OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

PHYSICS B

B752/01

Unit B752: Physics modules P4, P5, P6 (Foundation 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		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8		16	
Total			

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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 This question is about electricity.

(a) Colin is wiring a plug connected to a fridge.

The earth wire is connected to the conducting metal casing of the fridge.

Colin thinks that the **brown** wire should be connected to the earth connection.

Is he correct?

answer .....

Explain what will happen as a result of Colin's wiring.

.....

.....

.....

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

(b) Sally's electric hairdryer is double insulated.

It has only two wires.

Which **two** wires are connected to the hairdryer?

Choose from

blue and brown

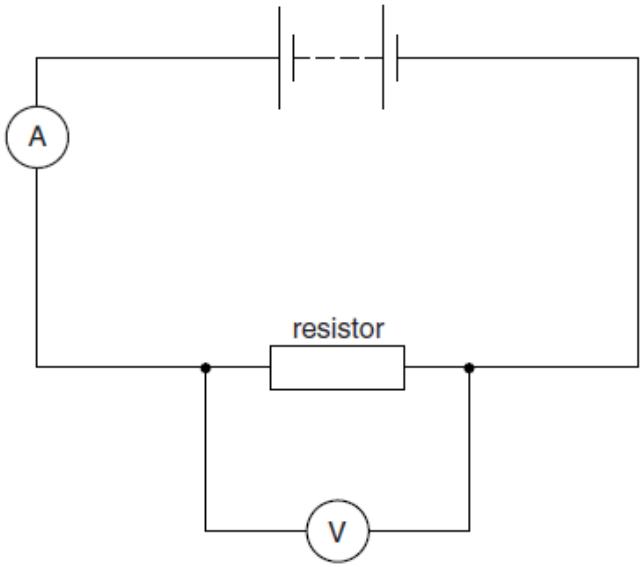
blue and green/yellow

brown and green/yellow

brown and red

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

(c) (i) Phil makes the following circuit.



Phil adds a second resistor to the circuit. The resistance is doubled.

The voltage is kept constant.

What happens to the current?

.....

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

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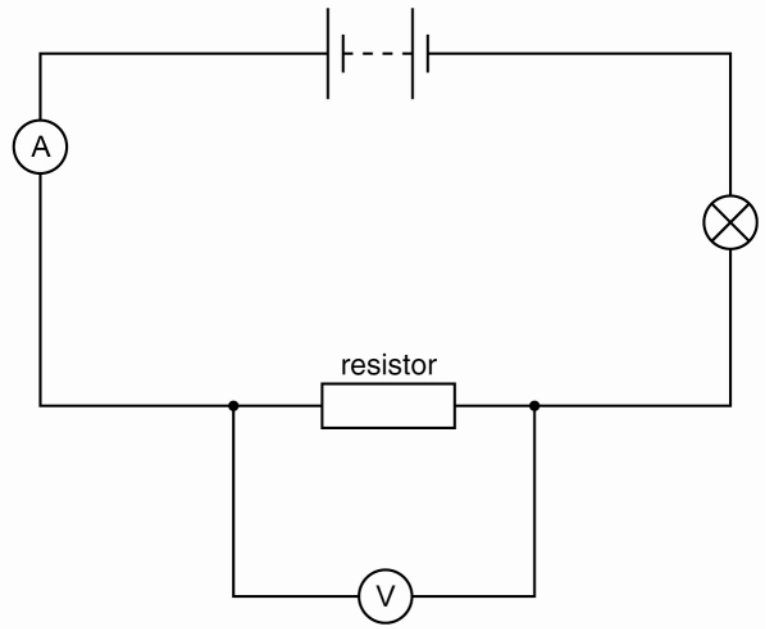
(ii) Phil adds a bulb to his circuit.



He wants to change the brightness of the bulb but he needs to make sure the bulb is not damaged.

He could do this by changing or adding components.

Describe the components he could change or add. Explain how this makes a difference.

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.....

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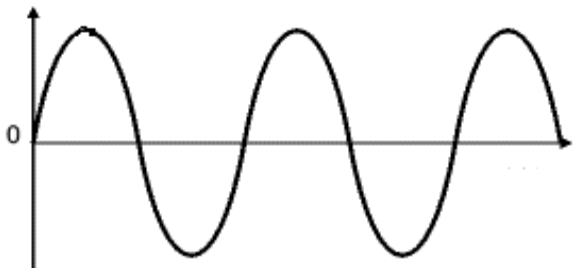
..... **[3]**

[Total: 7]

2 **(a)** Ultrasound is a longitudinal wave.

Look at the diagram of an ultrasound wave.



The wavelength of the wave is made shorter but the amplitude remains the same.

Draw a diagram of this wave.

[1]

(b) Ultrasound is used in **medicine**.

Write about **one** use for ultrasound and why it is used.

.....

.....

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

(c) Technetium-99 is a radioactive material. It is used as a medical tracer.

Technetium-99 emits gamma radiation and has a half-life of a few hours.

Give **two** reasons why technetium is a suitable medical tracer.

.....

.....

