SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE   **B752/02**

PHYSICS B

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

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

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

power = force × speed

$KE = \frac{1}{2}mv^2$

momentum = mass × velocity

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

GPE = mgh

$mgh = \frac{1}{2}mv^2$

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

$v = u + at$

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

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

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

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

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

$I_e = I_b + I_c$

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

power loss = (current)^2 × resistance

$V_pI_p = V_sI_s$

SPECIMEN

Answer **all** the questions.

Section A – Module P4

1 **(a)** Nita rubs a rod with a duster.
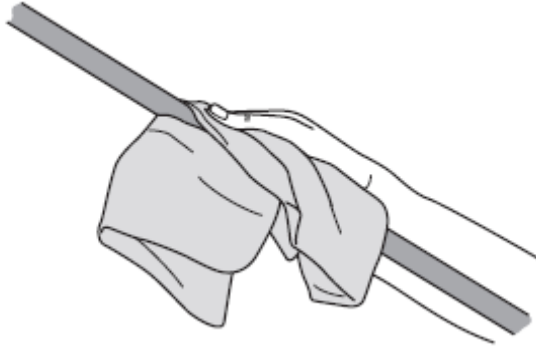
The rod is made from an **insulating** material.

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.

car body
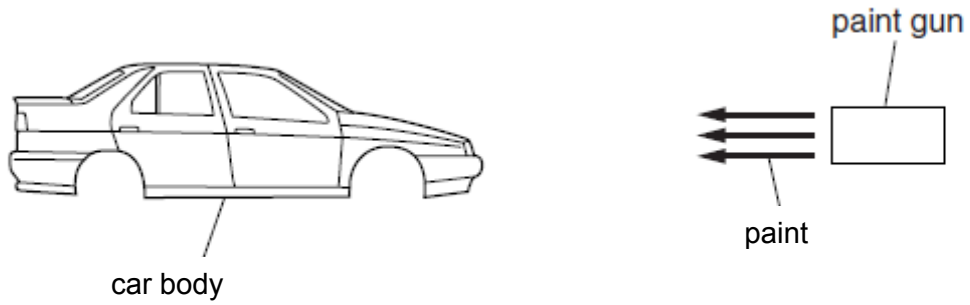
paint gun

paint

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.

....

....

....

....

.... **[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?

....

....

.... **[2]**

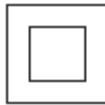**(b)** Phil also has a kettle and a hairdryer.

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.

....

....

.... **[2]**

[Total: 4]

3 Ultrasound is a longitudinal wave.

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

Look at the diagram.

P
• • • • •• • • • •

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

Put a (ring) around the correct answer.

$\updownarrow$ $\leftrightarrow$ $\uparrow$ $\rightarrow$ $\downarrow$ $\leftarrow$

[1]

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

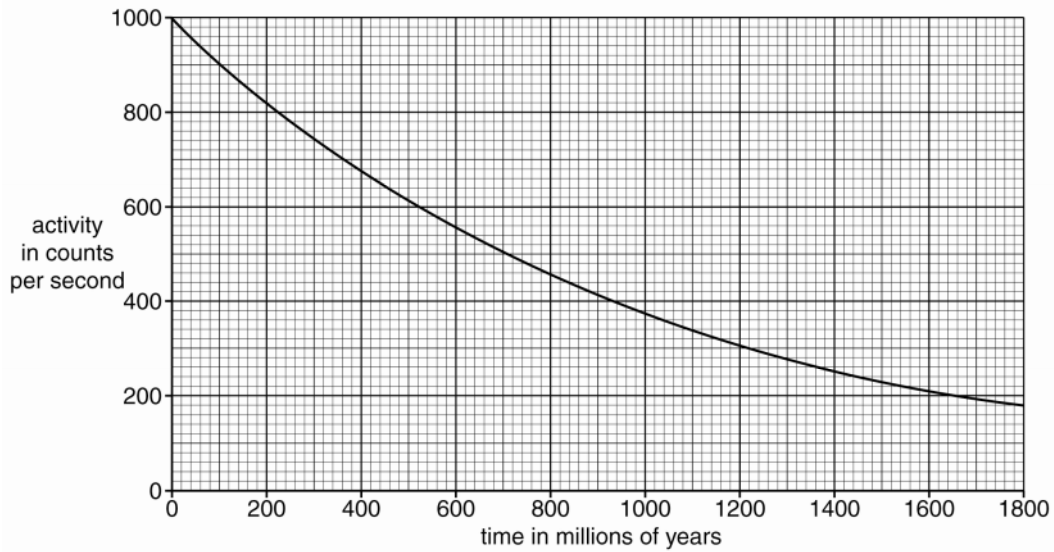Give **two** reasons why ultrasound is used rather than X-rays.

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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.

....

....

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.

