OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A182/01**

PHYSICS A

Unit A182: 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

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 useful relationships is printed on page **2**.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**7**	
2	**5**	
3	**6**	
4	**2**	
5	**3**	
6	**6**	
7	**6**	
8	**3**	
9	**2**	
10	**3**	
11	**2**	
12	**3**	
13	**6**	
14	**3**	
15	**3**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining Motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

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

momentum = mass x velocity

change of momentum = resultant force x time for which it acts

work done by a force = force x distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric Circuits

power = voltage x current

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

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

Radioactive Materials

energy = mass x [speed of light in a vacuum]^2

Answer **all** the questions.

1 This question is about different journeys made in a lorry.

(a) The lorry is passing through a built up area where the speed limit is 14 m/s.

In 20 seconds, the lorry travels 250 metres.

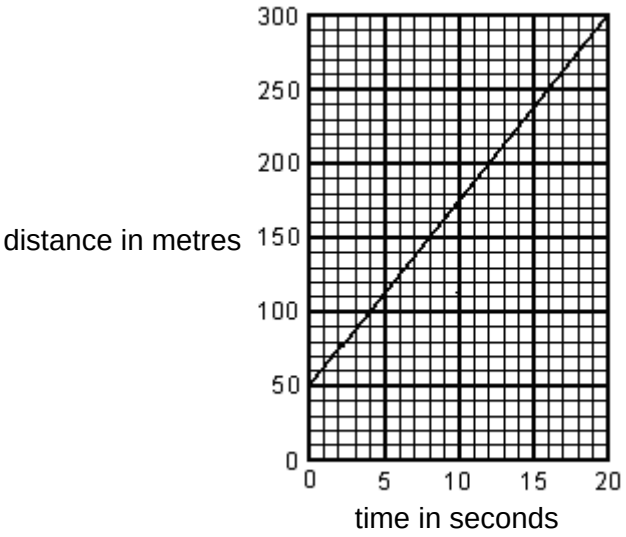
(i) Calculate the speed of the lorry, and decide whether the lorry is within the speed limit.

speed = ... m/s

.....

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

(ii) Here is the distance-time graph for the 250 metre part of the journey.



Explain how the graph increases your confidence in your decision about whether the lorry is within the speed limit.

.....

.....

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

(b) The lorry is fitted with a speed limiter.

This sets its maximum speed to 25 m/s.

The lorry is driven down a test track at full speed to test the limiter.

Here are the results of four measurements.

trial number	measured speed
1	24.5 m/s
2	25.2 m/s
3	24.9 m/s
4	24.8 m/s

(i) Suggest why four measurements were taken instead of just one.

.....

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

(ii) Calculate the mean of the four measurements.

speed = ... m/s **[1]**

(iii) The speed measured in trial number five is 20.2 m/s.

What should be done with this result?

Give a reason in your answer.

.....

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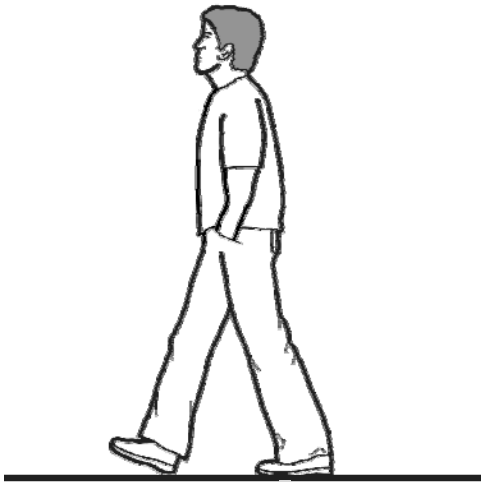
..... **[2]**

[Total: 7]

2 Tom goes for a walk in the park.



(a) There are two forces acting on Tom's feet from the ground.

Complete the table. Choose words from the list.

You may **not** use the same word twice.

friction **mass** **reaction** **weight**

direction of force from ground	name of force
vertical ↑	
horizontal →	

[2]

(b) Tom is moving forward at a steady speed.

Complete the sentences.

Choose words from this list.

You may **not** use the same word twice.

weight **friction** **upwards** **forwards** **backwards**

To move forwards, Tom's foot applies a force in the .....direction.