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

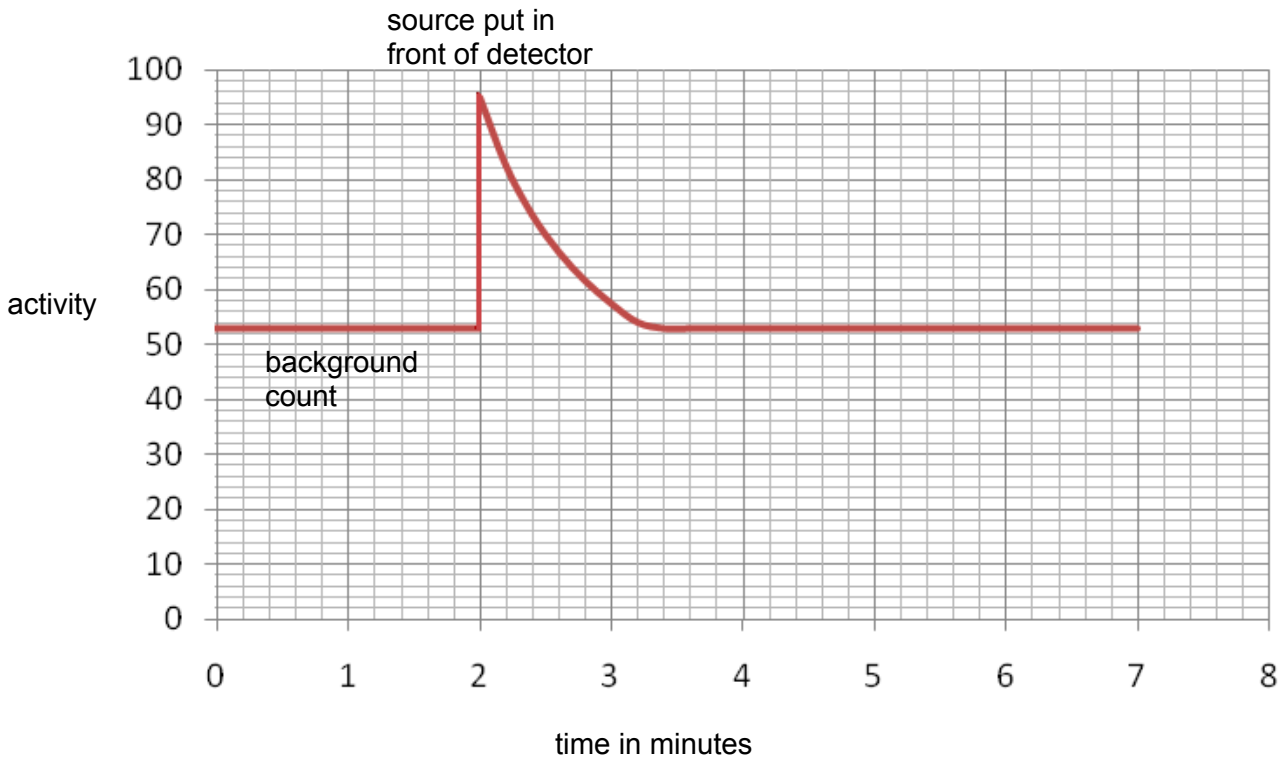
[Total: 5]

3 This question is about nuclear radiation and radioactivity.

Riswan is doing an experiment to see how the radioactivity of a source changes over time.

He wants to measure the half-life of the radioactive source.

Look at the graph of his data.



(a) What does the activity measure?

.....

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

(b) Write down **one** possible source of the background count on the graph.

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

(c) Riswan is trying to measure the half-life.

(i) What is meant by the half-life?

.....

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

(ii) Can Riswan use his data to find out the half-life of the source? Explain your answer.

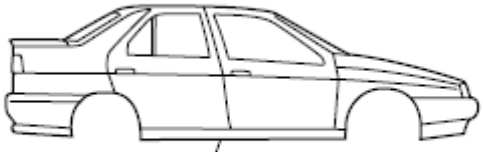
.....

.....

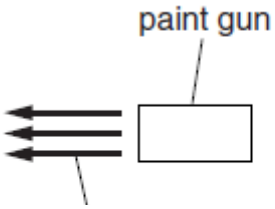
..... **[2]**

[Total: 5]

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



car body



The paint travels to the car.

Explain how electrostatic charge is useful in spray painting **and** suggest how the manufacturers can reduce potential dangers to the workers doing the spray painting.

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

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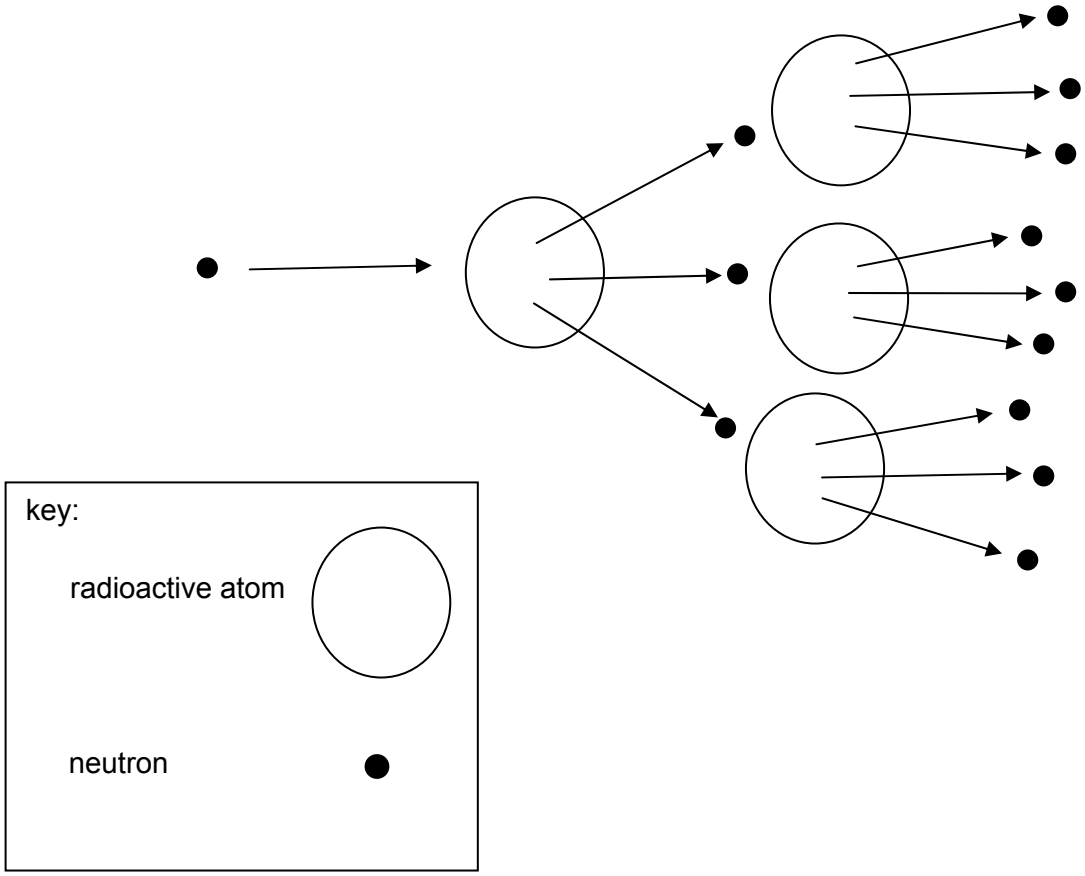
..... **[6]**

[Total: 6]

5 Nuclear power stations and nuclear bombs use a type of nuclear reaction.

Look at the diagram which represents a possible reaction.



