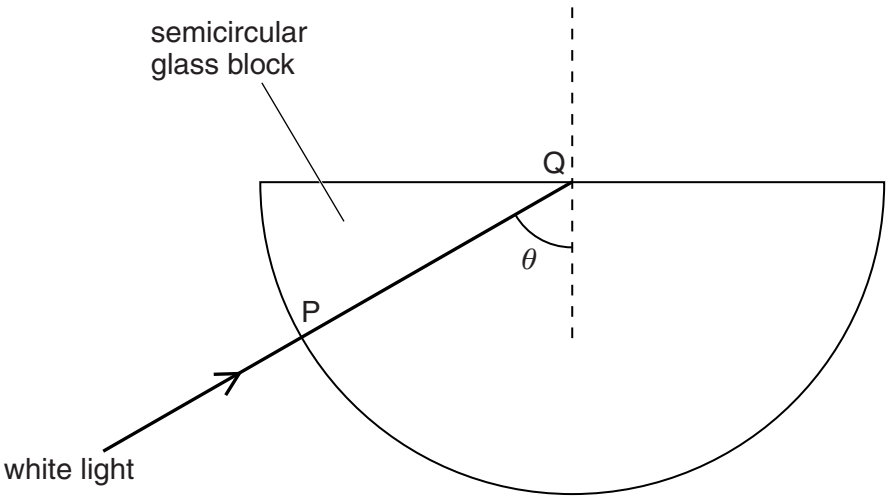


Fig. 10.2

The student finds that there is no change in direction as the ray enters the glass at P and that no light passes out of the glass at Q.

(i) Explain why the ray does not change direction at P.

.....

..... [1]

(ii) Explain why no light passes out of the glass at Q.

.....

.....

..... [2]

(iii) On Fig. 10.2, draw the complete path followed by this ray. [1]

(iv) The student directs the ray of white light into the glass along different paths, so that the angle θ is slowly reduced.

Describe what happens to the ray at Q.

.....

.....

..... [2]

11 A student places a small electrical heater inside a cup of water, as shown in Fig. 11.1.

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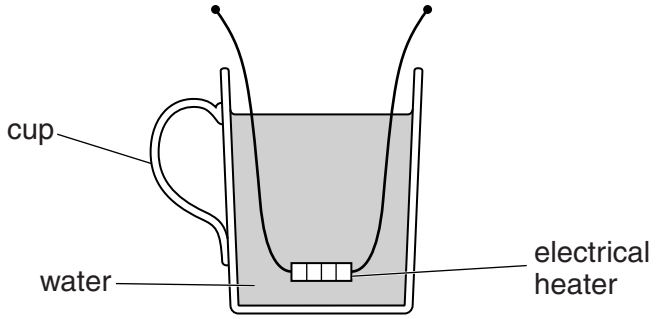


Fig. 11.1

The student determines the electrical power of the heater.

(a) In the space above the cup on Fig. 11.1, draw the electrical circuit that the student uses. Include an ammeter, a voltmeter and a power supply. [2]

(b) The voltage of the power supply is 12 V and the current is 4.2 A.

(i) Calculate the electrical power input to the heater.

power = ... [2]

(ii) Calculate the energy input to the heater in 8.0 minutes. Give your answer in kW h.

energy = ... kW h [3]

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(c) During heating, the student notices that some of the water evaporates from the cup.

(i) Describe, using ideas about molecules of water, what happens during evaporation.

.....

.....

..... [2]

(ii) The student finds that the amount of evaporation increases when the temperature of the water is higher.

State and explain one other change that increases the amount of evaporation.

.....

.....

..... [2]

(iii) State two differences between evaporation and boiling.

1. .....

.....

2. .....

.....

[2]

(d) The student turns off the power supply and the water cools.

Describe and explain how convection in the air causes the water to cool.

.....

.....

.....

..... [2]

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