The foot does not slip because of ..... .

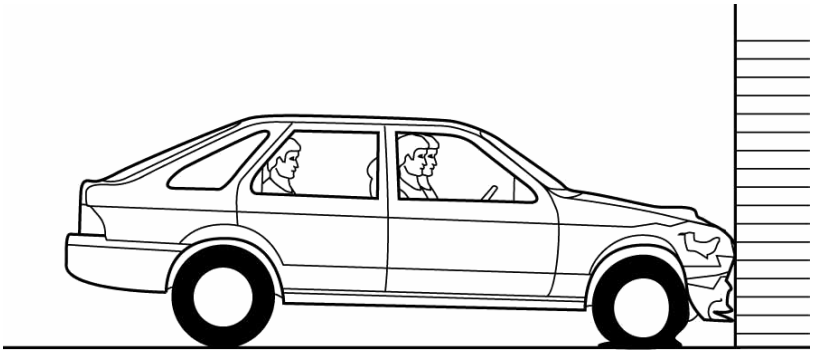
The horizontal force from the ground pushes Tom's foot in the .....direction.

[3]

[Total: 5]

3 Car manufacturers build safety features into their cars.

.



Describe safety features that are designed to protect people in the car when it has a crash.

Use ideas of momentum to explain how they protect people in a crash.

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

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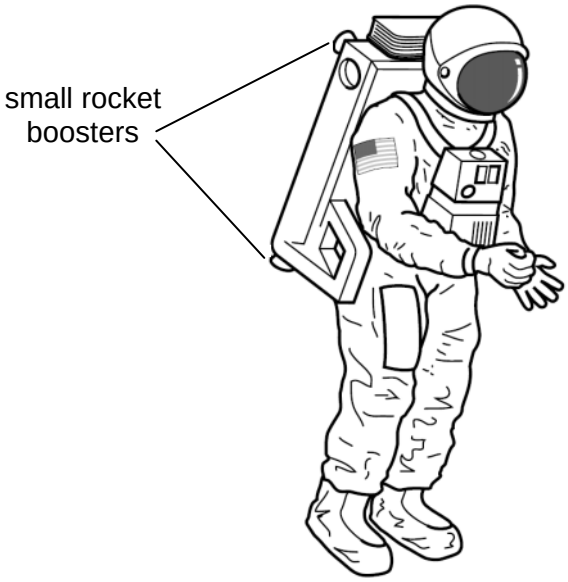
.....**[6]**

[Total: 6]

4 Buzz is an astronaut.

He is floating in space far away from the Sun or any planets.

He uses small rocket boosters on his space pack to move about.



Complete the sentences.

Choose words from this list.

charge **kinetic energy** **potential energy** **power** **work**

The rocket boosters exert a force on the astronaut.

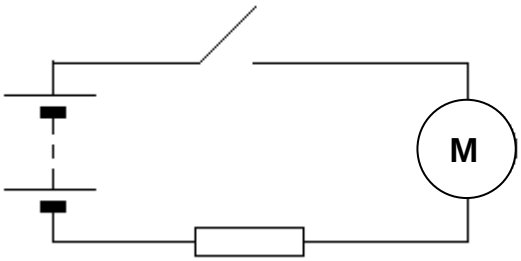
The astronaut speeds up, gaining .....

This happens because the rockets do ..... on the astronaut.

[2]

[Total: 2]

5 Bill assembles this circuit.



Explain why the motor spins when Bill presses the switch.

