Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9580629300

PHYSICS **5054/21**

Paper 2 Theory **May/June 2017**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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.

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.

© UCLES 2017

CAMBRIDGE International Examinations

Section A

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

1 Fig. 1.1 shows the directions of four forces acting on a racing car as it travels in a horizontal straight line.

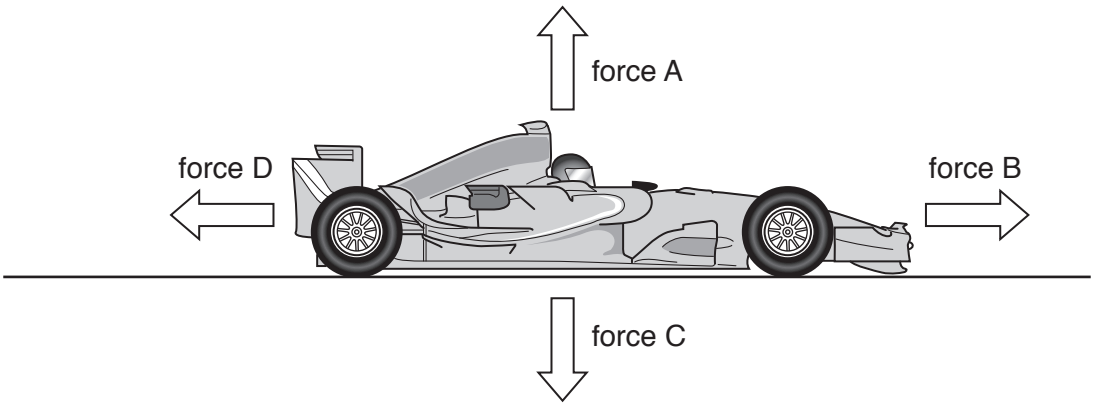


Fig. 1.1

(a) Draw a line from each box on the left to the correct description of each force.

force A	driving force
force B	contact or normal reaction force
force C	air resistance and friction
force D	force of gravity

[1]

© UCLES 2017

(b) The table shows the sizes of the forces acting on the car at one time.

force A/N	force B/N	force C/N	force D/N
8000	1000	8000	600

The gravitational field strength g is 10 N/kg.

Calculate

(i) the mass of the car,

mass = ...[1]

(ii) the resultant force on the car,

resultant force = ...[1]

(iii) the acceleration of the car.

acceleration = ...[2]

(c) At another time, the car is travelling at speed u. It then accelerates for 5.0 s with an acceleration of 1.6 m/s^2, and reaches a speed of 20 m/s.

Calculate the value of u.

u = ...[2]

2 Fig. 2.1 shows a student sitting on a chair. Fig. 2.2 shows the same student with his chair tilted backwards slightly.



Fig. 2.1



Fig. 2.2

(a) State and explain how the pressure of the chair on the floor differs in the two positions.

.....

.....

.....

.....[2]

(b) The chair and student fall over if the chair is tilted backwards more than in Fig. 2.2.

Explain why.

.....

.....

.....

.....

.....[2]

© UCLES 2017

3 Fig. 3.1 shows a metal coffee cup on a metal warming plate.

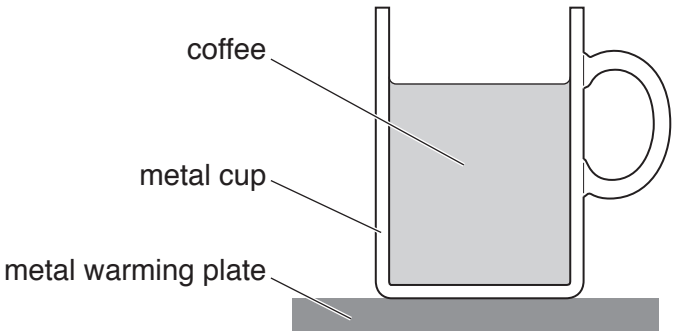


Fig. 3.1

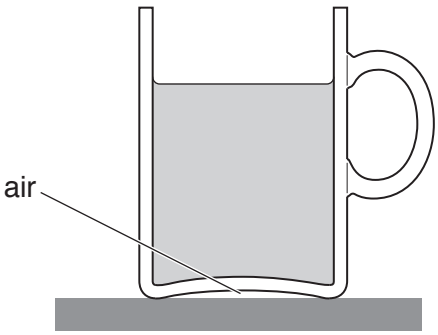


Fig. 3.2

There is a small electrical heater inside the warming plate that keeps the plate hotter than the coffee.

