OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

PHYSICS B

B752/02

Unit B752: Physics modules P4, P5, P6 (Higher Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **85**.
- This document consists of **32** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9			
10			
Total			

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \tfrac{1}{2}\, mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \tfrac{1}{2}\, mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \tfrac{1}{2}\, at^2$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$$I_e = I_b + I_c$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across seconday coil}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

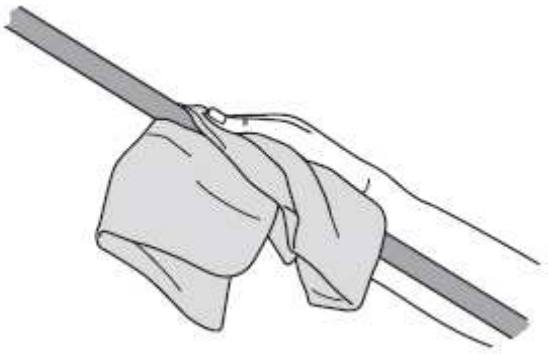
power loss = (current)^2 × resistance

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

Section A – Module P4

1 (a) Nita rubs a rod with a duster.



The rod is made from an **insulating** material.

The rod becomes **negatively** charged.

Which statement is true?

A The rod has **gained neutrons** from the cloth.

B The rod has **gained electrons** from the cloth.

C The rod has **gained protons** from the cloth.

D The rod has **lost neutrons** to the cloth.

E The rod has **lost electrons** to the cloth.

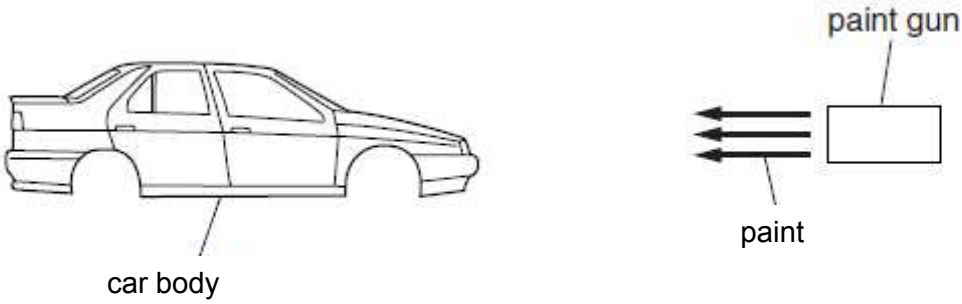
F The rod has **lost protons** to the cloth.

Choose **A**, **B**, **C**, **D**, **E** or **F**.

answer ..... **[1]**

(b) Kevin works in the car manufacturing industry.

Electrostatics is used in the car manufacturing industry to spray paint cars.



The paint travels towards the car body.

Kevin connects the car body to the negative terminal of the power supply. He forgets to connect the paint gun to the positive terminal.

The paint does not spray evenly over the car.

Explain why.

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..... **[4]**

[Total: 5]

2 **(a)** Phil has a desktop computer.

It has a 5 A wire fuse in the plug.

What could be the consequence of replacing the 5 A fuse with a 13 A fuse?

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..... **[2]**

(b) Phil also has a kettle and a hairdryer.

The kettle has three wires connecting it to the mains supply.

The hairdryer only has **two** wires connecting it to the mains supply.

The two wires are brown and blue.

Appliances with only two wires are **double insulated**.

This symbol is shown on the appliance.

Explain why a double insulated appliance does **not** need the third wire.

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..... **[2]**

[Total: 4]

3 Ultrasound is a longitudinal wave.

(a) P is a particle in a longitudinal wave.

Look at the diagram.

How does the particle **P move** in the longitudinal wave?

Put a (ring) around the correct answer.

[1]

(b) Doctors use ultrasound for some medical scans rather than X-rays.

Give **two** reasons why ultrasound is used rather than X-rays.

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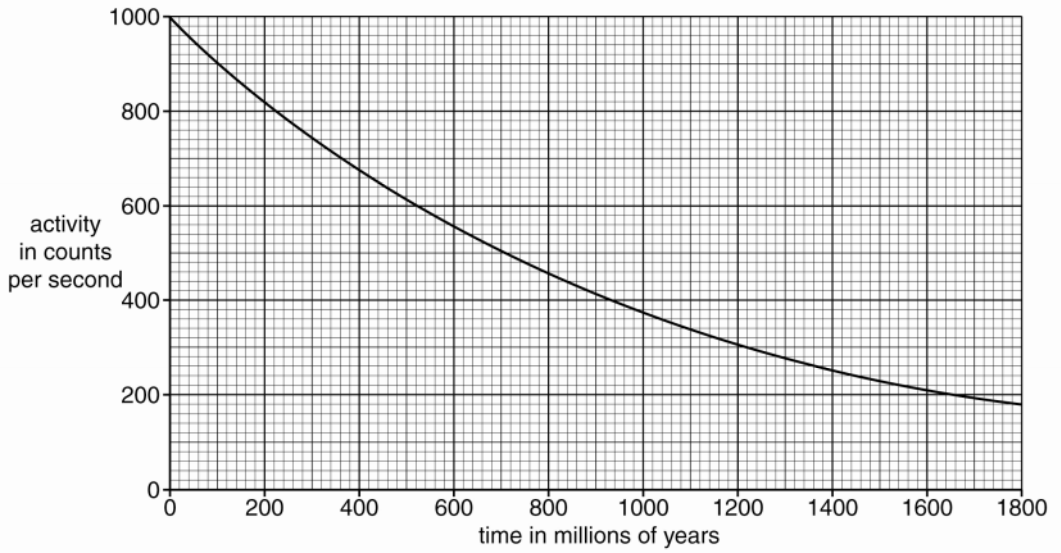
..... **[2]**

[Total: 3]

4 (a) (i) Some nuclear powers stations use uranium-235.