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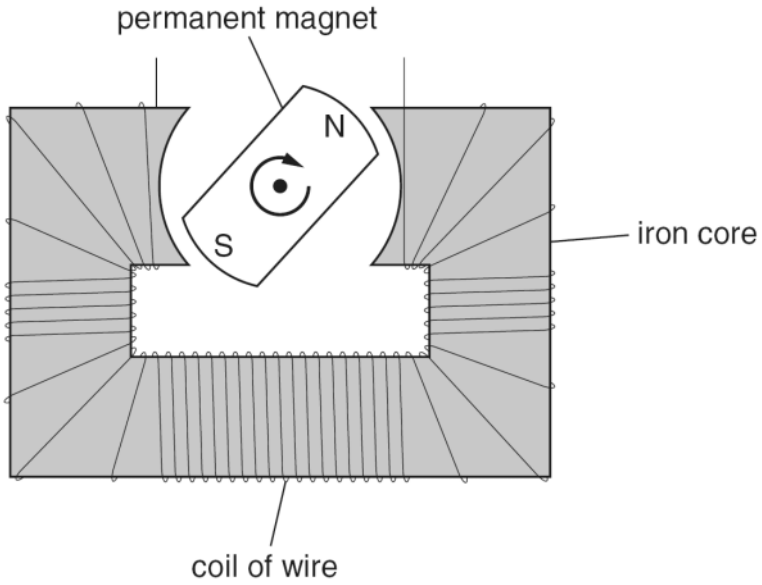
..... **[3]**

[Total: 3]

6 The diagram shows a simple generator.



Describe how a simple generator produces electricity.

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

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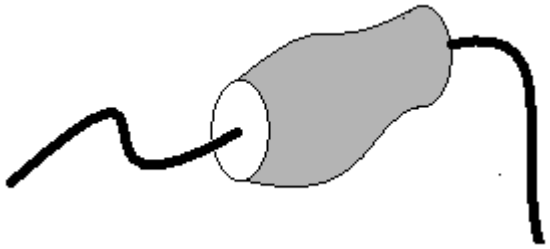
..... **[6]**

[Total: 6]

7 Jeff and Rita investigate a component.



They connect it to three different batteries, measuring the current and voltage each time.

Here are their results.

voltage in volts	current in amps	resistance in ohms
2.8	0.70	
5.9	1.2	4.9
12	1.8	

(a) Complete the table by filling in the two missing values for resistance.

[1]

(b) Jeff says that any changes in the resistance are caused by changes in the current.

Explain whether Jeff's explanation is supported by the results.

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.....

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

(c) Rita knows that the resistance of many electrical components depends on their temperature. She thinks that this might explain the results.

Suggest what they could do to find out who is right.

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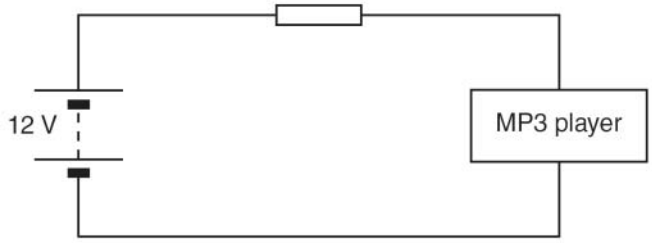
..... **[3]**

[Total: 6]

8 Jo likes to listen to her MP3 player.

She uses this circuit to connect her MP3 player to a 12 V battery.



(a) When the MP3 player is switched on, the potential difference across it is 3.0 V and the current in it is 0.15 A.

Calculate the power of her MP3 player.

Include the unit of power in your answer.

answer = ... **[2]**

(b) The battery supplies a potential difference of 12 V for the circuit.

The potential difference across the MP3 player is only 3 V.

What is the potential difference across the resistor?

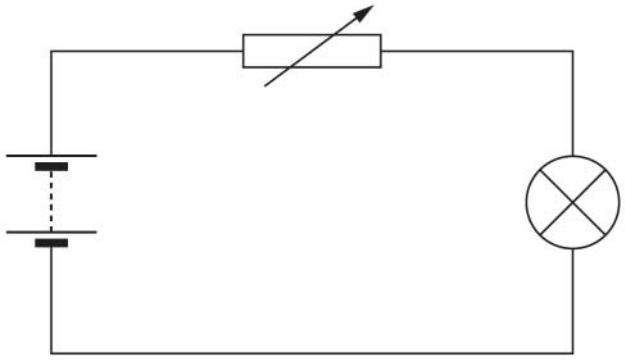
Put a (ring) around the correct answer.

3 V **9 V** **12 V** **15 V**

[1]

[Total: 3]

9 Sylvia sets up this circuit.



(a) Sylvia decides to measure the potential difference across the lamp.

Draw another component on the circuit diagram to show how she could do this.

[1]

(b) Sylvia finds that the potential difference across the lamp reads 4 V. Sylvia asks her friends what this means.