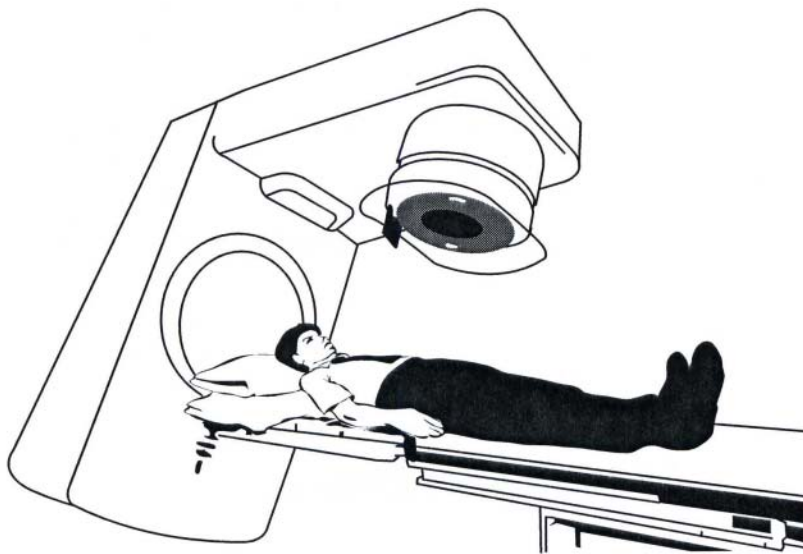Is this an appropriate conclusion? Explain why.

....

....

....

.... **[2]**

[Total: 7]

SPECIMEN

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]**
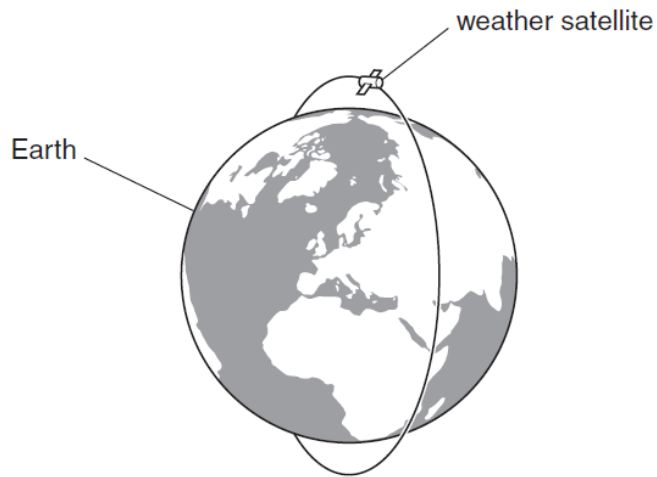
[Total: 6]

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?

....

....**[1]**

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

....

.... **[1]**

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

....

....

....

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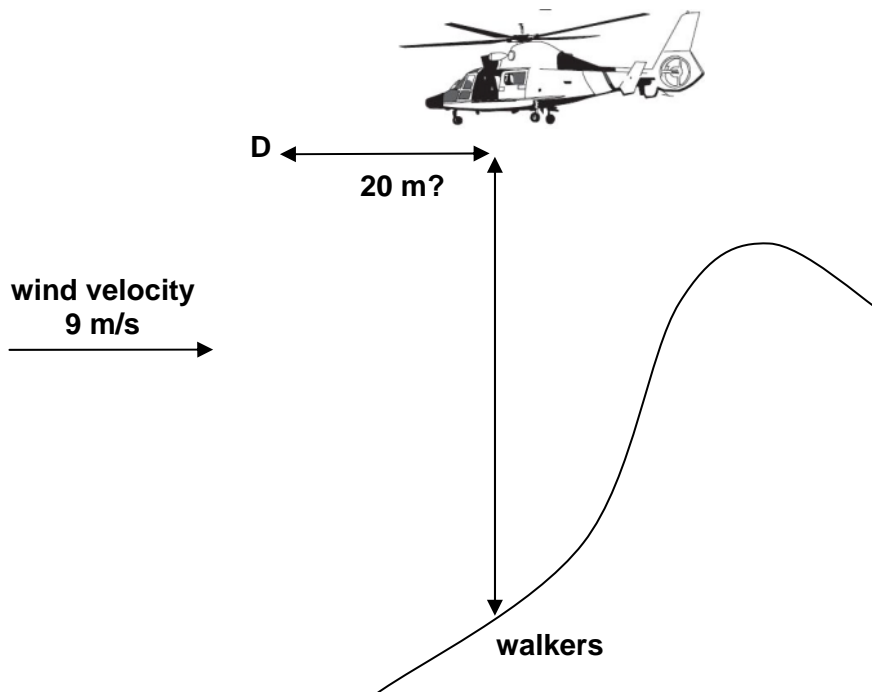
(a) What is the size of the resultant velocity of the supplies as they fall?

....

....

.... **[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.

....

....

.... **[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.
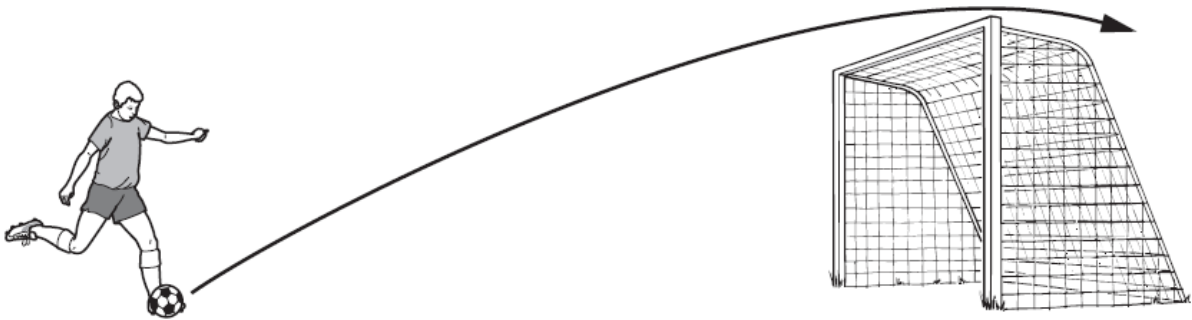
The football travels in a curved path.