(a) Describe how heat is transferred through the metal and then to all of the liquid in the cup.

.....

.....

.....

.....

.....

.....

.....[3]

(b) A cup of a different shape is placed on the same heater, as shown in Fig. 3.2. The two cups are made of the same metal and contain the same amount of coffee.

Explain why the coffee in the cup in Fig. 3.2 is not kept as warm as the coffee in the cup in Fig. 3.1.

.....

.....[1]

(c) The outside surface of the cup can be either black or white and can be either dull or shiny.

(i) Underline which colour **and** which type of surface is best to keep the coffee warm.

black **white** **dull** **shiny** [1]

(ii) Explain your answer to **(c)(i)**.

.....

.....
[1]

4 Fig. 4.1 shows a converging lens, an object O and the image I produced by the lens.

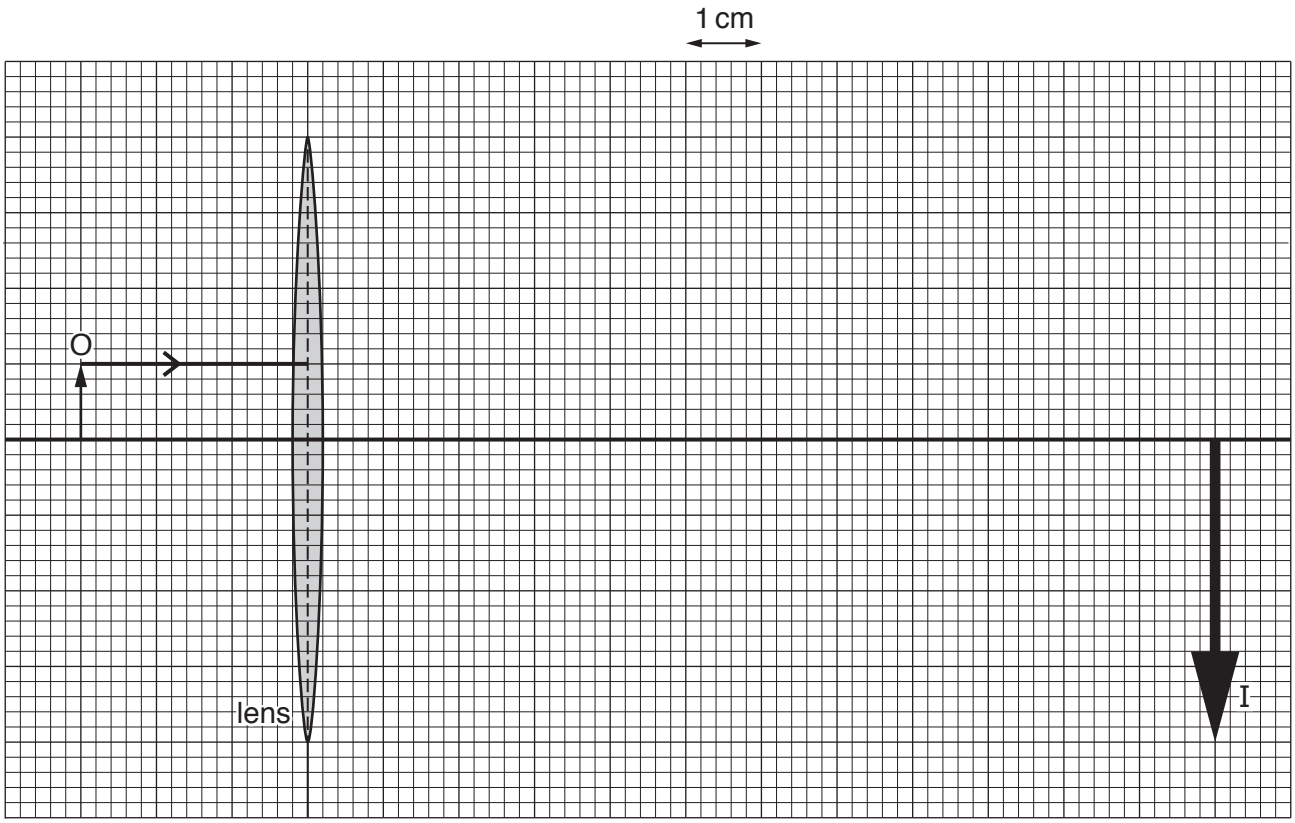


Fig. 4.1

(a) The image formed is real and has a linear magnification of 4.0.