Alan

It tells you about the energy lost by the charge on its way through the lamp.

Bess

It's the rate at which charge passes through the lamp.

Carlo

It tells you how much energy there is in the battery.

Davina

It's the amount of charge in the lamp.

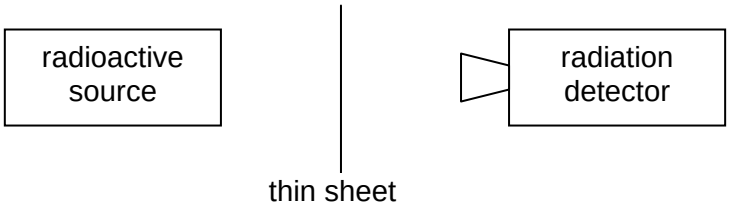
Who gives the correct explanation?

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

[Total: 2]

10 Gordon wants to know whether a thin sheet is made of paper or gold foil.

He places a radioactive source on one side of the sheet. On the other side of the sheet a detector measures the amount of radiation that is received.



Which would be the best type of radiation to use?

Justify your answer.

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

[Total: 3]

11 The annual dose **limit** for a worker in a nuclear power station is higher than for a member of the public.

(a) Why might it be acceptable for workers in the power station to receive a higher dose than members of the public?

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

Members of the public are not exposed to as much radiation. ☐

Nuclear power provides us with energy. This is worth the small risk to the workers. ☐

Workers in a nuclear power station are used to a higher dose. ☐

[1]

(b) What precautions could be taken to sensibly reduce the risk to the workers in a nuclear power station?

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

Not allow the workers to bring any visitors to the power station. ☐

Reduce the number of workers. ☐

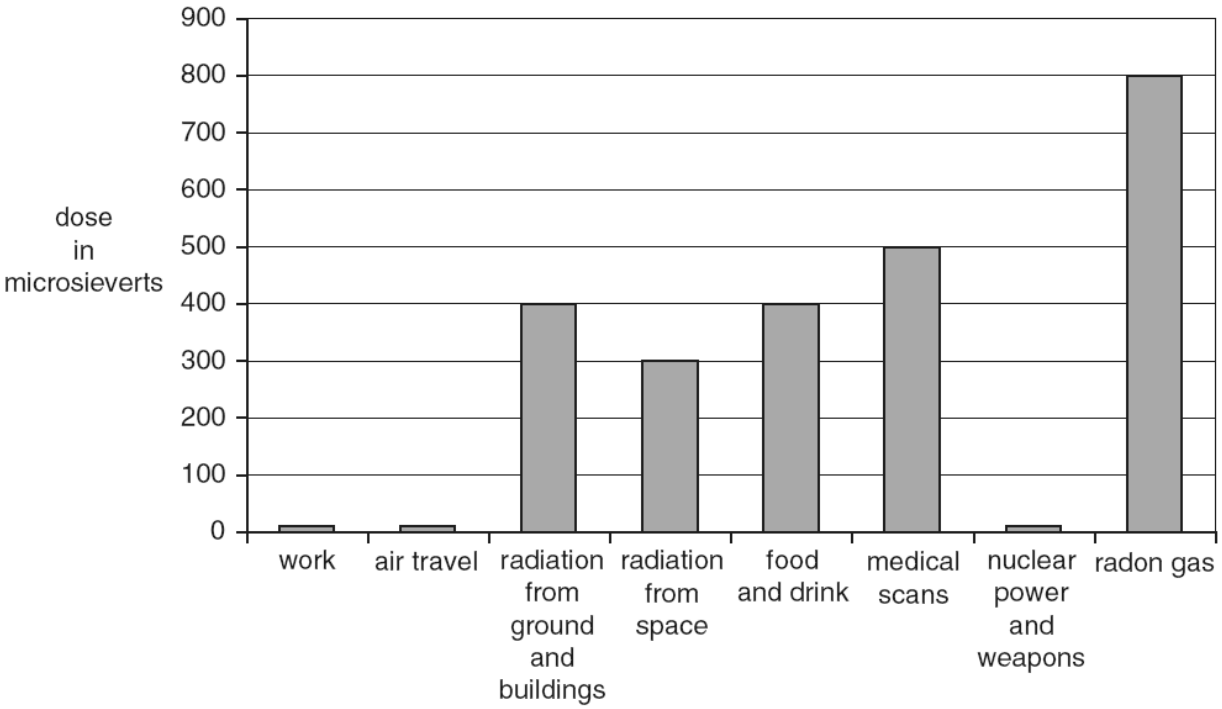
Provide food for the workers that has been sterilised by irradiation. ☐