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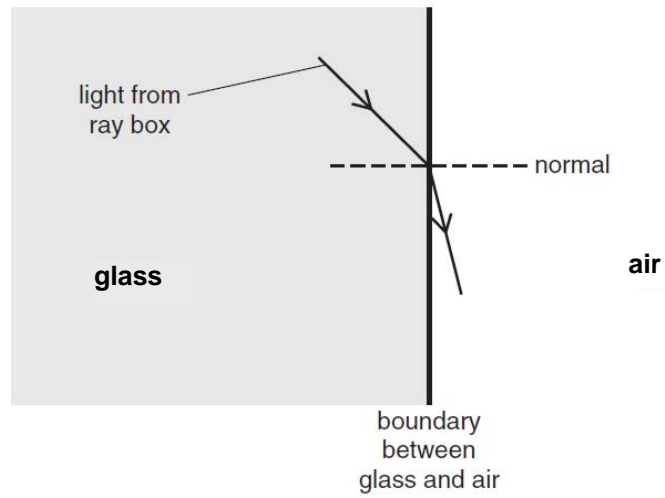
Explain what causes the ray of light to bend the **way it does** at the boundary.

....

....

.... **[2]**

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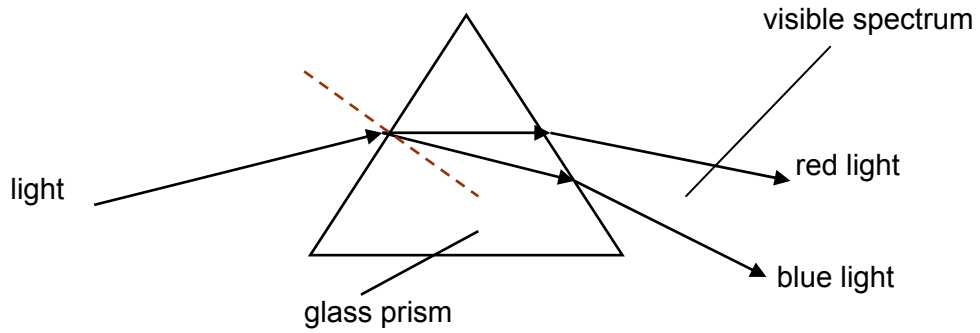
Look at the table

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

The diagram shows that different colours refract by different amounts.

Use the information in the table to explain why.

....

....

....

.... **[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.

double slits

interference pattern produced in front of double slits

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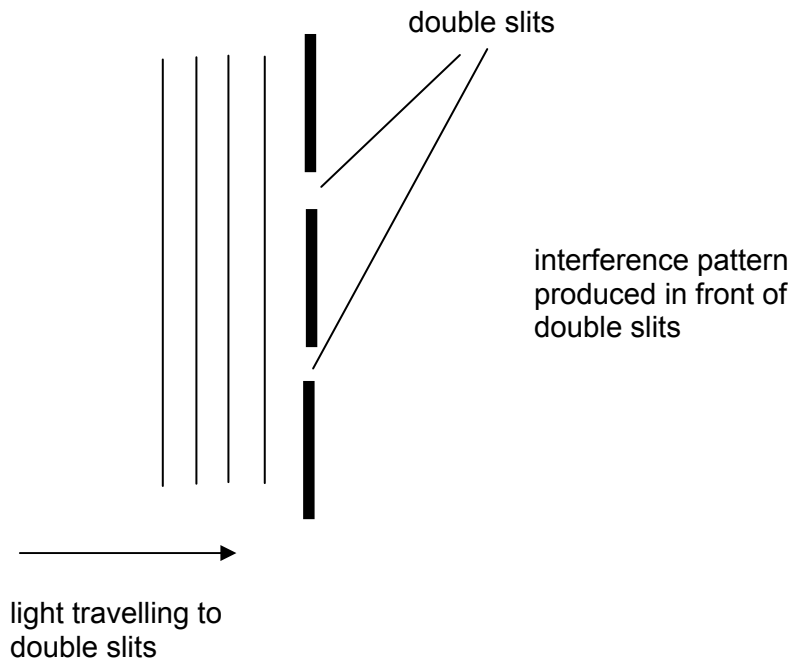
Bharat's teacher explains that this famous experiment provided evidence for the wave nature of light.

Explain how the interference pattern provided this evidence.

....

....

.... **[2]**

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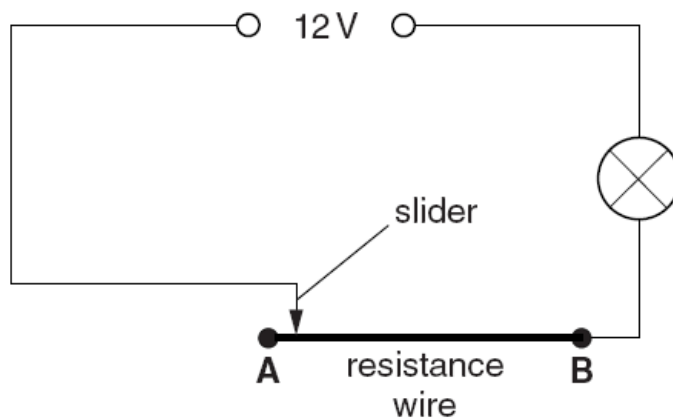
(i) Sally puts the slider at position **A**. The bulb lights up.