Describe the type of reaction **and** explain how the reactions are different in a power station and a nuclear bomb.

.....

.....

.....

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

[Total: 2]

Section B – Module P5

6 Artificial satellites orbit the Earth and send back information.

Satellites have many different uses. The choice of orbit for the satellite depends on what the satellite is used for.

Describe how different types of satellite orbit the Earth. Give examples of different uses of satellites and explain what type of orbit should be used and why.

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

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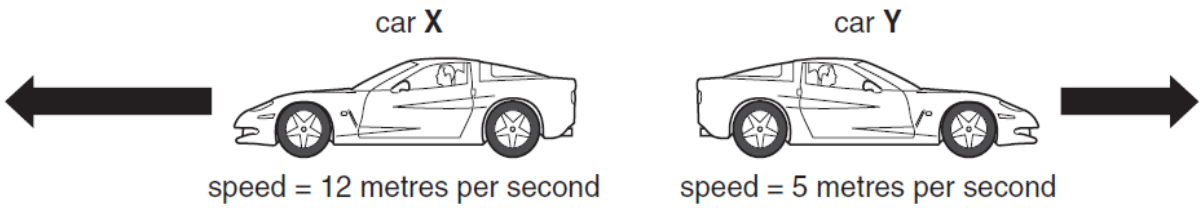
..... **[6]**

[Total: 6]

7 Look at the diagram of two cars.

Car **X** moves in the **opposite** direction to car **Y**.



(a) They then move in the same direction.

Look at the diagram below.

What happens to the **relative** speed of the cars? Explain why.

.....

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

(b) (i) Car **Y** moves at a speed of 5 metres per second.

It accelerates steadily to a new speed of 15 metres per second. This takes 30 seconds.

Calculate the distance travelled in this time.

.....

.....

.....

answer ..... m **[2]**

(ii) Car **X** is following 10 metres behind car **Y**.

Car **X** stays at a speed of 12 m/s.

How far does car **X** travel in the 30 seconds? Using your answer to part **(i)**, explain whether car **X** overtakes car **Y**.

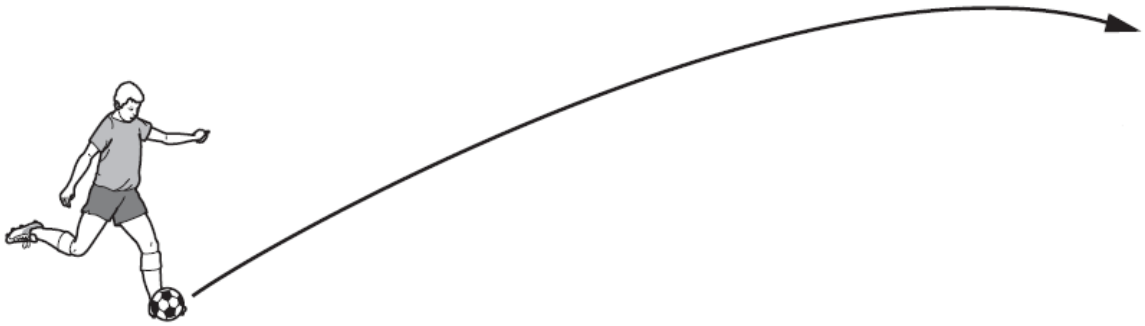
.....

.....

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

[Total: 5]

8 Fred is practising his goal kicks.



Fred thinks that increasing the angle above the ground will increase the range of his kick.

He tests his prediction.

Look at the table of his results.

angle in °	max height in m	range in m
10	4	27
25	21	61
40	50	79
55	80	75
70	106	51

Is Fred's prediction correct?

Use the data and your own knowledge to explain why you reached your conclusion.

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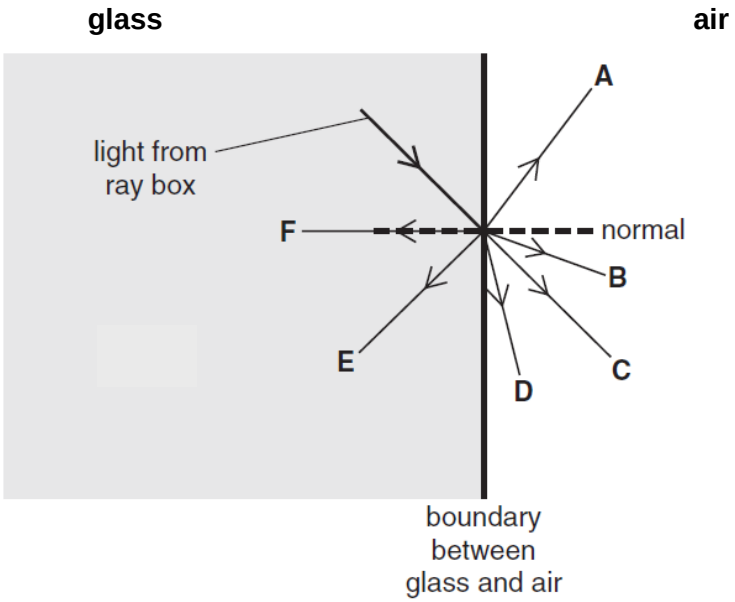
..... **[3]**

[Total: 3]

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

He looks at the paths of light **after** it hits the boundary.



Which path shows the two rays he sees?

Choose **two** from **A**, **B**, **C**, **D**, **E** and **F**

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

(b) What happens to light, at a boundary, as it passes **from** glass to air?

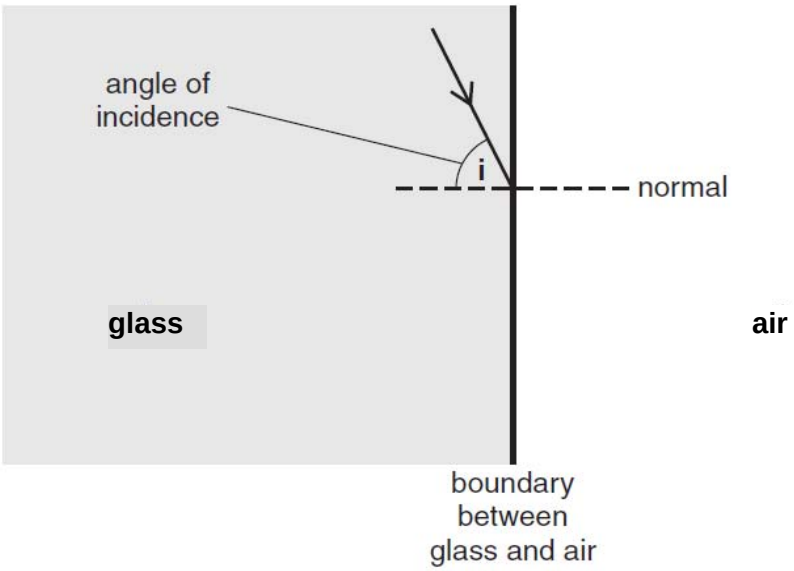
Put a tick (✓) in the box next to the correct answer

light is absorbed	☐
light is radiated	☐
light is reflected	☐
light is refracted	☐

[1]

(c) Danny moves the ray box.