(i) Define the term *linear magnification*.

.....

.....[1]

(ii) Explain what is meant by *real image*.

.....

.....[1]

(b) On Fig. 4.1 a horizontal ray has been drawn from the top of the object to the lens.

(i) Continue this ray until it meets the image.

(ii) Using Fig. 4.1, determine the focal length of the lens.

focal length = ...

(iii) Draw another two rays from the top of the object to show how the image is formed.

[3]

© UCLES 2017

5 Fig. 5.1 shows an arrangement of three resistors.

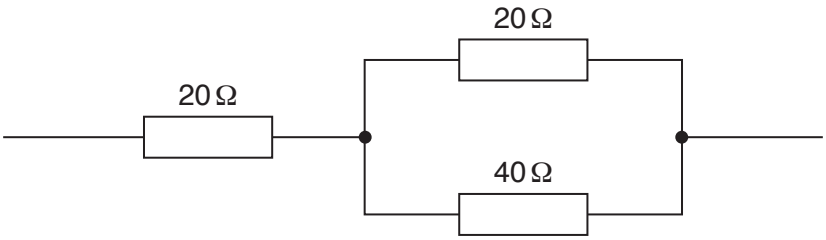


Fig. 5.1

(a) Calculate the total resistance of this arrangement.

resistance = ...[3]

(b) The arrangement is connected to a d.c. power supply.

Voltmeters are placed across the resistors, as shown in Fig. 5.2. There is a current in each resistor.

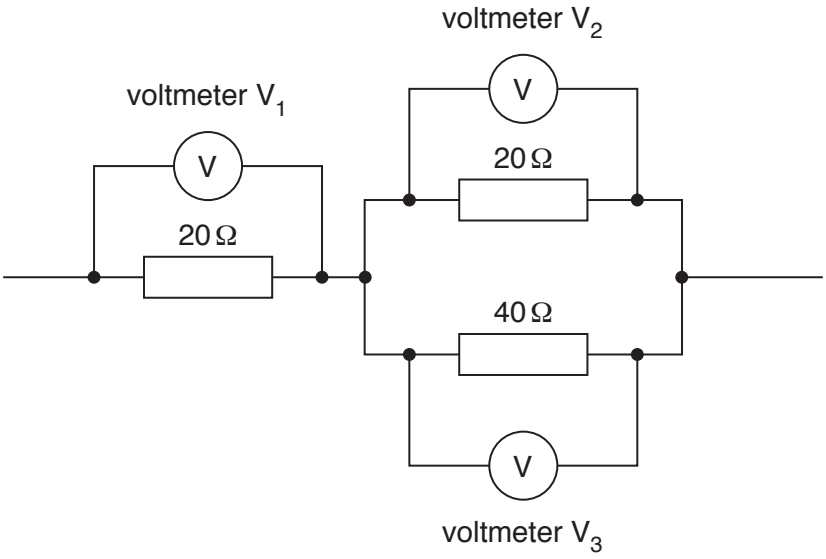


Fig. 5.2

Compare the readings on the three voltmeters. There is no need for any calculation.

.....

.....