The graph shows how the activity of uranium-235 decreases with time.



Use the graph to work out the half-life of uranium-235.

You must draw lines on the graph to show how you calculated your answer.

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.....

half-life of uranium-235 = ... million years **[2]**

(ii) Uranium is not used as a medical tracer because it is an alpha (α) emitter.

Explain one **other** reason why uranium-235 is unsuitable for use as a tracer.

.....

..... **[1]**

(b) The activity of a nuclear material decreases when radioactive particles are emitted.

This can be caused by the emission of an alpha (α) particle.

Complete the nuclear equation below to represent the **alpha** decay of uranium -235 (U) into thorium (Th)**.**

Put your answers on the dotted lines.

$$^{235}_{92}U \longrightarrow {}^{\text{-------}}_{\text{-------}}Th + {}^{\text{-------}}_{\text{-------}}\alpha$$

[2]

(c) Look at the data showing the sources that contribute to the average UK radiation dose.

source	contribution
rocks	50%
cosmic rays	25%
medical	15%
from inside the human body	9.5%
work-related	0.2%
other	0.3%

Stephen uses the data to conclude that rocks and cosmic rays are the only significant contributors to his radiation dose.

Is this an appropriate conclusion? Explain why.

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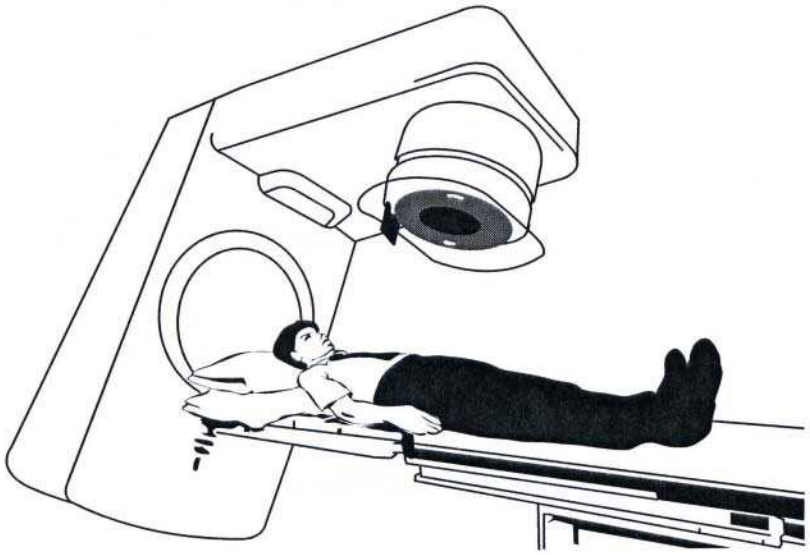
..... **[2]**

[Total: 7]

5 Doctors use gamma rays to treat cancer.

They rotate a gamma source around the patient.

Look at the picture.



Explain how the treatment works **and** the potential risks and benefits that the patient must consider before deciding whether to have the treatment.

The quality of written communication will be assessed in your answer to this question.

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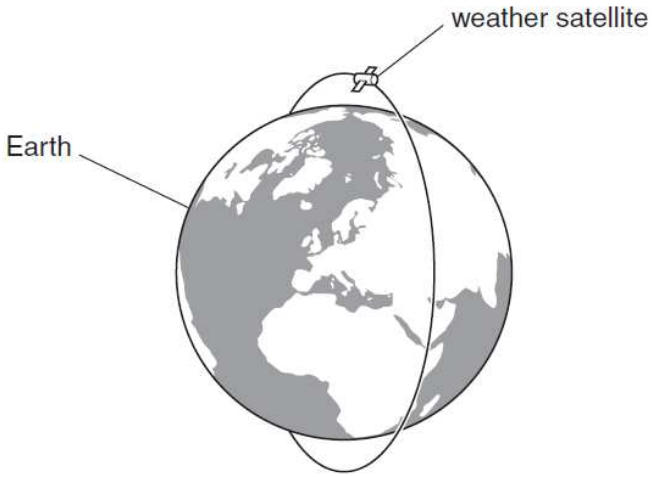
..... **[6]**

[Total: 6]

Section B – Module P5

6 This question is about satellites.

(a) Look at the diagram.



This type of satellite is used for weather forecasting.

Explain why the orbit of this satellite makes it suitable for imaging the Earth.

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..... **[3]**

(b) Another type of artificial satellite is a **geostationary** satellite.

Why do geostationary satellites have higher orbits than satellites used for imaging the Earth?

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..... **[1]**

(c) **(i)** Explain what happens to the gravitational force when the distance between a satellite and the Earth doubles.