Use shielding to reduce the level of radiation. ☐

[1]

[Total: 2]

12 The bar chart shows the typical yearly radiation dose for a person in Britain from different sources.



(a) What would be the total radiation dose a typical person in Britain would get from the ground and buildings, and medical scans in a year?

Put a ring around the correct answer. All values are in microsieverts.

100 **400** **500** **900**

[1]

(b) The total for all sources is 2430 microsieverts.

Which of the following statements are correct conclusions **from the bar chart**?

Put ticks (✓) in the boxes next to the **two** correct statements.

Not everyone will have medical scans. ☐

Radon gas provides more than half the total dose. ☐

The fraction of dose received from nuclear power stations is very small. ☐

The dose from radon gas will be different in different parts of Britain. ☐

The dose from food and drink is less than a quarter of the total dose. ☐

[2]

[Total: 3]

13 A nuclear reactor produces radioactive materials for use in hospitals. The radioactive materials are used to treat patients.

Identify the different types of radioactive waste generated by the production and use of these radioactive materials and describe how the waste should be dealt with.

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

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

[Total: 6]

14 Hospitals use a generator containing a radioactive substance called Mo – 99 to make an isotope called Tc – 99 m.

Mo – 99 has a half life of 66 hours.

Tc – 99 m has a half life of 6 hours.

The technician tests a sample from the generator to find out what it contains.

He measures its activity at four different times.

Here are the results.

time of measurement	activity of sample in Bq
06:00h	5200
12:00h	2600
18:00h	1300
24:00h	650

What does the sample contain? Use data from the table to justify your answer.

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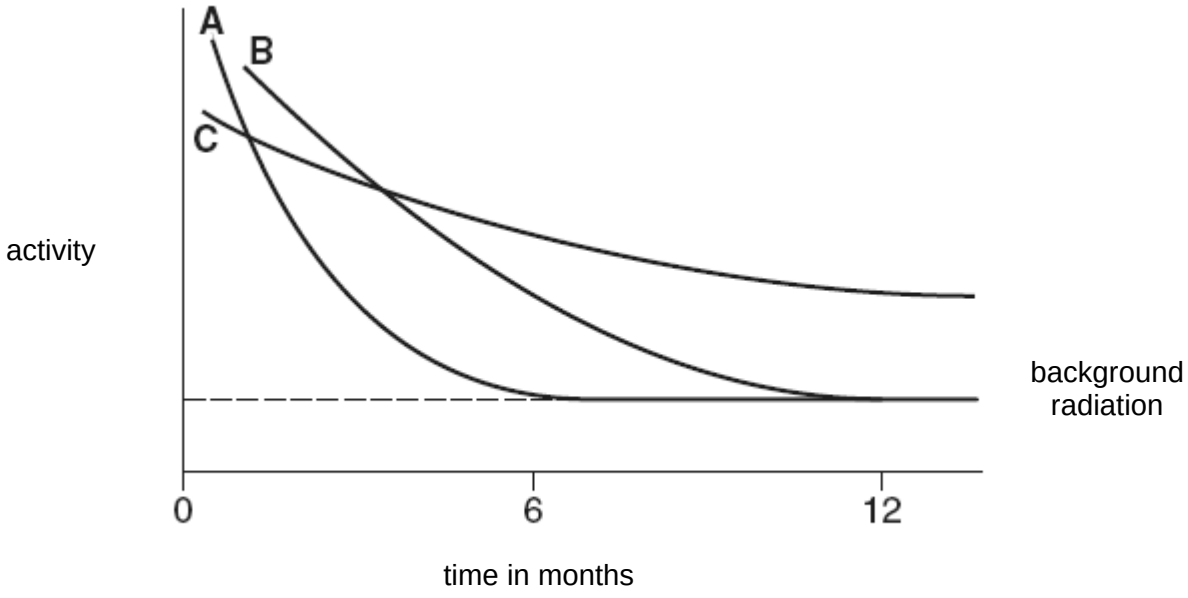
..... **[3]**

[Total: 3]

15 Different radioactive sources are used in hospitals for different purposes.

The graph shows activity over time of three different radioactive sources.