The angle of incidence, **i**, is larger than the critical angle.



Complete the diagram **accurately** to show what happens to the ray of light. **[1]**

[Total: 3]

10 This question is about waves.

(a) Look at the sentences about waves.

Put a tick (✓) in the box beside the sentence if it is true.

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

One has been done for you.

	✓ or ✗
Eclipses happen because light travels in straight lines.	✓
Light can never 'bend'.	
Electromagnetic waves are longitudinal.	

[1]

(b) Bharat's science teacher is explaining interference using two loudspeakers.

The loudspeakers are producing identical sound waves.

Bharat walks along a line in front of the speakers as shown

Describe what Bharat hears as he walks along the line and why the sound waves produce this effect.

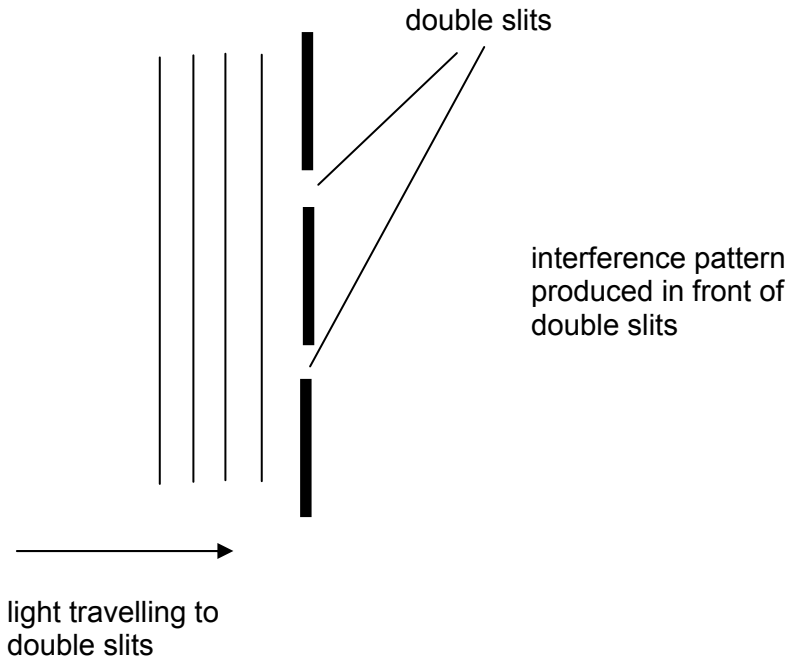
.....

.....

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

(c) Bharat's teacher then shows his class an experiment with light.

When the experiment was first performed many years ago it altered 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.

.....

.....

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

(d) Radio waves can be used to communicate with satellites beyond the Earth's atmosphere.

Look at the table.

radio wave	frequency
A	25 MHz
B	40 GHz
C	10 GHz

One of these radio waves can be used to communicate with a satellite beyond the Earth's atmosphere.

Bharat thinks radio wave **B** can be used.

Is he correct?

Explain your answer.

.....

.....

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

[Total: 8]

Section C – Module P6

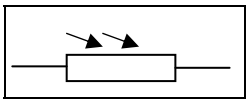
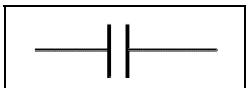
11 (a) Sally does some experiments about electricity in a physics lesson.

Sally's teacher gives her some cards to help her understand what some electrical components are used for. There are three sets of cards:

name of component	**component symbol**	**description of what the component does**

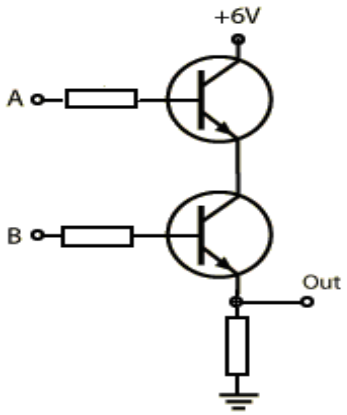
Draw straight lines to join each **name** to the correct **symbol**.

Draw straight lines from each **symbol** to the correct **description**.

name	**symbol**	**description**
capacitor		stores charge
thermistor		responds to a change in light
LDR		responds to a change in temperature

[2]

(b) (i) Look at the diagram of a logic gate.



What type of logic gate is shown in the diagram?

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

(ii) Describe how the inputs at **A** and **B** affect the behaviour of the two transistors, and the output of the logic gate.

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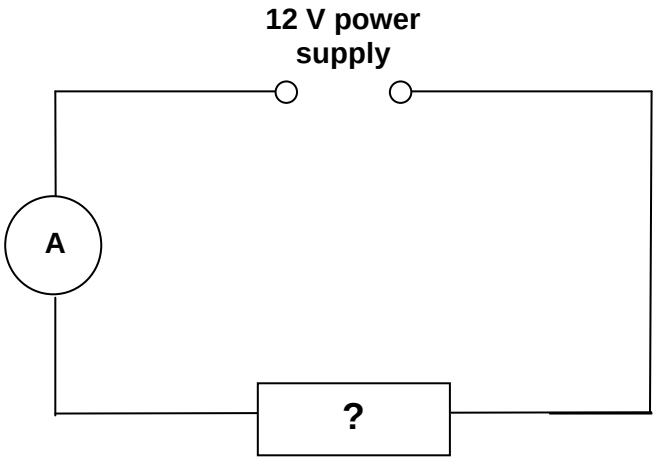
..... **[3]**

[Total: 6]

12 (a) Sally is investigating an unknown electrical component.