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

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

....

.... **[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.
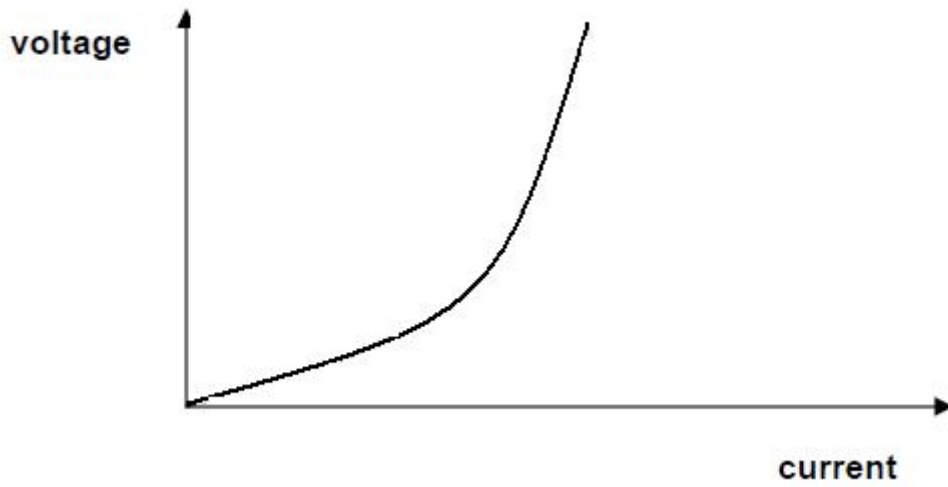
She expects a straight line graph.

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.

12V
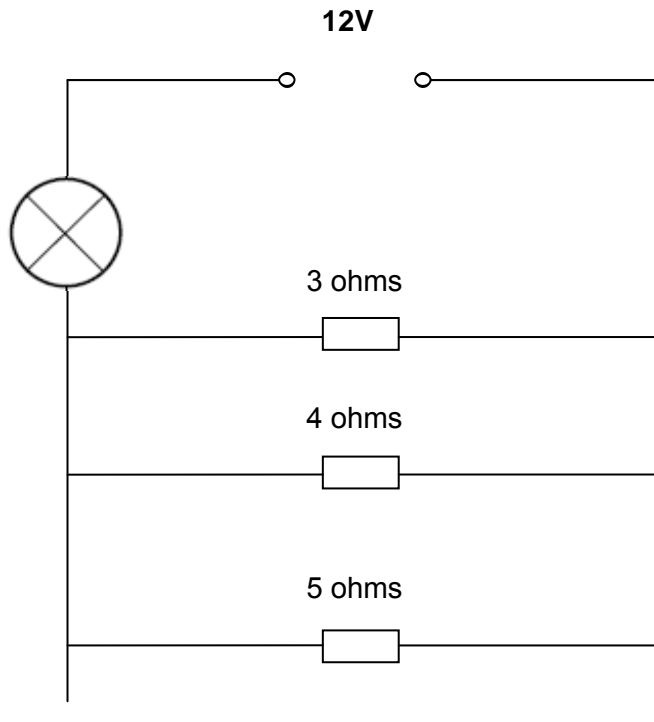
Calculate the **total resistance** of the three resistors.

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.

coil wound on
wood core

rubber bands

insulating
tape

brushes   coil

current into coil
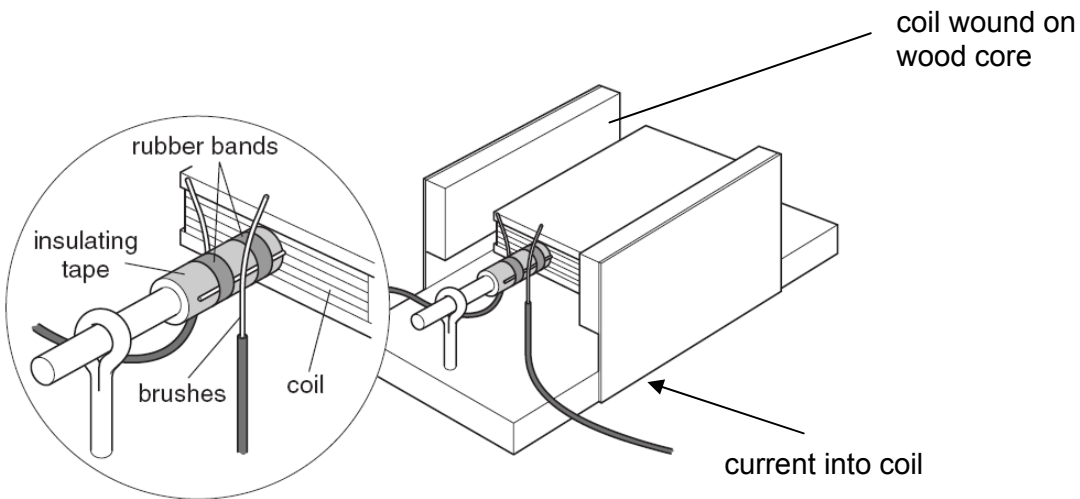
Declan connects the motor to a DC power supply.