(a) Which radioactive source has the shortest half-life **A**, **B** or **C**? .....

[1]

(b) Which has the most activity after 12 months **A**, **B** or **C**? .....

[1]

(c) Which source is likely to be a long term storage problem **A**, **B** or **C**? .....

[1]

[Total : 3]

[Paper Total: 60]

END OF QUESTION PAPER

OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

PHYSICS A **A182/01**

Unit A182: Modules P4, P5, P6 (Foundation Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

This document consists of 16 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
words	=	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. Annotations:
The following annotations are available on SCORIS.

✓	=	correct response
✖	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt **not** given
ECF	=	error carried forward
^	=	information omitted
I	=	ignore
R	=	reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. 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.

   Eg
   For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	☒
☐	☐	☒
✓	☒	✓
☒	☒	✓
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
- Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
- *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
- *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
- *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Marks	Additional guidance
1	(a)	(i)	speed = 250/20 = 12.5 m/s, so below the speed limit	[1]	
		(ii)	the calculated speed is an average (so lorry could have exceeded the limit at certain points in the journey) but the graph shows that the speed was constant during the time period	[2]	
	(b)	(i)	to get a better value / in case any measurements are wrong	[1]	
		(ii)	(24.5 + 25.2 + 24.9 + 24.8)/4 = 24.85	[1]	**accept** 24.8 or 24.9
		(iii)	result should be checked / ignored / repeated because it is very different from the others	[2]	**accept** "it is an outlier" OWTTE
			Total	[7]	

Question			Expected answers	Marks	Additional guidance
2	(a)		reaction friction	[2]	
	(b)		backwards friction forwards	[3]	
			Total	[5]	

Question			Expected answers	Marks	Additional guidance
3	✎		**[Level 3]** Mentions all three devices. Clearly links reduction in force during a collision to the increase in time needed to change momentum. 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]** Mentions at least two devices that protect passengers during a crash. Includes two out of three points about how they work. 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]** Mentions at least two devices that protect passengers during a crash. Includes one relevant point about how they work. 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:** Safety devices that protect in the event of a crash: • crumple zones • seat belts • air bags How they work: • increase time taken for person to slow down • slowing down momentum change • reducing force on the person **accept** clear descriptions of devices instead of names **ignore** other safety measures such as ABS and traction control that prevent a crash from occurring **ignore** references to impact, pressure or energy
			Total	**[6]**	

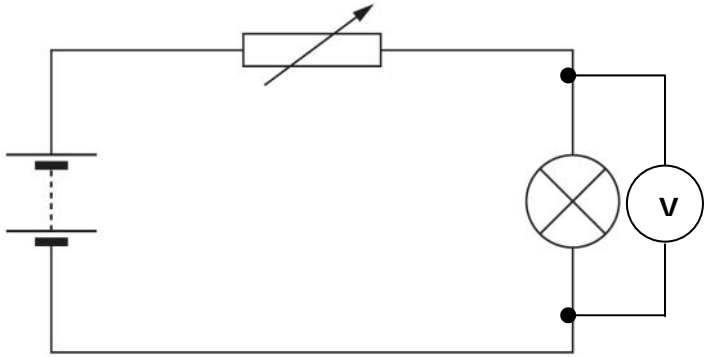
Question			Expected answers	Marks	Additional guidance
4			kinetic energy work	[2]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
5			pressing the switch completes the circuit which allows charges/electrons to move around the circuit / allows the battery to push charges/electrons around the circuit and energy is transferred from the power supply/electrons/charges to the motor	[3]	
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
6	✎		**[Level 3]** Includes all main details and some additional details. 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]** Includes some of the main details and some additional details. 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]** Includes at least one main detail and at least one additional detail. 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:** Main details: • rotate magnet • to alter magnetism / magnetic field of iron / coil • voltage across / current in coil Additional details: • process is called (electromagnetic) induction • voltage keeps on changing / a.c / not d.c • current in components connected to ends of coil • work done turning magnet transfers to electrical energy **accept** charge / electron flow for current **reject** electricity / power as voltage / current / charge
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
7	(a)		0.70 A gives 4.0 Ω, 1.8 A gives 6.7 Ω	[1]	
	(b)		the results show that resistance increases with increasing current / there is a correlation between resistance and current but this (correlation) does not prove Jeff's explanation (without a causal link)	[2]	**accept** resistance depends on current for (1)
	(c)		repeat the experiment with component kept at constant temperature checked with a thermometer	[3]	**accept** effective way of keeping temperature fixed
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
8	(a)		0.45 watts / W	[2]	
	(b)		**9 V**	[1]	
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
9	(a)			[1]	black dot at junction of conductors is ideal, but is not necessary for the mark
	(b)		Alan	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
10			beta radiation because alpha radiation would be stopped by paper and gold foil / would not be sufficiently penetrating and gamma radiation would not be stopped by either / will penetrate both **OR** beta radiation because it will pass through/penetrate paper but will be stopped/will not penetrate gold foil	**[3]**	
			Total	**[3]**	