She builds a circuit and measures the current.

Look at the diagram.



She exposes the component to different temperature and light levels.

She records the current each time. Here are her results.

temperature in ^{o}C	light level	current in amps
0	normal	0.08
20	normal	0.12
75	normal	0.36
0	high	0.08
20	high	0.12

Use the data in the table to suggest what the unknown component could be.

Explain your answer.

.....

.....

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.....

.....

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

(b) (i) Sally replaces the unknown component with a bulb.

She switches the circuit on for a short time.

A current of 3.0 A passes through the bulb.

Calculate the **resistance** of the bulb.

.....

.....

.....

answer …….. unit ..... **[2]**

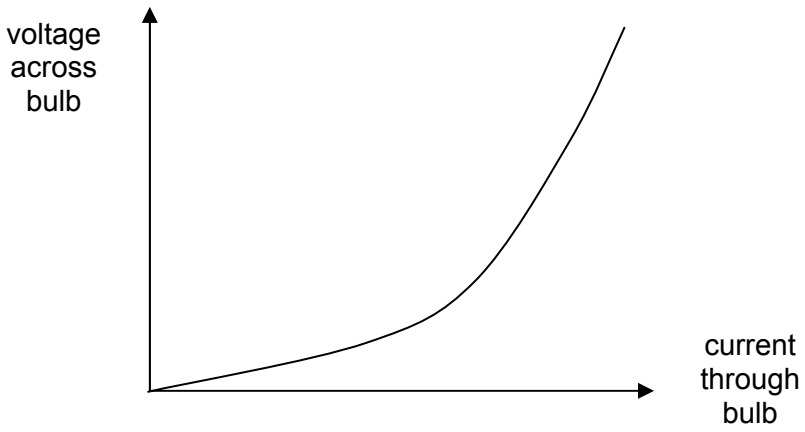
(ii) Sally switches the circuit back on.

She varies the voltage of the power supply.

She records the values of voltage and current for the bulb.

For each result she leaves the circuit switched on for a long time.

Look at the graph of her results.



What is happening to the resistance of the bulb and how is this shown by the graph?

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

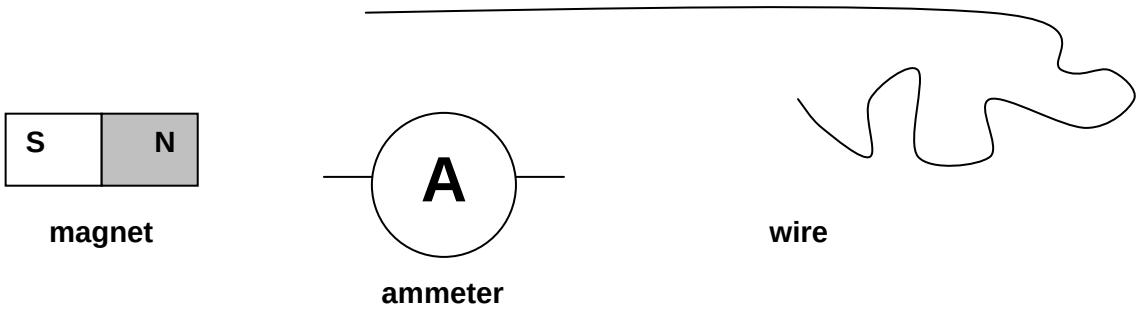
[Total: 8]

13 This question is about generating electricity.

(a) Dave has some scientific equipment.

He wants to **generate** electricity.

Look at the equipment.



Explain how he uses this equipment to generate a current and how he would know that a current is generated.

.....

.....

.....

.....

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

(b) Electricity is generated in power stations.

It is supplied to homes through cables and transformers in the National Grid.

Before it can be used in houses the voltage must be reduced.

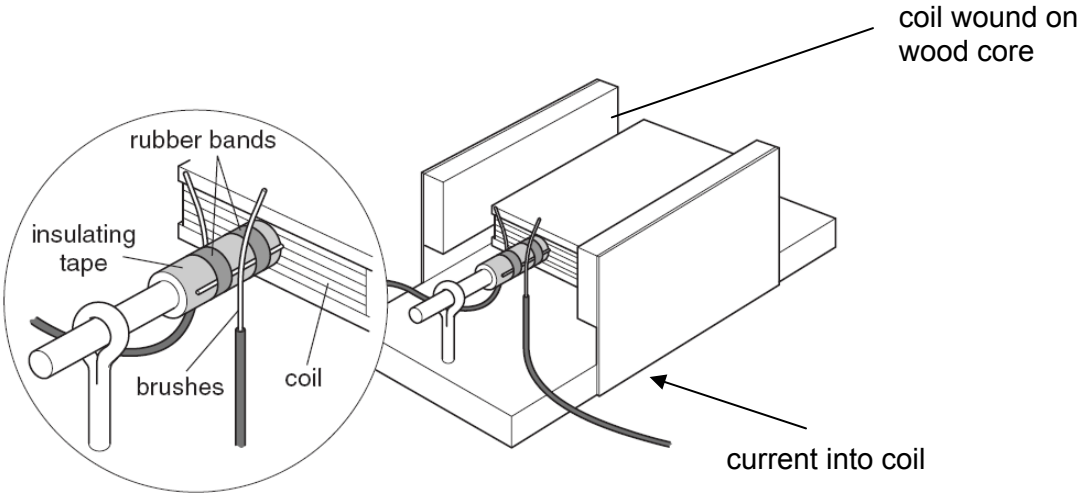
What is used to **reduce** the voltage?

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

[Total: 3]

14 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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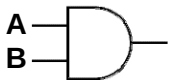
..... **[6]**

[Total: 6]

15 Gates are used to control electronic devices.

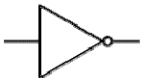
Here are the logic tables for two types of logic gate.

AND gate logic table



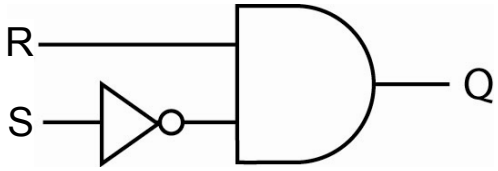
Input A	Input B	Output
0	0	0
0	1	0
1	0	0
1	1	1

NOT gate logic table



Input	Output
0	1
1	0

Logic gates can be combined to create new logic tables. For example, a **NOT** gate and an **AND** gate can be combined like this.