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..... **[1]**

(ii) Explain why the speed of a comet changes as it approaches the Sun.

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..... **[2]**

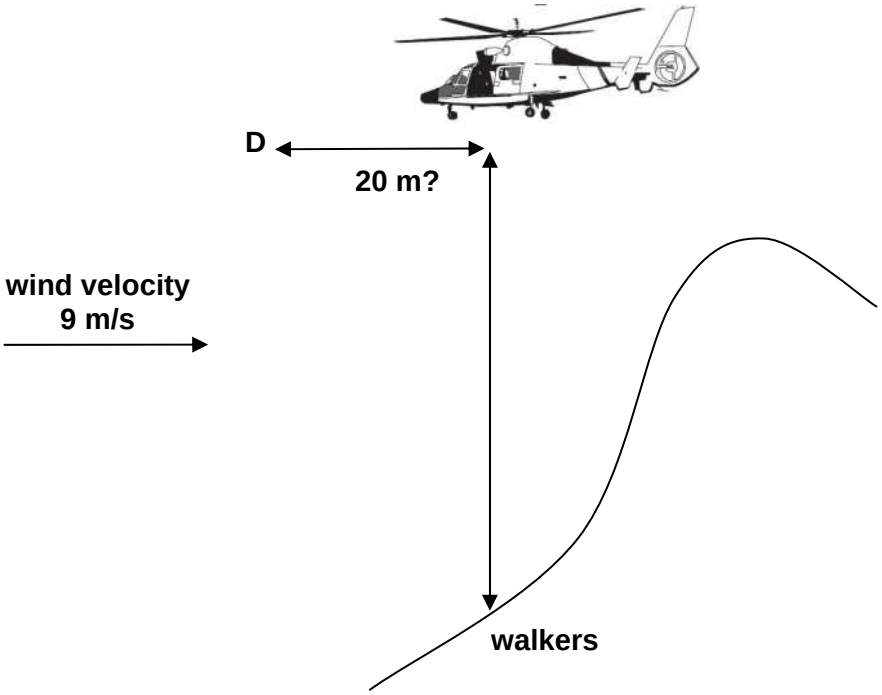
[Total: 7]

7 William is a search and rescue pilot in a helicopter.

He is trying to help some walkers on a mountain by dropping them some supplies from his helicopter.

The supplies have a small parachute so they fall with a steady vertical velocity of 12 m/s

Look at the diagram.



(a) What is the size of the resultant velocity of the supplies as they fall?

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..... **[2]**

(b) It takes 5 seconds for the supplies to fall to the walkers.

William's co-pilot realises the supplies need to be dropped before the helicopter is vertically above the walkers.

He says the supplies should be dropped from **D**, 20 m before being vertically above.

Is William's co-pilot correct?

Show any working you use to draw your conclusion.

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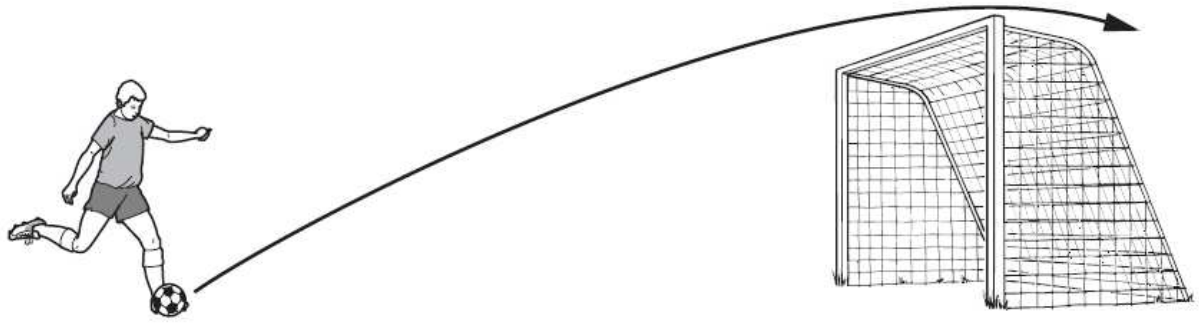
..... **[2]**

[Total: 4]

8 James kicks a football in the air.

It travels in a curve. This is an example of a **projectile**.

Look at the diagram.



The football travels in a curved path.

Explain why the path of the football is curved.

✎ *The quality of written communication will be assessed in your answer to this question*.

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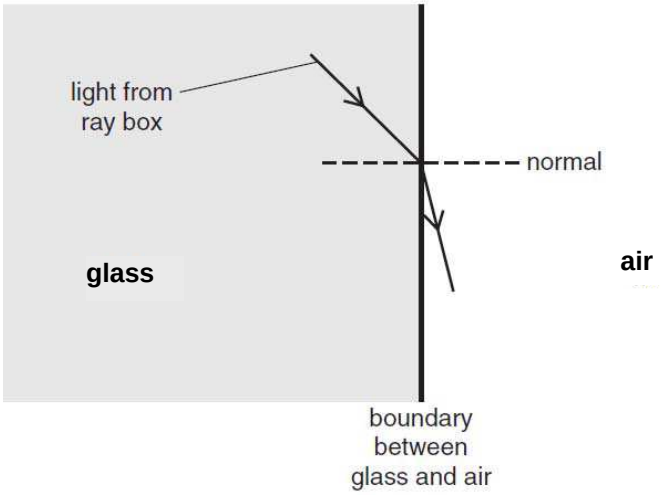
..... **[6]**

[Total: 6]

9 (a) Danny shines a ray of light from a ray box through a glass block.