Question			Expected answers	Marks	Additional guidance
11	(a)		Nuclear power provides us with energy … ☐ ✓ ☐	[1]	
	(b)		☐ ☐ ☐ Use shielding to reduce the level … ✓	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
12	(a)		**900**	**[1]**	
	(b)		The fraction of dose received … ☐ ☐ ☑ ☐ The dose from food and drink … ☑	**[2]**	correct pattern for (2) one mistake for (1)
			Total	**[3]**	

Question			Expected answers	Marks	Additional guidance
13	✎		**[Level 3]** Evaluates production and use of the radioactive materials, and correctly identifies sources for all three types of waste. Suggests how to dispose of them safely. Will give a valid reason why waste needs to be stored carefully. 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]** Evaluates production and/or use of the radioactive materials, and correctly identifies sources for at least two types of waste, perhaps omitting some important details. 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]** Refers to at least one type of waste and a valid disposal method for it. May not give a reason for the need for careful disposal. 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:** • high level <u>only</u> produced in reactor • high level waste is very radioactive • so is stored in ponds of water • until it becomes intermediate waste / less radioactive • hospital produces mostly intermediate • intermediate waste is encased in concrete / glass • and stored in metal drums • under guard / in secure conditions • low level produced at both hospital and reactor • low level waste is put in landfill • with waterproof linings • to keep radioactivity out of ground water • all radioactive waste is harmful / cancerous • becoming less harmful as time goes on **accept** descriptions of type / source of waste instead of names eg nuclear power station giving high level waste. **accept** references to underground burial for intermediate waste
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
14			Tc-99 m because activity drops a lot in the time Mo-99 would hardly change in the time	[3]	 **accept** 2600 is half of 5200 for (1) **accept** 1300 is half of 2600 and 650 is half of 1300 for (1) **accept** half life is 6 hours **accept** cannot say whether Mo is present, as sample only tested for 24 hours for (1)
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
15	(a)		**A**	[1]	
	(b)		**C**	[1]	
	(c)		**C**	[1]	
			Total	[3]	

Assessment Objectives (AO) Grid

(includes quality of written communication✎)

Question	AO1	AO2	AO3	Total
1(a)(i)		1		**1**
1(a)(ii)			2	**2**
1(b)(i)	1			**1**
1(b)(ii)		1		**1**
1(b)(iii)	1	1		**2**
2(a)	2			**2**
2(b)		3		**3**
3✎	5	1		**6**
4	2			**2**
5	3			**3**
6✎	6			**6**
7(a)		1		**1**
7(b)		1	1	**2**
7(c)	1	2		**3**
8(a)	1	1		**2**
8(b)		1		**1**
9(a)		1		**1**
9(b)		1		**1**
10		3		**3**
11(a)		1		**1**
11(b)		1		**1**
12(a)		1		**1**
12(b)			2	**2**
13✎	3	2	1	**6**
14			3	**3**
15		3		**3**
Totals	**25**	**26**	**9**	**60**