Complete the logic table for this combination. The first two rows have been done for you.

Input R	Input S	Output Q
0	0	0
0	1	0
1	0	
1	1	

[2]

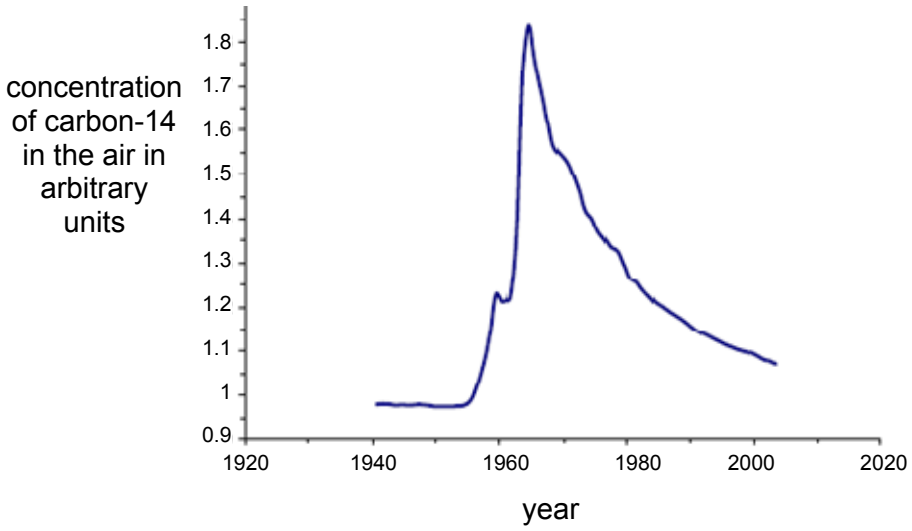
[Total: 2]

Section D

16 (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.



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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.

Ian's tooth contains the equivalent of 1.05 arbitrary units of carbon-14.

The graph in **(a)** suggests that the year Ian's tooth was formed was 1957.

Fred's tooth contains the equivalent of 1.22 arbitrary units of carbon-14.

Use the graph to suggest why it is harder to estimate when Fred's tooth was formed.

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.....

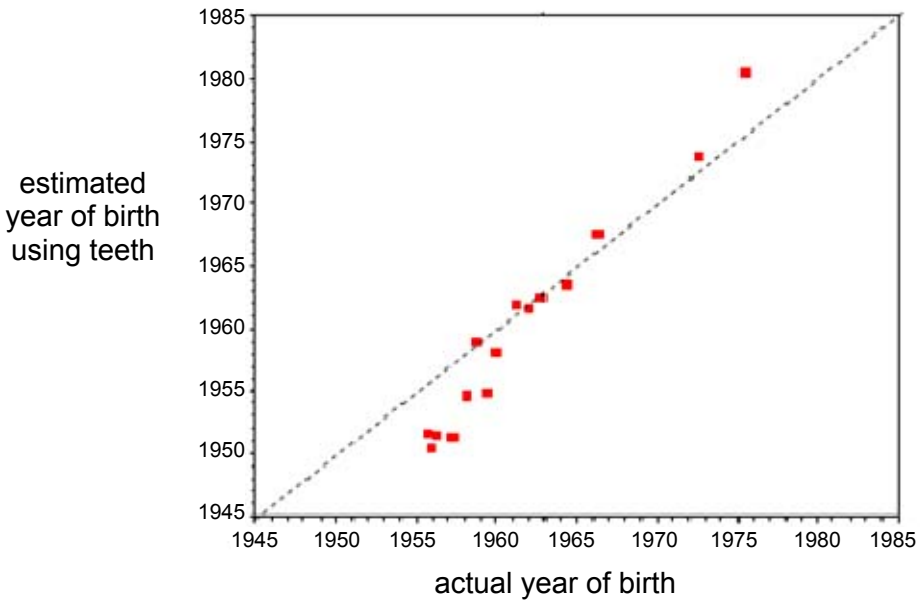
..... **[2]**

(c) The concentration of carbon-14 can be used to estimate the dates of birth of people.

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

They have plotted their results on a graph.

Look at the graph.



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(i) How can you tell that more than 10 teeth were tested?

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

(ii) What does the graph show about the scientists' estimates?

.....

.....

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

(iii) How could the scientists improve their estimates?

Put a tick (✓) in the box next to the best answer.

test more teeth from older people	☐
test more teeth from people of different ages	☐
plot the dates in months not years	☐

Explain your answer.

.....

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

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

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RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B752/01

PHYSICS B

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

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 20 pages

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Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant – applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

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Question			Expected answers	Marks	Additional guidance
1	(a)		no (no mark) the brown is live wire so this would mean that the fridge will not work and the casing/fridge would become live if brown was connected (2) **OR** the brown is live wire / green yellow is the correct earth wire / AW (1)	2	if answer is 'yes' no marks **answer must link identification of brown wire to effect on the fridge to gain full credit** **allow** the green-yellow is the correct earth wire but if this is connected to the live connection the casing/fridge would become live (2)
	(b)		blue and brown (1)	1	if answer line is blank **allow** correct answer ticked circled or underlined
	(c)	(i)	(as resistor is in series the current) halves /1.5 (A) (1)	1	**ignore** just falls / AW
		(ii)	protect bulb by: fuse / circuit breaker to protect the lamp **if** current gets too high (1) increase brightness by: add more cells / batteries, which increases voltage / higher current flows (1) remove resistor already in circuit so higher current flows (1) use variable resistor **to** vary the brightness by varying the current (1)	3	**answers must link component to how this affects the current/voltage/bulb for each marking point** **allow** use lower (value) resistor (1) **allow** description of variable resistor eg decrease length of wire / increase thickness of wire / ora (1)
			Total	**7**	

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Question			Expected answers	Marks	Additional guidance
2	(a)		diagram correctly drawn to show shorter wavelength (1)	1	**not** any change in amplitude
	(b)		scans / pregnancy scan / AW (1) to check development of foetus / (unborn) baby (1) **OR** blood flow measurements (1) to check circulation system / heart is pumping correctly (1) **OR** breaking (kidney) stones (1) so they can pass out the body easily / avoids need for surgery or general anaesthetic (1)	2	**allow** examples of foetal development e.g. check heart or brain is normal (size) (1) **allow** look for tumours (1) to target treatment (1) **allow** cleaning (medical) equipment (1) so that idea that particles are removed (1) **allow** to treat muscle injury (1) so allows quicker healing process (1) **allow** cancer treatment or HIFU (1) as avoids need for surgery or general anaesthetic / chemotherapy or radiation (1)
	(c)		because it emits gamma, which penetrates the skin, it will be possible to trace it through the skin (1) because it has a short half-life it will, decay quickly / stop producing ionizing radiation quickly, so will minimise damage to tissues/risk (1)	2	
			Total	**5**	