The light is refracted.

He looks at the path of the light **leaving** the block.



Explain what causes the ray of light to bend the **way it does** at the boundary.

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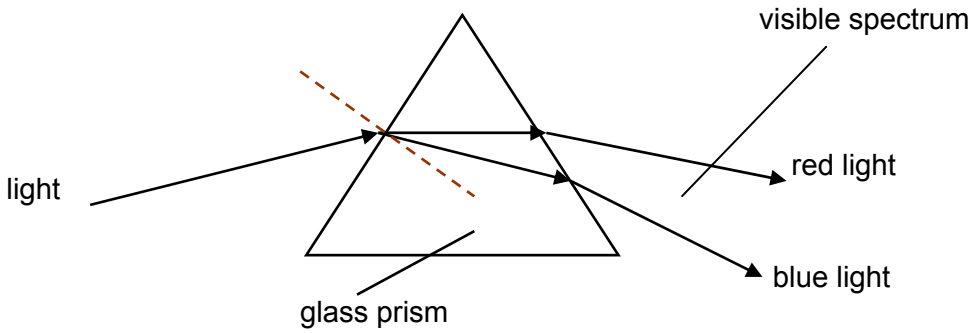
..... **[2]**

(b) In addition to refraction, light is dispersed when it travels from one medium to another.



Look at the table

colour of light	wavelength (m)	refractive index
blue	4.34×10^{-7}	1.528
red	7.00×10^{-7}	1.510

The diagram shows that different colours refract by different amounts.

Use the information in the table to explain why.

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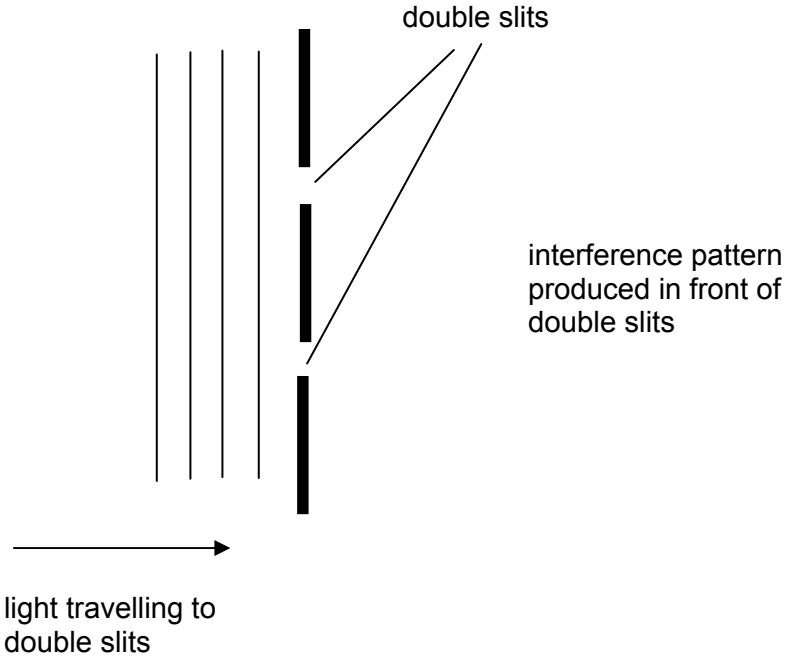
..... **[2]**

[Total: 4]

10 Bharat's teacher shows his class an experiment with light.

When the experiment was first performed many years ago it changed scientists' views about the properties of light.



Bharat's teacher explains that this famous experiment provided evidence for the wave nature of light.

Explain how the interference pattern provided this evidence.

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..... **[2]**

[Total: 2]

11 This question is about waves.

Look at the sentences about waves.

Put a tick (✓) if the sentence is **true**.

Put a cross (✗) if the sentence is **false**.

sentence	**✓ or ✗**
Greatest diffraction happens when the gap size equals the wavelength of the wave.	
Radio frequencies between 30MHz and 30GHz are stopped by the Earth's atmosphere.	
Microwaves are used in satellite broadcasting because the dish aerial produces a lot of diffraction.	
Coherent waves have the same frequency with different amplitudes and are out of phase.	

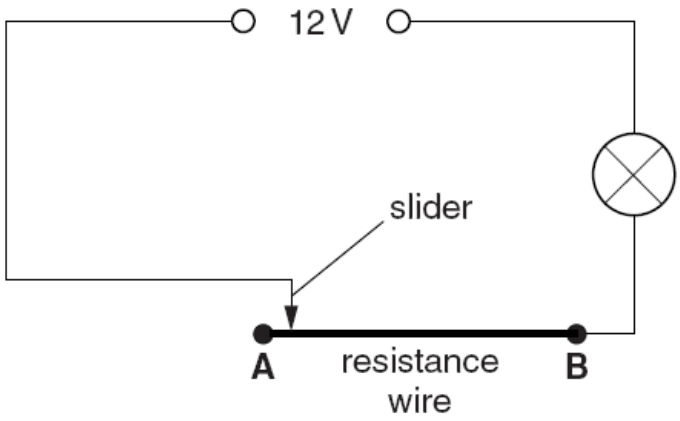
[2]

[Total: 2]

Section C – Module P6

12 Sally does some experiments with electricity.

(a) Look at the diagram. The resistance wire is used to control the bulb.