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.
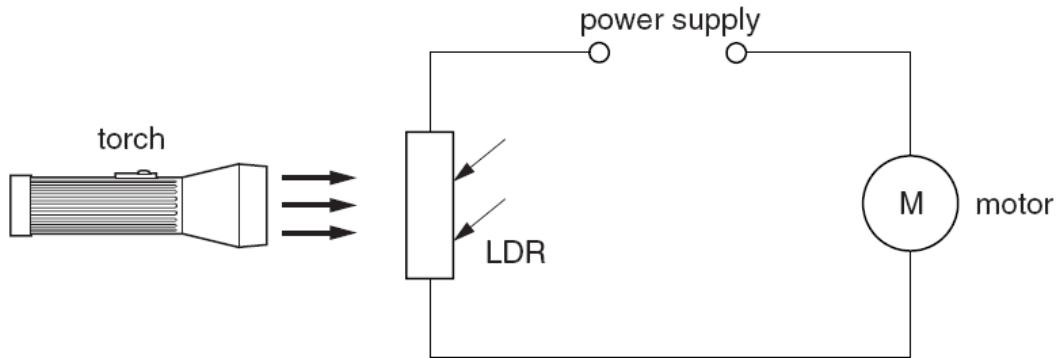
The torch is not switched on.

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

....

....

.... **[2]**

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

Look at the information in the diagram.

V in ——————
|
| R_1 = 12 ohms
|
—————— **V out**
|
| R_2 = 36 ohms
|
0 V —————— **0 V**
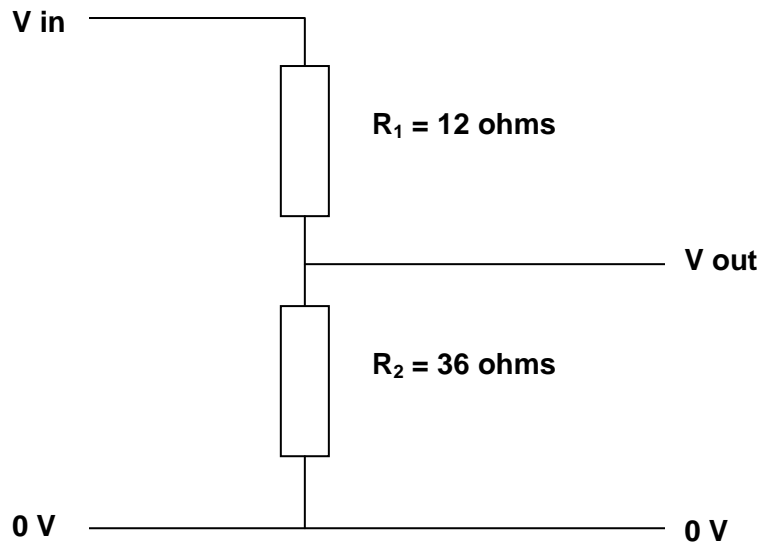
The **input** voltage = 5 V.

Calculate the **output** voltage.

....

....

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.

230V

logic gates | motor
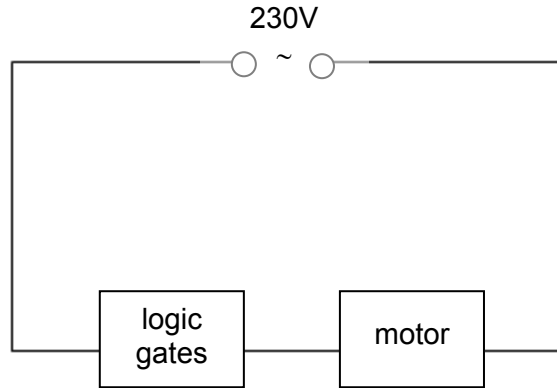
Connecting the washing machine as shown in the diagram will not work.

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.

primary coil
220 V input voltage
4000 turns

secondary coil
11 V output voltage
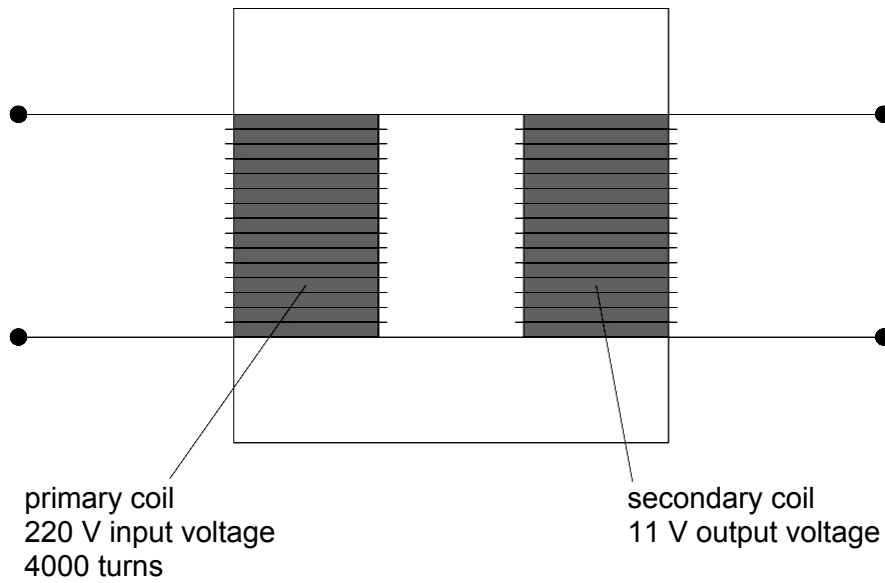
(a) Calculate the number of turns in the secondary coil.