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Question			Expected answers	Marks	Additional guidance
3	(a)		the number of nuclear decays emitted (1)	1	**allow number of nuclear decays detected** (1) **ignore** idea of per second or per minute
	(b)		(background radiation from) rocks / cosmic rays (1)	1	**allow** reference to (waste from) hospitals / industry (1) **ignore** just nuclear power stations
	(c)	(i)	the time taken for the activity of the source to halve (1)	1	**not** just 'it halving' **allow** time for the activity to decrease by a factor of 2 (1)
	(d)	(ii)	no (no mark) because it reaches the background radiation level before it halves (2) **but just** (activity) does not halve (1) **OR** idea of line levelling out (before it halves) (1)	2	**allow** higher level correct quantitative answers e.g. starts with an activity of 95 and never falls below 50 (1)
			Total	**5**	

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Question			Expected answers	Marks	Additional guidance
4			**Level 3** Detailed explanation of how charge is useful, in terms of paint droplets repelling and car attracting, and including the effect on the end result, and applies understanding of charges to explain how dangers could be reduced. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Limited explanation of how charge is useful, using the idea of opposite charges attracting. Applies understanding of charges to give some suggestion of how dangers could be reduced. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** An incomplete answer explaining few aspects of the process. Dangers identified in terms of risk of shock from electrical current. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • paint gun charged • car body earthed/opposite charge to paint • paint charged by paint gun • droplets all have same charge • (paint) droplets or particles repel/fine mist formed then • paint attracted to car/body/object • all of car painted including 'shadows' • even coat produced/no runs in paint and • risk of large charge flowing to earth through people • results in an electric shock • need to isolate charge • insulating footwear could reduce dangers • risk of inhaling vapour from paint • wearing a mask over the nose and mouth **allow** answers in terms of paint positive/car negative ORA **ignore** reference to nice finish **ignore** paint sticks to car
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
5			idea it is (a model of) a chain reaction (1) idea that the reaction is controlled in a nuclear power station **and** is out of control in a bomb (1)	2	**allow** fission
			Total	**2**	

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Question			Expected answers	Marks	Additional guidance
6			**Level 3** Answer clearly describes forces involved in orbiting satellites. Answer gives a broad range of satellite uses and explains which orbits are suitable with detailed reference to a number of characteristics. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Answer gives a range of satellite uses with some description of the different types of orbit **and** at least one linking of characteristic included. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** An incomplete answer that gives a use of satellites and recognises a difference between types of orbit. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • gravitational force needed to maintain orbit • lower speed at higher orbit and v.v. • orbits include geostationary/fixed position/equatorial and polar • lower orbits tend to be used for polar orbit satellites • higher orbits tend to be used for equatorial/geostationary orbit satellites uses • communications • weather forecasting • military/spying • research • GPS links for characteristic of orbit to use • polar orbits view different areas of the Earth eg for spying • lower orbit increases the rate of image updating eg for weather forecasting • lower orbit results in a higher period/speed which means the same point on Earth is covered more often/frequently eg for GPS • geostationary orbits are in a fixed-position over the Earth eg for TV satellite communications/weather forecasting • higher the orbit the greater the ground coverage eg for TV or radio
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
7	(a)		(relative speed) decreases / AW (1) because the cars were moving in the opposite direction / apart, but now they are moving in the same direction (1)	2	**allow** from 17 to 7 m/s or 12 m/s + 5 m/s (1)
	(b)	(i)	300 (m) (2) **but if answer is incorrect** average speed (10 or {15 + 5} ÷ 2) or correct working (10 x 30) (1)	2	
		(ii)	360 (m) **and** (yes), because 300+10<360 / distance travelled by car **X** is greater than the distance travelled by car **Y** and the starting position 10m behind (1)	1	both calculation and explanation needed for the mark **allow** ecf from part (i)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
8			no (no mark) because the range increases as the angle increases to 40° but then the range decreases (1) because the optimum angle is 45° (1) **then** because increasing the angle increases the time the ball spends in the air but decreases the horizontal velocity (2) **OR** increasing angle increases the time the ball spends in the air / increasing angle decreases horizontal velocity (1)	3	**allow** max 1 mark for comments relating to fair testing or experimental method eg he didn't kick the ball equally hard each time / he didn't do repeats and get an average linking the effect of increasing angle to time and horizontal velocity is worth 2 marks **allow** answers in terms of at high angles more energy being used to move the ball upwards than across (1)
			Total	**3**	

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Question			Expected answers	Marks	Additional guidance
9	(a)		**D** and **E** (1)	1	any order
	(b)		light is <u>refracted</u> (1)	1	tick in fourth box
	(c)		light is reflected (internally and correct side of the normal) correctly with reflected angles equal to incident angle by inspection – margin of error +/- 2^{o} (1)	1	any refracted light shown on diagram scores zero
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
10	(a)		light travels... (✓) light can bend... × EM longitudinal… ×	1	2 correct = (1) 1 correct = (0)
	(b)		idea of he hears loud and quiet areas / quiet or soft area followed by louder area followed by quiet or soft area (1) because of the overlap of waves from the two speakers (1)	2	**allow** different loudness (1) **allow** sound and no sound (1) **allow** higher level answers in terms of constructive and destructive interference (1)
	(c)		because waves overlap an interference pattern is produced this can only be explained in terms of a wave model/theory / the particle model could not explain this interference pattern (2) **OR** idea of interference pattern produced (1)	2	**answers must link the interference pattern to the model which can explain it in order to gain full credit** **allow** higher level answers in terms of constructive and destructive interference **allow** higher level answers in terms of corpuscular or particle theory not being able to explain the interference pattern

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Question			Expected answers	Marks	Additional guidance
10	(d)		no (no mark) idea that signal **B** will be **reduced in strength** because of atmospheric effects and so will not pass through (1) idea that signal **A** will be **reflected** because it is below 30 MHz (1) idea that signal **C** (10 GHz) is in the band that can **pass through** the atmosphere so can be used (1)	3	**for full credit answers must link signals with their behaviour in the atmosphere**
			Total	**8**	