(i) Sally puts the slider at position **A**. The bulb lights up.

She moves the slider from position **A** to position **B**.

What happens to the resistance of the circuit and the brightness of the bulb?

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..... **[1]**

(ii) Sally leaves the slider at position **B**.

The bulb carries a current of 1.5A. The resistance of the bulb is 6Ω.

Calculate the voltage across the bulb.

Put a tick (✓) in the box beside the correct answer.

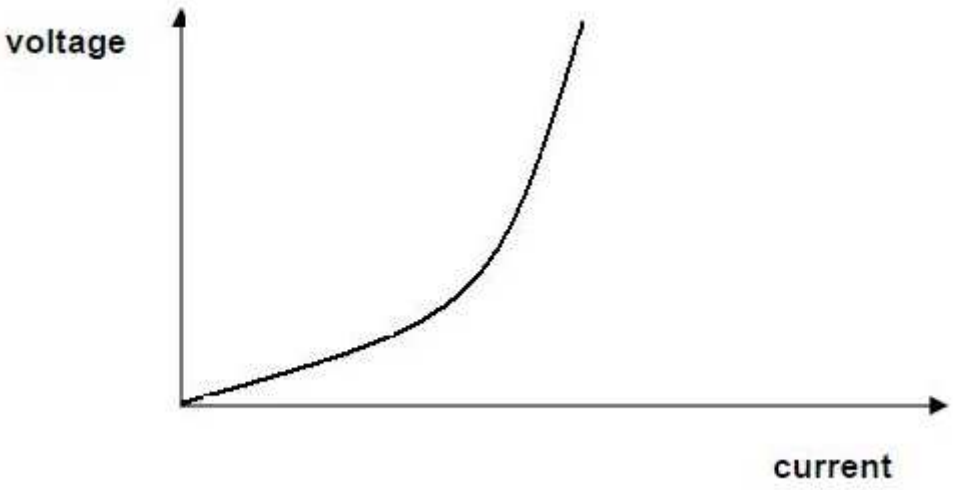
voltage in V	tick the correct box
0.5	
2.0	
3.0	
9.0	
18.0	

[1]

(iii) Sally increases the voltage in her circuit.

This changes the current in the bulb.

Look at the graph of her results.



She expects a straight line graph.

The graph is curved because the resistance of the bulb increases.

Use kinetic theory to explain why the resistance of the bulb increases.

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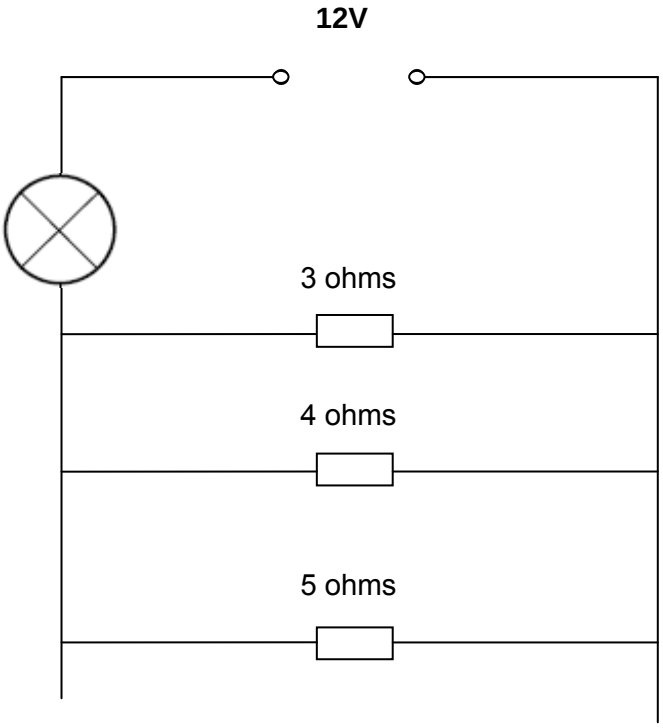
..... **[3]**

(b) Sally builds another circuit.

This time she uses three resistors.

Look at the diagram.



Calculate the **total resistance** of the three resistors.

Choose your answer from

0.75 Ω **1 Ω** **1.28 Ω** **12 Ω** **60 Ω**

.....