....

....

....

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.
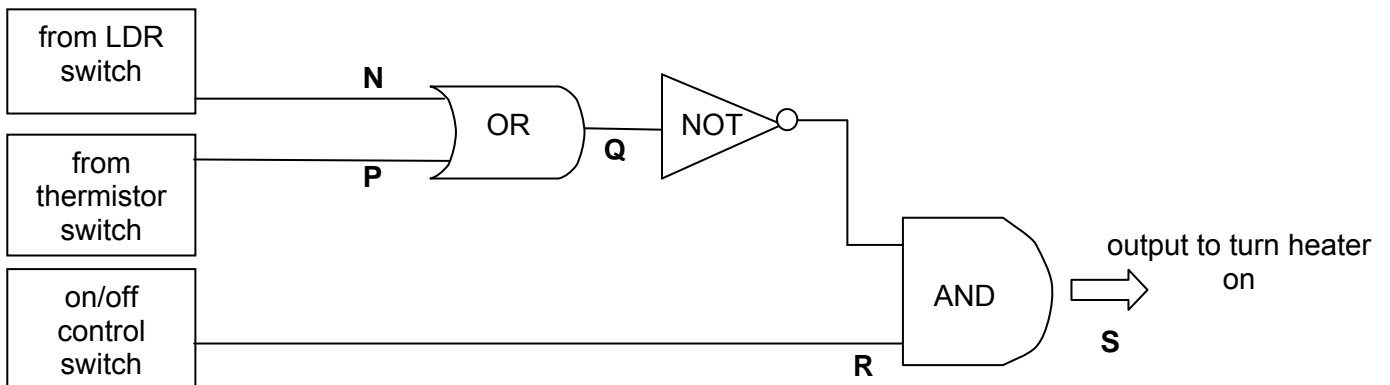
Truth tables can explain how an electronic system works.

Complete the truth table for the above system.

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

[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.
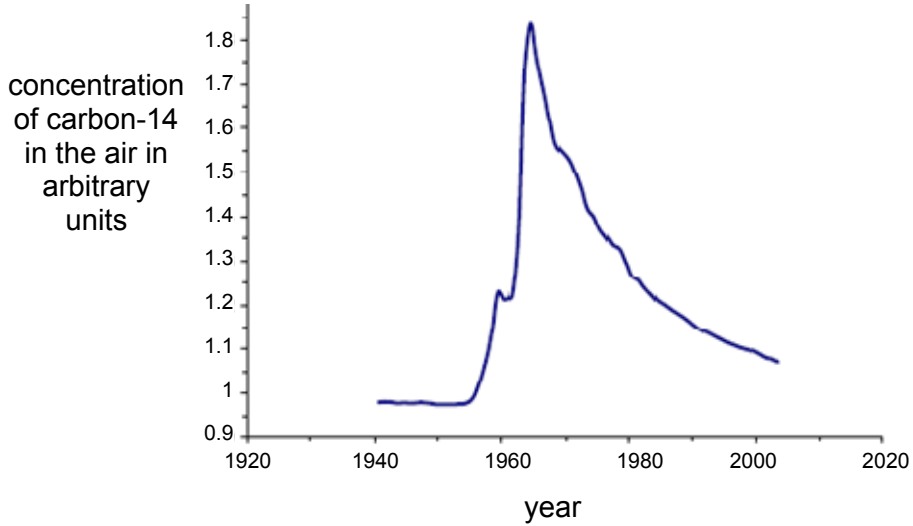
© National Criminal Justice Reference Service (NCJRS)

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?

....

....

....

.... **[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.

....

....

.... **[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.
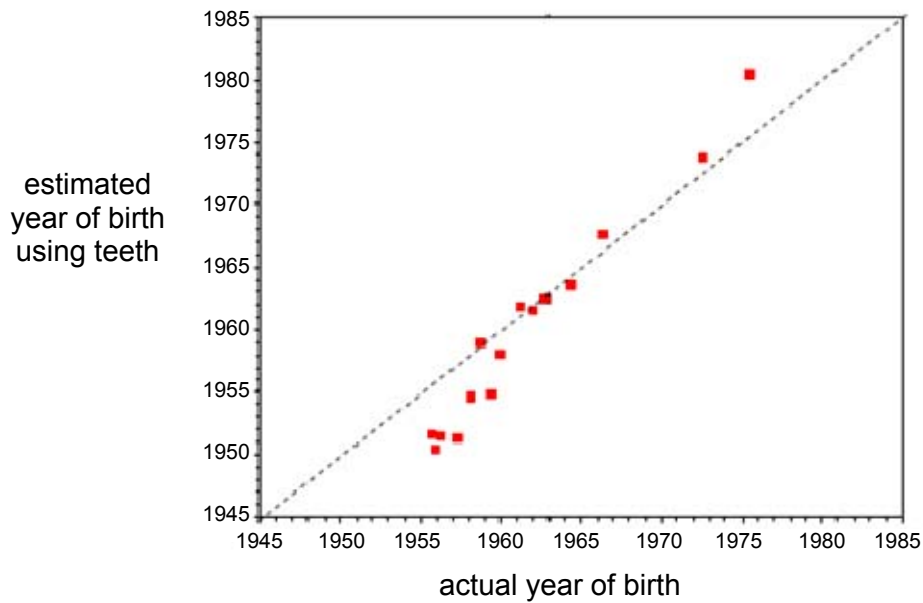
© National Criminal Justice Reference Service (NCJRS)

What does the graph show about the scientists' estimates?