.....[2]

6 Fig. 6.1 shows a 240 V a.c. mains supply connected to a television and two lamps.

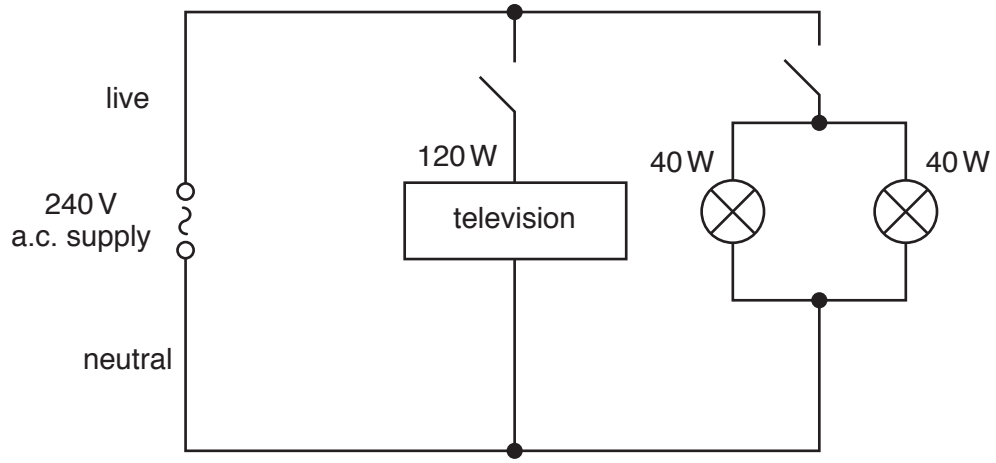


Fig. 6.1

In normal operation, the power supplied to each lamp is 40 W and the power supplied to the television is 120 W.

(a) Calculate, in normal operation,

(i) the total power supplied,

power = ...[1]

(ii) the total number of kilowatt-hours (kW h) of energy supplied to the circuit in 3.0 hours,

number of kW h = ...[2]

(iii) the current in each lamp.

current = ...[2]

(b) Explain why the switches are placed in the live wire and not in the neutral wire.

.....

.....

.....

.....[2]

© UCLES 2017

7 Fig. 7.1 shows a metal rod placed between the poles of a magnet.

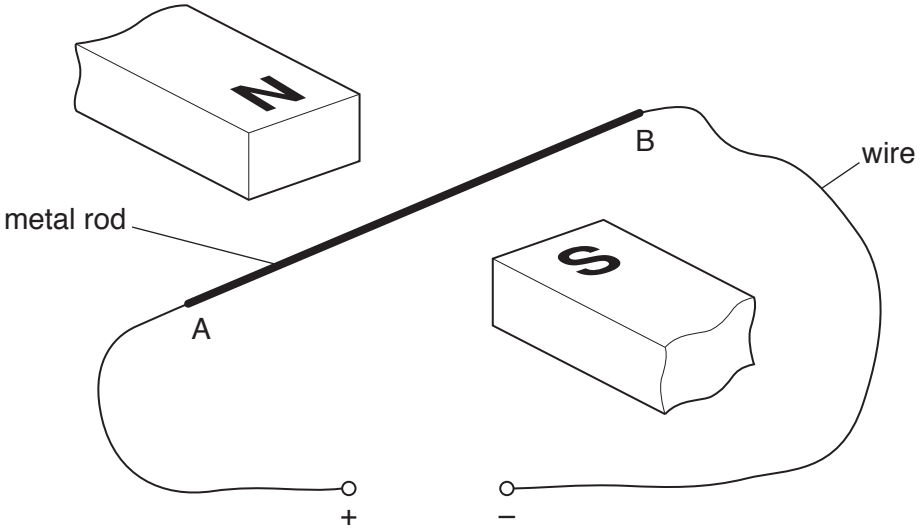


Fig. 7.1

(a) End A of the rod is connected to the positive terminal of a d.c. power supply and end B is connected to the negative terminal. The current in the rod and the magnetic field produce a force on the rod.

On Fig. 7.1 draw arrows to show

(i) the direction of the current in the metal rod; label this arrow C,

(ii) the direction of the magnetic field that acts on the metal rod; label this arrow M,

(iii) the direction of the force on the rod; label this arrow F.

[3]

(b) The power supply is removed and a sensitive voltmeter is connected between the ends A and B.