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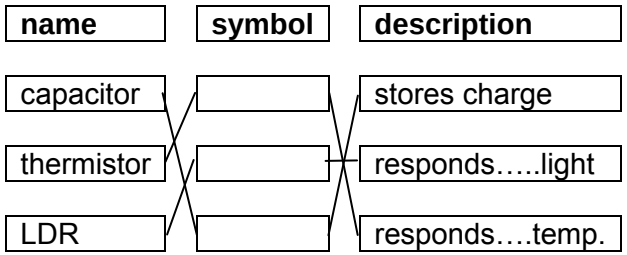
Question			Expected answers	Marks	Additional guidance
11	(a)			2	name symbol and description all linked correctly all three correct 2 marks one or two correct 1 mark
	(b)	(i)	AND gate (1)	1	
		(ii)	inputs at **A** & **B** are to the base connector, and allow current to pass through each transistor (1) input at **A** allows current to reach collector of 2nd transistor (1) input at **B** allows current to reach the 'Out' terminal (1)	3	**ignore** truth table, answers must describe behaviour of each transistor to gain full credit
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
12	(a)		thermistor (1) because changing the temperature changes the current / AW (1) and the change in current shows that the resistance must have changed (1) changing light level has no effect / AW (1)	4	**answers must link temperature, resistance and current to gain full credit for this question** **allow** 'changing the temperature, will change the resistance of a thermistor, and this change in resistance will cause a change in the current in the circuit' (2) as an alternative to 2nd and 3rd marking points **allow** cannot be LDR as an LDR does not respond to temperature (change) (1)
	(b)	(i)	4 (1) ohms/Ω (1)	2	
		(ii)	resistance is not constant / increases (at higher currents) / ora (1) the graph is a curve / not a straight line / gradient of graph is changing / AW (1)	2	**allow** higher level answers above target level eg because V is not directly proportional to I, R must be changing (1)
			Total	**8**	

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Question			Expected answers	Marks	Additional guidance
13	(a)		by placing the wire in complete circuit with the ammeter and moving the magnet/wire (1) this will show a current because there will be a reading on the ammeter (1)	2	magnet must **not** be in the circuit for the complete circuit mark **allow** higher level answers eg move the wire so it cuts the magnetic field (1)
	(b)		step-down transformer (1)	1	step-down needed for the mark
			Total	**3**	

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Question			Expected answers	Marks	Additional guidance
14			**Level 3** Comprehensive explanation of the action of forces and of a broad range of methods for increasing speed. Application of knowledge about current and field to bring about a change in direction. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Limited explanation of the action of forces, and a range of methods for increasing speed. Application of knowledge about current or field to bring about a change in direction. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** Explanation incomplete including factors that affect speed or direction. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include** **forces** on the coil • forces in opposite directions on opposite sides of coil • produce rotation • sides at right angles to (magnetic) field for maximum force **speed** of rotation increased by stronger (magnetic) field • stronger magnets • higher current • more turns on coil/more turns/per m • adding a (soft) iron core **allow** more powerful magnets higher voltage more coils bigger coil area **ignore** bigger magnets stronger current more wire **direction** of rotation • reverse direction of magnetic field • reverse current direction • interaction of current and field direction determines the direction of rotation **allow** swap magnets around reverse connections to electricity or voltage supply higher level answers making correct reference to Fleming's Left Hand Rule.
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
15			1 (row 3) (1) 0 (row 4) (1)	2	
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
16	(a)		**any three from** idea that before testing started concentration levels of carbon-14 between 1940 and 1955 relatively constant showing that no other factor affected the levels (1) level increases (significantly/rapidly) between 1955 and 1963 which is during the testing of nuclear bombs (1) after 1963, levels start to decrease when testing stopped (1) makes link between more carbon-14 and increased background radiation level likely (1)	3	**allow** concentration of carbon-14 at 1 arbitrary unit between 1940 and 1955, which increases to 1.9 at its peak and then starts to decrease again after 1963 / AW (1)
	(b)		concentration level of carbon-14 'fluctuates' at 1.22 units / there is more than one year on the graph at 1.22 units (1) so cannot be certain which year 'value' to choose (1)	2	**allow** graph indicates two different years one in 1960 and one in 1985
	(c)	(i)	because there are more than 10 points plotted on the graph (1)	1	

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Question			Expected answers	Marks	Additional guidance
16	(c)	(ii)	**any two from** quite accurate / reliable / close to actual date in middle of graph (1) older teeth are estimated as being too old (1) younger teeth are estimated as being too young (1)	2	 **allow** idea that not all the estimates are accurate (1) **allow** worse when the teeth are older or younger (1) **allow** not so accurate / not reliable on older teeth or younger teeth (1)
		(iii)	test more teeth from people of different ages (1) Idea that estimates are better when based on more data (1)	2	 **allow** because graph shows gaps in the data (1)
			Total	**10**	

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Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1	1		**2**
1(b)	1			**1**
1(c)(i)		1		**1**
1(c)(ii)	1	2		**3**
2(a)		1		**1**
2(b)	2			**2**
2(c)		2		**2**
3(a)	1			**1**
3(b)	1			**1**
3(c)(i)	1			**1**
3(c)(ii)			2	**2**
4✎	4	2		**6**
5		2		**2**
6✎	4	2		**6**
7(a)	1	1		**2**
7(b)(i)	1	1		**2**
7(b)(ii)		1		**1**
8	1		2	**3**
9(a)		1		**1**
9(b)	1			**1**
9(c)		1		**1**
10(a)	1			**1**
10(b)	2			**2**
10(c)	1	1		**2**
10(d)		2	1	**3**
11(a)	2			**2**
11(b)(i)	1			**1**
11(b)(ii)		3		**3**
12(a)		2	2	**4**
12(b)(i)	1	1		**2**
12(b)(ii)	1	1		**2**
13(a)	1	1		**2**
13(b)	1			**1**
14✎	4	2		**6**
15		2		**2**
16(a)			3	**3**
16(b)			2	**2**
16(c)(i)			1	**1**
16(c)(ii)			2	**2**
16(c)(iii)			2	**2**
Totals	**35**	**33**	**17**	**85**

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