....

....

.... **[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.

....

.... **[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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SPECIMEN

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

PHYSICS B

B752/02

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

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK   85

This document consists of 20 pages

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.

Question			Expected answers	Marks	Additional guidance
1	**(a)**		**B** (1)	1	if answer line is blank **allow** correct answer ticked circled or underlined
	(b)		because the droplets have no charge they do not repel (1) this means that the paint does not produce mist / fine spray (1) because the paint is not charged opposite to car, the car does not attract paint (1) this means that the paint is not attracted into the shadows / not an even coat of paint (1)	4	**answers must link no charge to effect on paint to gain full credit in this question** **not** paint does not stick to car
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
2	**(a)**		when current is too high for the computer, the 13A fuse will not melt / blow (1) this could result in overheating / damage / possible fire in the computer (1)	2	**both** needed **allow** power (1) **ignore** energy **not** voltage (1st answer) **not** fuse blows up / burns / snaps / leaks (2nd answer)
	(b)		third wire is for earthing or earth(ing)wire not needed (1) (because) case made of insulator or plastic so that it cannot become live (1)	2	**allow** case does not conduct (1) **or** **allow** cannot normally give shock/prevents electrocution (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
3	**(a)**		ring around second diagram (side to side) (1)	1	**allow** two rings around 4th + 6th arrow (1)
	(b)		because ultrasound can give image of soft tissue which X-rays cannot (1) because ultrasound does not damage cells (1)	2	**allow** ORA **allow** non ionising (1) **allow** ORA **not** just less damaging / less harmful / safer
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
4	(a)	(i)	720 (1) **second mark for how the half-life was calculated** two acceptable horizontal lines/indications eg 1000 and 500/800 and 400 etc. with corresponding values on the time axis indicated (1)	2	**allow** +/- 1 small square ie answer in the range 700-740
		(ii)	idea that uranium has a long half-life and so remains active in the body for too long (1)	1	
	(b)		$$U \longrightarrow \ ^{231}_{90}Th + \ ^{4}_{2}\alpha$$ both Th mass and atomic numbers correct (1) both α mass and atomic numbers correct (1)	2	
	(c)		no because medical and / or from inside the human body are not that much smaller (1) no because the data is an average and Stephen could have a particular medical condition / job (1)	2	**answers must support candidates choice to gain credit** **allow** yes because these values together make up 75% of the total (1) **allow** references to particular job eg radiographer or conditions eg cancer
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
5 🖉			**Level 3** Answer thoroughly explains how gamma is used safely and the effect of the gamma radiation on the tumour and healthy tissue. Applies understanding of the risks of radiation and the benefits of treatment to explain in detail what the patient should consider including balancing risks against benefits of the treatment and the consequences of remaining untreated. 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 explains some aspects of how gamma radiation is used and recognises the need to limit dose. Applies understanding of risks of radiation and benefits of treatments to address some risks and benefits in limited detail. 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 explanation including gamma killing cancer cells. Identifies risks **or** benefits of treatment. 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:** • beam is fairly wide and / or relatively weak • idea that γ can penetrate body to reach the tumour • idea that γ can kill cancer(ous) cells • idea that healthy cells can be damaged • rotation with tumour at the centre • gamma rays are focussed on the tumour • tumour receives dose from all angles • gamma does not penetrate through the same healthy cells due to change of angle with rotation • dose is limited to healthy tissues / cells risks and benefits • idea that a relatively small exposure a number of times • risk of damage to healthy cells/tissue • risk of side effects from treatment • benefit of treatment curing the cancer • risk that treatment may be ineffective • risk of cancer spreading / causing death if not treated • benefit of not suffering side effects / having to spend time in hospital if not treated **allow** answers in terms of tumour / cells / tissue **reject** references to chemotherapy
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
6	(a)		because a polar orbit covers the whole of the Earth's surface over time (1) low orbit gives shorter orbital period (1) therefore idea that it can monitor changing weather patterns / can give early warning of potential dangerous weather situations (1)	3	**third marking point must be linked to either of the first two to gain credit** **allow** idea that low orbit allows higher resolution images (1)
	(b)		(geostationary satellites) need a longer orbital period (than imaging satellites) (1)	1	**ignore** just need 24 hours **but allow** comparison eg geostationary needs 24 hours but imaging need 1 hour / much less time to orbit (1)
	(c)	(i)	idea that force falls by a factor of 4 (1)	1	**allow** it is inversely proportional so falls by factor of 4 (1)
		(ii)	because the force increases as the comet approaches the Sun (1) this will cause the comet to accelerate/speed to increase (1)	2	**allow** answers in either order but must link increased force to increased speed to gain full credit
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
7	**(a)**		15 (m/s) (2) BUT evidence of use of Pythagoras / scale drawing (1)	2	
	(b)		no (no mark) drop should be 45 m away (1) because the wind has a larger effect / 9x5 (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
8 ✏			**Level 3** Answer thoroughly explains the path of the ball taking account of all forces, both horizontal and vertical effects and applies understanding of vector addition to explain the resultant velocity. 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 partially explains the path using some appreciation of the force of gravity acting to change the velocity. The explanation should include application of vector addition in terms of the resulting path as a combination of horizontal and vertical velocities. 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 explanation that may only mention one of the velocities in relation to gravity. Some appreciation that the direction of the velocities is important. 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:** • horizontal velocity constant • vertical velocity increasing (in the downward direction) due to gravitational force • gravity is the only force (neglecting air resistance) once 'kicking' force no longer acting on the ball • no horizontal acceleration • constant vertical acceleration then • idea of vector addition for resultant velocity • resultant is the ever increasing downward velocity • mention of the fact that if air resistance were not ignored, horizontal velocity would decrease **allow** diagrams when answering the vector sum part of the answer **allow** correct reference to the equations of motion
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
9	(a)		speed is greater in air compared to glass causing the bending away from the normal (2) **OR** speed changes / wavelength changes / AW (1)	2	**answer must identify where speed is greater to gain full credit**
	(b)		refractive index shows that blue light is travelling faster than red light in the glass (1) idea that amount/angle of refraction is higher for faster light / amount/angle of refraction is higher for higher refractive index / ora (1)	2	marking points may be in either order, candidate must link refractive index to speed of light and significance of speed difference to gain full credit
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
10			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
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
11			✓ ✗ ✗ ✗	2	4 correct = (2) 2/3 correct = (1) 1 correct = (0)
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
12	**(a)**	**(i)**	the resistance decreases **and** the brightness increases / AW (1)	1	**both** correct answers needed for the mark
		(ii)	9 (V) /✓ in second to last box (1)	1	if end column is blank **allow** correct answer ticked circled or underlined
		(iii)	because increased current increases collisions between charge carriers/electrons and atoms (1) this causes more atomic vibration / increased temperature / AW (1) more atomic vibration/higher temperature further increases number of collisions which means there is more resistance (1)	3	**marking points must be linked and in order to gain full credit** **allow** references to ions in place of atoms
	(b)		1.28 Ω (1)	1	if answer line is blank **allow** correct answer ticked circled or underlined
			Total	**6**	