When the rod is moved upwards or downwards there is a reading on the voltmeter.

(i) Explain why there is a reading on the voltmeter.

.....

.....

.....[2]

(ii) The reading on the voltmeter is increased by using a stronger magnetic field.

State one other way of producing a larger reading on the voltmeter.

.....

.....[1]

8 A doctor has the choice of two isotopes, $^{131}_{53}\mathrm{I}$ and $^{125}_{53}\mathrm{I}$, to inject into a patient.

These isotopes emit radiation from deep inside the body. The radiation is detected outside the body and provides information to help the doctor find out what is wrong with the patient.

The isotope $^{131}_{53}\mathrm{I}$ decays into a stable isotope of xenon by emitting a beta-particle (β) and a gamma ray (γ).

(a) State what is meant by a *gamma ray*.

.....

.....[1]

(b) Complete the equation to show the radioactive decay of $^{131}_{53}\mathrm{I}$.

$$^{131}_{53}\mathrm{I} \rightarrow {}^{\cdots\cdots}_{\cdots\cdots}\mathrm{Xe} + {}^{\cdots\cdots}_{-1}\beta + \gamma$$

[2]

(c) When a nucleus of $^{125}_{53}\mathrm{I}$ decays, only a gamma ray is emitted.

Suggest why it is better for the doctor to inject the isotope $^{125}_{53}\mathrm{I}$ into the patient.

.....

.....

.....

.....[2]

© UCLES 2017

Section B

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

9 Different energy sources are used to generate electricity.

(a) Energy sources are renewable or non-renewable.

(i) Nuclear energy is described as a non-renewable source.

Explain what is meant by a *non-renewable* energy source.

.....

.....[1]

(ii) Four of the energy sources used are:

hydroelectric **oil** **geothermal** **wind**

Write the name of these energy sources in the correct column of the table below.

non-renewable	renewable and caused by energy from the Sun	renewable and not caused by energy from the Sun

[3]

(iii) State one way in which using nuclear energy is better for the environment than using oil.

.....

.....[1]

(iv) State one way in which using nuclear energy is worse for the environment than using oil.

.....

.....[1]

© UCLES 2017

[Turn over

(b) Fig. 9.1 is a block diagram of a power station that produces electrical energy from oil.

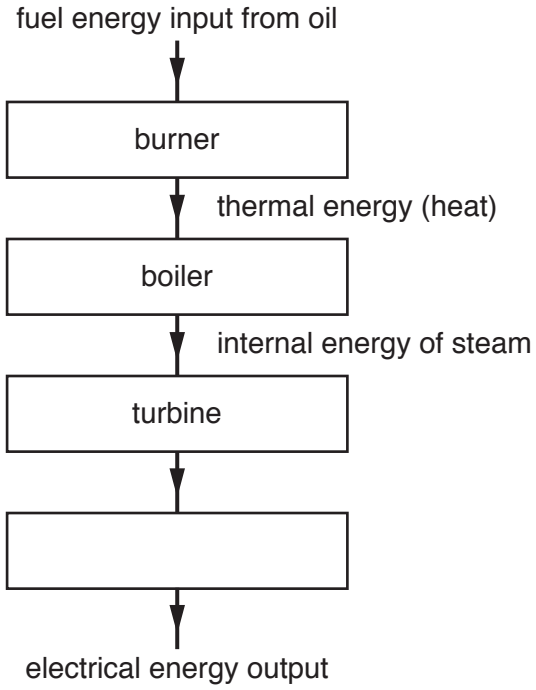


Fig. 9.1

(i) Write the name of the missing part of the power station in the empty box on Fig. 9.1. [1]

(ii) State the form of energy that the turbine possesses.

.....[1]

(iii) A small boiler in the power station contains 24 m^3 of water at 30 °C. High pressure in the boiler increases the boiling point of water to 120 °C.

Thermal energy supplied to the boiler is used to heat the water from 30 °C to 120 °C and then to turn it all to steam at 120 °C.

The density of water is 1000 kg / m^3.
The specific heat capacity of water is 4200 J / (kg °C).
The specific latent heat of vaporisation of water is 2.3×10^6 J / kg.