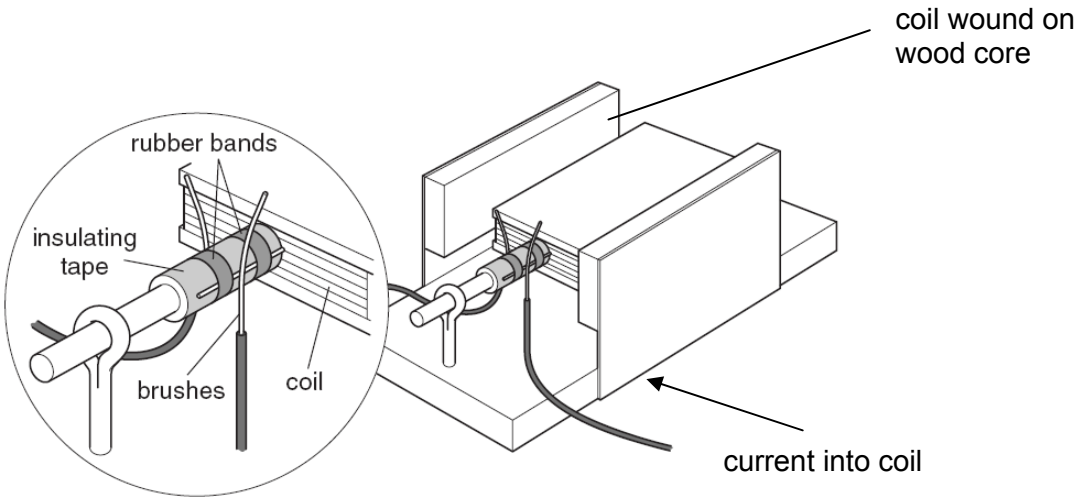
.....

answer ..... Ω **[1]**

[Total: 6]

13 Declan builds an electric motor.

Look at the diagram of his electric motor.



Declan connects the motor to a DC power supply.

It spins round slowly. Declan wants to make the motor spin **faster** in the **opposite** direction.

Explain how the forces on the current-carrying coil in the magnetic field cause the coil to rotate and how Declan could make the motor spin faster **and** in the opposite direction.

✎ *The quality of written communication will be assessed in your answer to this question*.

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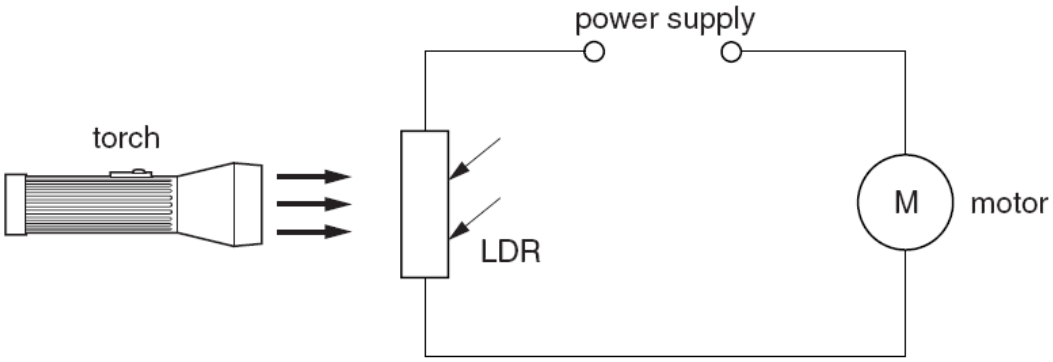
..... **[6]**

[Total: 6]

14 (a) Dan builds a circuit using an LDR.

Look at the diagram.



The torch is not switched on.

Describe what happens to the **resistance** of the LDR and the **speed** of the motor when Dan switches the torch on.

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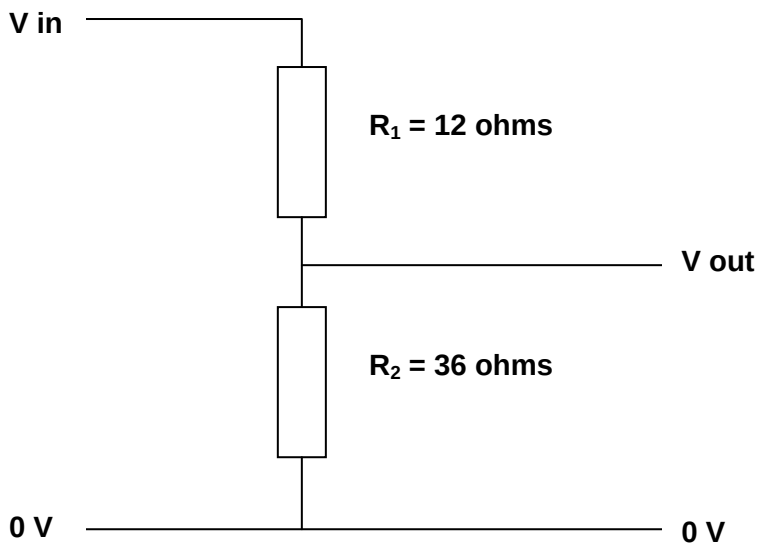
..... **[2]**

(b) Dan uses a potential divider in a circuit.

Look at the information in the diagram.



The **input** voltage = 5 V.

Calculate the **output** voltage.

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answer ..... V **[2]**

[Total: 4]

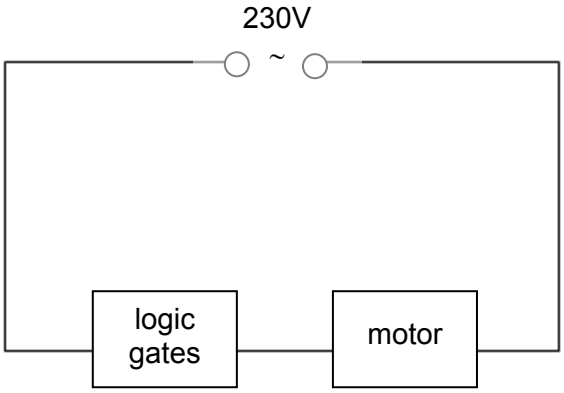
15 Bill has a programmable washing machine.