Question			Expected answers	Marks	Additional guidance

13	✎		**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 of 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/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**	

Question			Expected answers	Marks	Additional guidance
14	**(a)**		idea that resistance is reduced in higher light levels / AW (1) causing the speed to increase (1)	2	**allow** current increases (1) but resistance increases scores (0)
	(b)		3.75 (V) scores (2) **but if answer is incorrect** 5 x 36/(12 + 36) / 5 x 3/4 (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
15			because the logic gates will be damaged due to exposure to high voltage/mains power (1) a relay should be used (1) because a relay isolates the logic gates and uses a low voltage from the logic gates to switch the high voltage to the motor (1)	3	**answers must link use of relay to isolating logic gates from mains power to gain full credit**
				3	

Question			Expected answers	Marks	Additional guidance
16	**(a)**		200 (2) **but if answer is incorrect** 4000 x (11 ÷ 220) (1)	2	
	(b)		idea of higher output voltage from transformer produces a lower current from I_s = I_pV_p / V_s / ORA / current at higher voltage less by a factor of 20 (1) **then** at higher voltage or lower current there is less heat / power / energy loss in cables because loss depends on I^2 / power loss less by a factor of $400/20^2$ (1) **then** idea that therefore low current decreases losses which increases efficiency (1)	3	**answers must be in correct order to gain full credit**
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
17			<table><tr><td>**Q**</td><td>**S**</td></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td></tr></table>	1	all values need to be correct
			Total	**1**	

Question			Expected answers	Marks	Additional guidance
18	(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)		**any one from** concentration level of carbon-14 'fluctuates' at 1.22 units / there is more than one year on the graph at 1.22 units so cannot be certain which year 'value' to choose (1) **and** idea of repeating process using concentration levels of carbon-14 in other teeth to check for consistency in predictions (1)	2	**allow** graph indicates two different years one in 1960 and one in 1985 **allow** repeating with other teeth where the value does not fluctuate (1)
	(c)		**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)

Question			Expected answers	Marks	Additional guidance
18	(d)		no (no mark) because the carbon-14 will not have decayed much / AW (1)	1	

	(e)		**carbon 14 test** **teeth wear test**
			
			    ✓ ✗
			
			   ✗ ✗
			
			   ✗ ✓
				2	six correct = (2)
					four or five correct = (1)

			Total	10	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1			**1**
1(b)		4		**4**
2(a)		2		**2**
2(b)	1	1		**2**
3(a)	1			**1**
3(b)	2			**2**
4(a)(i)		2		**2**
4(a)(ii)		1		**1**
4(b)	1	1		**2**
4(c)			2	**2**
5✎	4	2		**6**
6(a)	1	2		**3**
6(b)		1		**1**
6(c)(i)		1		**1**
6(c)(ii)		2		**2**
7(a)		2		**2**
7(b)			2	**2**
8 ✎	5	1		**6**
9(a)	1	1		**2**
9(b)	1	1		**2**
10	1	1		**2**
11	2			**2**
12(a)(i)	1			**1**
12(a)(ii)		1		**1**
12(a)(iii)	2	1		**3**
12(b)		1		**1**
13✎	4	2		**6**
14(a)	1	1		**2**
14(b)		2		**2**
15	2	1		**3**
16(a)	1	1		**2**
16(b)	1		2	**3**
17		1		**1**
18(a)			3	**3**
18(b)			2	**2**
18(c)			2	**2**
18(d)			1	**1**
18(e)			2	**2**
Totals	**33**	**36**	**16**	**85**

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