1. Calculate the mass of water in the boiler.

mass = ...[1]

© UCLES 2017

2. Calculate the total thermal energy (heat) supplied to the boiler.

thermal energy = ...[4]

(iv) The electrical energy output from the power station is transmitted over long distances at a high voltage.

Explain why electricity is transmitted at a high voltage.

.....

.....

.....

.....[2]

10 (a) Fig. 10.1 shows two rays from an object that is placed in front of a plane mirror.

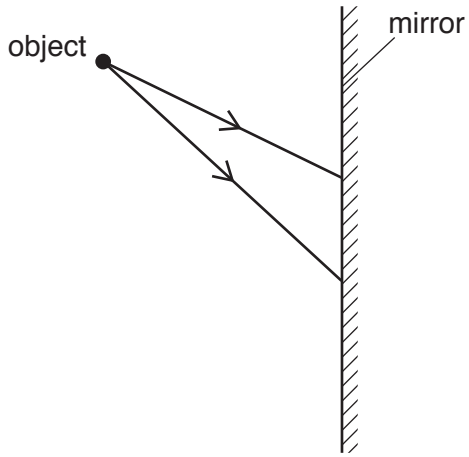


Fig. 10.1

(i) On Fig. 10.1, draw the two reflected rays and locate the position of the image. [2]

(ii) Apart from its position, state one characteristic of the image.

.....[1]

(b) Fig. 10.2 shows wavefronts in a ripple tank. They move in the direction of the arrow.

The wave hits the boundary between two regions and the wave slows down as it enters the shaded region.

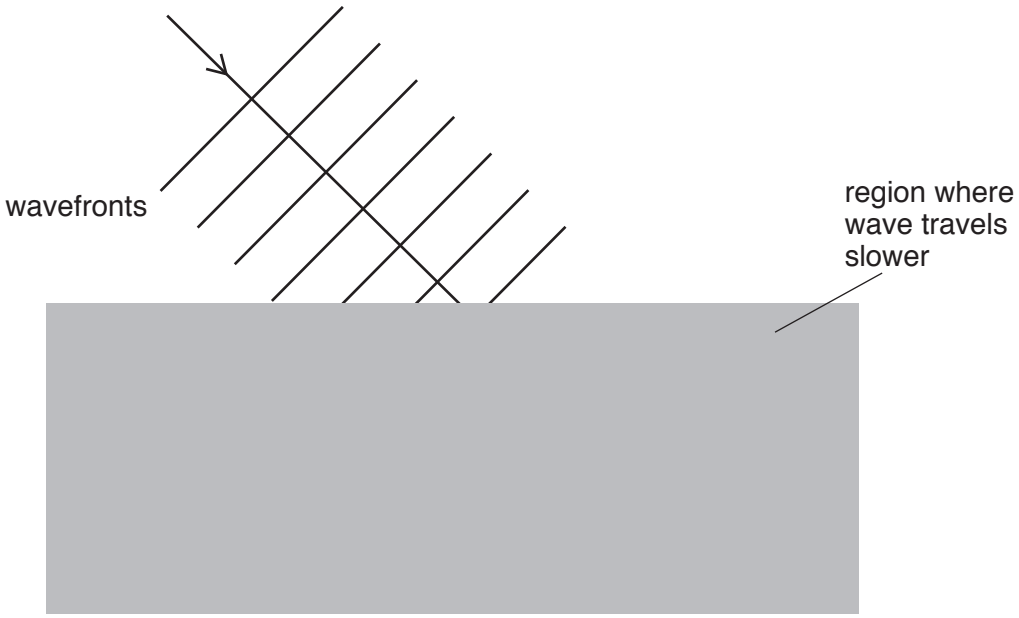


Fig. 10.2

(i) State what is meant by *wavefront*.

.....

.....[2]

(ii) Both reflection and refraction occur at the boundary.

1. On Fig. 10.2, draw the reflected wavefronts. [1]

2. On Fig. 10.2, draw the refracted wavefronts. [2]

(c) A loudspeaker produces a sound of frequency 2.0 kHz. The wavelength of this sound in air is 16 cm.