A combination of logic gates controls the motor in the washing machine.

The motor in the washing machine runs on a 230 V mains voltage.

He draws a diagram to show how the circuits in the washing machine should be connected.

Look at the diagram.



Connecting the washing machine as shown in the diagram will not work.

Explain why and how the circuits should be connected.

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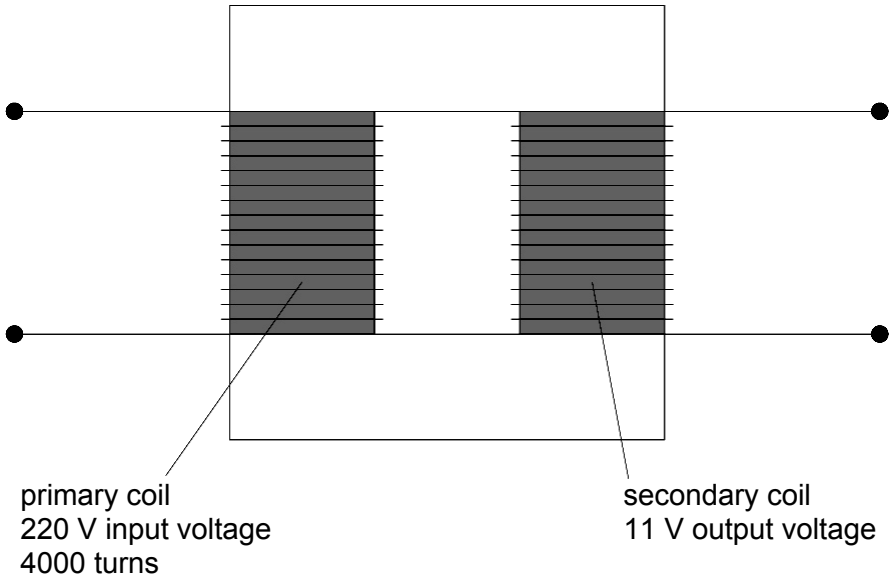
..... **[3]**

[Total: 3]

16 This question is about transformers and power transmission.

Look at the diagram of a transformer.



(a) Calculate the number of turns in the secondary coil.

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answer ..... turns **[2]**

(b) A town requires 100 000 000 W of electrical power from a power station.

Transformers at the power station step up the voltage to thousands of volts.

Look at the information in the table about transmission of power to the town.

The information compares two possible supply voltages (20 000V and 4 000 000V).

power requirements of town (W)	100 000 000	
supply voltage (V)	20 000	400 000
current needed (A)	5 000	250
power loss in cables due to heating (W)	75 000 000	187 500
efficiency of transmission (%)	57.1	99.8

It is more efficient to transmit at 400 000V.

Explain why.

Use relevant equations in your answer.

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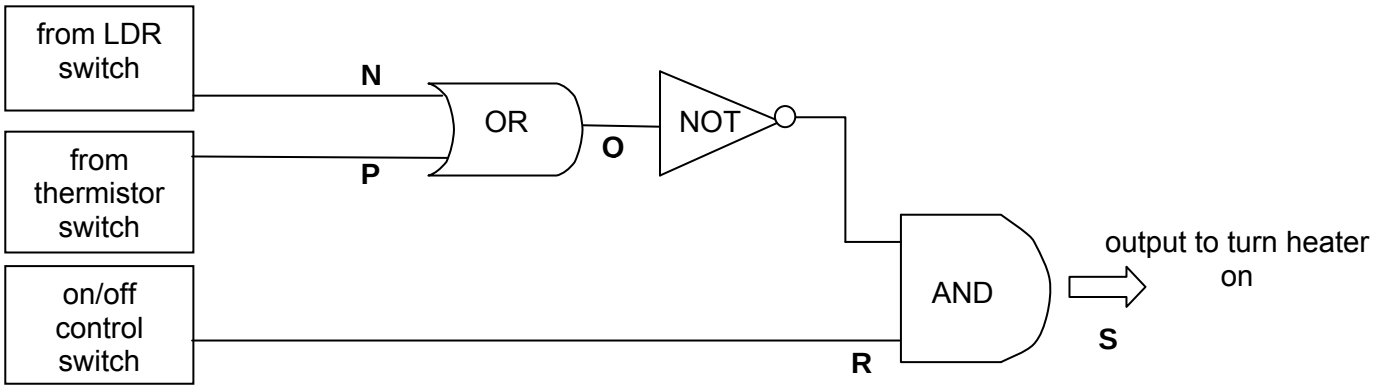
..... **[3]**

[Total: 5]

17 A farmer grows strawberries in large greenhouses.

He wants to protect the strawberry plants if it becomes cold at night.

Look at the circuit diagram.



Truth tables can explain how an electronic system works.

Complete the truth table for the above system.

inputs			Q	S
N	**P**	**R**		
0	**0**	**0**		
0	**1**	**0**		
0	**0**	**1**		
1	**0**	**0**		
1	**1**	**1**		

[1]

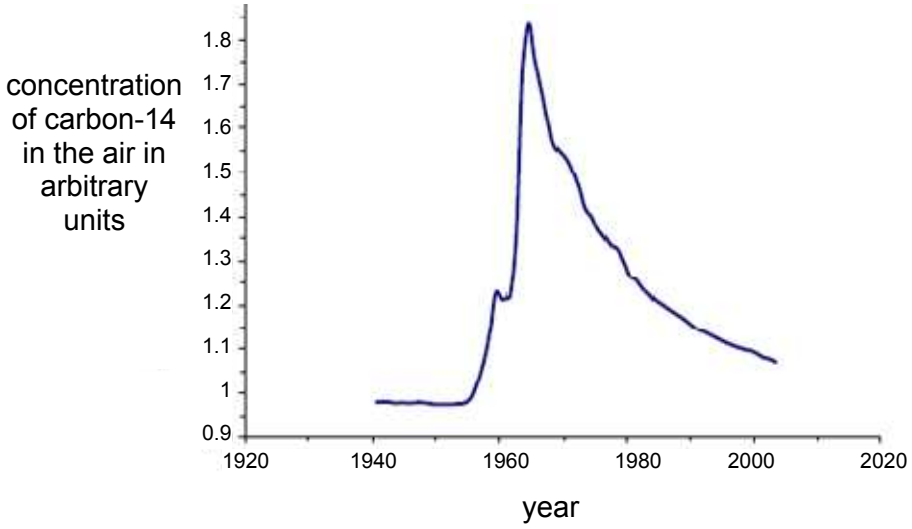
[Total: 1]

Section D

18 (a) Carbon-14 is a radioactive isotope of carbon.

It occurs naturally in small amounts.

Scientists have plotted the concentration of carbon-14 in the air since 1940.



Testing of nuclear bombs started in 1955. The testing was banned in 1963.

Scientists have used this graph to conclude that testing nuclear bombs increased the background radiation level.

How does the graph support this conclusion?

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..... **[3]**

(b) Teeth trap small amounts of carbon-14 when they are formed.

Scientists use the amount of carbon-14 trapped in a tooth to estimate when it was formed.

The table shows the age of a person when different types of teeth are formed.

type of tooth	1st incisor	1st premolar	1st molar	3rd molar
age in years when tooth formed	3	7	3	14

Ian's 1st premolar tooth contains the equivalent of 1.22 arbitrary units of carbon-14.

The scientists used this information and the graph to estimate that Ian was born in 1953.

The scientists were not confident in the accuracy of this estimate.

Suggest why they were not confident and how they could improve their level of confidence.

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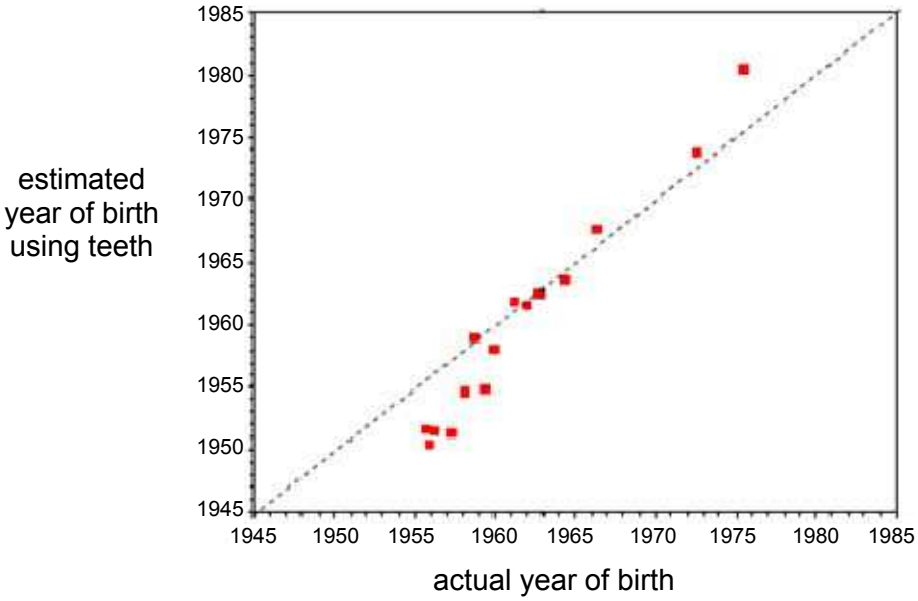
..... **[2]**

(c) Scientists have used this method on teeth from people of different ages.

They have plotted their results on a graph.

Look at the graph.



What does the graph show about the scientists' estimates?

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..... **[2]**

(d) Carbon-14 is radioactive so it will decay.

Its half life is 5700 years.

Explain if this is likely to significantly affect the estimate of year of birth made by the scientists.

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..... **[1]**

(e) Forensic scientists use another method to find out approximately how old a person was when they died.

They look at how worn the teeth are.

Both the carbon-14 test and the 'teeth wear test' have limitations.

Put a tick (✓) or a cross (✗) in each of these boxes to show if each test works in each of these situations.

	carbon-14 test	**teeth wear test**
could be used to find out in which year a person was born		
could be used to find out where a person was born		
provides useful information on a person born before 1930		

[2]

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

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