(i) Calculate the speed of sound in air.

speed = ...[2]

(ii) **1.** State the range of frequencies that can be heard by a healthy human ear.

.....[1]

2. Calculate the smallest wavelength of sound that can be heard by a healthy human ear.

wavelength = ...[1]

(iii) Describe a simple experiment to show that sound waves obey the law of reflection. You may draw a diagram if you wish.

.....

.....

.....

.....[3]

© UCLES 2017

[Turn over

11 A student connects a thermistor in series with a battery and an ammeter. He uses the resistance of the thermistor to determine temperature.

(a) In the space below, draw a circuit diagram showing the thermistor, the battery and the ammeter.

[3]

(b) The student places the thermistor in a water bath at various temperatures and records the reading on the ammeter.

Fig. 11.1 shows how the current varies with temperature.

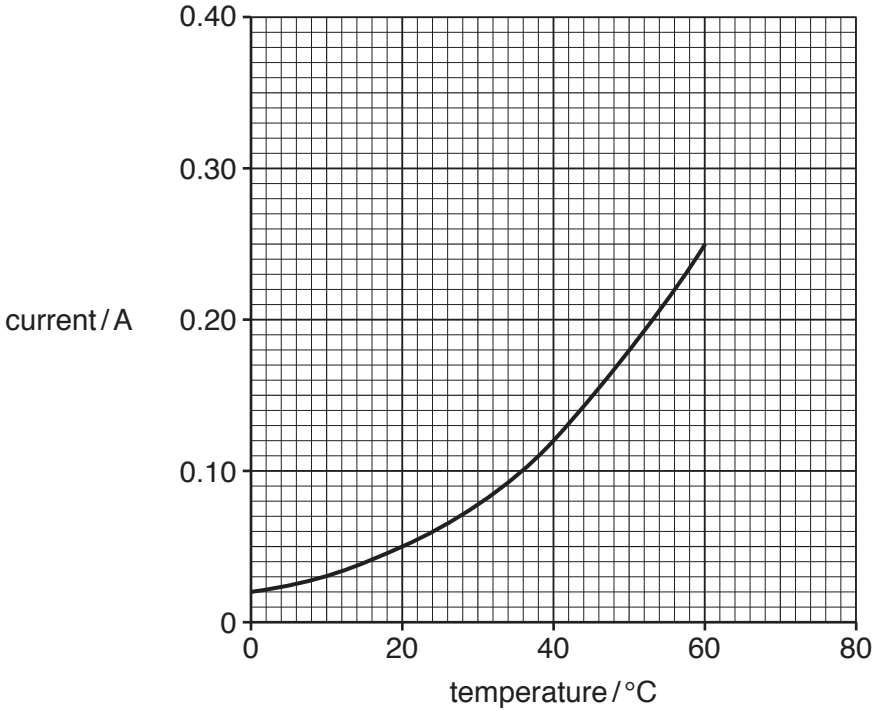


Fig. 11.1

The potential difference (p.d.) across the thermistor **remains constant**.

The resistance of the thermistor is 240 Ω at a temperature of 20 °C.

(i) Using Fig. 11.1, calculate

1. the potential difference (p.d.) across the thermistor,

p.d. = ...[3]

2. the resistance of the thermistor at a temperature of 40 °C.

resistance = ...[2]

(ii) The resistance of the thermistor is 240 Ω at a temperature of 20 °C and 48 Ω at a temperature of 60 °C.

The resistance of the thermistor does not change linearly with temperature.

Describe how the resistances at 20 °C, 40 °C and 60 °C show this is true.

.....

.....

.....

.....

.....[2]

(c) A thermocouple thermometer is another type of thermometer.

(i) Describe the structure of a thermocouple thermometer. You may draw a diagram if you wish.

.....

.....

.....

.....

.....[3]

(ii) State two advantages of a thermocouple thermometer over a liquid-in-glass thermometer.

1. .....

.....

2. .....

.....
[2]

© UCLES 2017

BLANK PAGE

© UCLES 2017

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© UCLES 2017