OCR RECOGNISING ACHIEVEMENT

SPECIMEN **F**

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

A151/01

ADDITIONAL SCIENCE A

Unit A151: Modules B4, C4, P4 (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
- A list of physics equations is printed on page **2**.
- The Periodic Table is printed on the back page.
- Your quality of written communication is assessed in questions marked with a pencil (✐).
- 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 **24** pages. Any blank pages are indicated.

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

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

Answer **all** the questions.

1 Katy uses the enzyme catalase to break down hydrogen peroxide.

The reaction gives off oxygen gas. She collects this oxygen gas.

Katy investigates the effect of different temperatures on the activity of the enzyme.

(a) Here are Katy's results.

temperature of catalase and hydrogen peroxide in °C	**mean volume of gas collected in 1 minute in cm^3**
20	16
30	35
40	40
90	0

(i) Explain the result obtained at 90 °C.

....

....

.... **[3]**

(ii) Katy was careful to make sure that all factors other than temperature were kept constant in her experiment.

Explain why.

....

....

.... **[2]**

(b) Katy calculated the mean volumes from seven repeats of the experiment at each temperature.

Here are the raw data she collected at 20 °C.

volume of gas collected in 1 minute at 20 °C in cm^3						
14	15	20	16	15	14	18

(i) Calculate the **size** of the range of these raw data.

.... **[1]**

(ii) Katy concludes that the rate of reaction increases from 20°C to 30°C.

What does the size of this range compared to the results suggest about the confidence that Katy should have in her conclusion?

Explain your answer.

....

....

.... **[2]**

(c) Katy repeats the experiment at 20 °C with fresh catalase enzyme.

She uses starch solution instead of hydrogen peroxide solution.

Suggest how much gas she will collect in 1 minute, and **explain** why.

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

....

....

....

....

....

....

....

.... **[6]**

[Total: 14]

2 This question is about respiration.

(a) A number of structures in plant cells have roles in the process of respiration.

Describe the roles of the mitochondria and cytoplasm in respiration.

(i) mitochondria

....

.... **[1]**

(ii) cytoplasm

....

.... **[1]**

(b) Plant cells can carry out **anaerobic** respiration.

Complete the word equation for anaerobic respiration in plants.

glucose → .... + carbon dioxide (+ energy released) **[1]**

(c) Why do human muscle cells sometimes undergo anaerobic respiration during vigorous exercise?

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

The blood does not supply enough glucose to the muscle cells.	☐
Too much blood reaches the muscle cells.	☐
The blood removes too much carbon dioxide from the muscle cells.	☐
The blood supplies too much lactic acid to the muscle cells.	☐
The blood does not supply enough oxygen to the muscle cells.	☐
The blood removes too much water from the muscle cells.	☐

[1]

[Total: 4]

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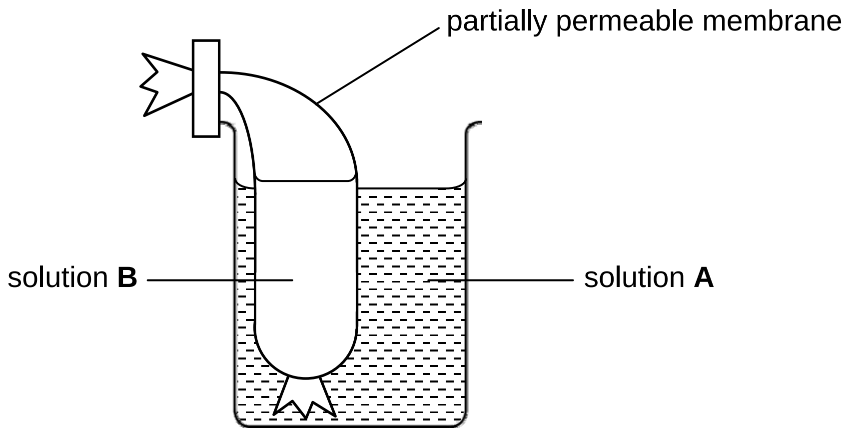
3 Jenny is investigating the diffusion of glucose molecules across a partially permeable membrane.

She uses two solutions of glucose, **A** and **B**, separated by the membrane.



The concentration of glucose in solution **A** is higher than in solution **B**.

She measures the glucose concentration in each solution every two minutes. She records her results in arbitrary units.

time following the start of the investigation in minutes	**glucose concentration in arbitrary units**	
	solution A	**solution B**
2	30	10
4	25	15
6	22	18
8	20	20

(a) **(i)** Between which of these times is there the most movement of glucose from solution **A** to solution **B**?

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

(ii) What does this result tell you about the link between diffusion and concentration difference?

....

.... **[1]**

(b) Look at Jenny's results for solution **A** and solution **B**. The glucose concentrations in the two solutions appear to have balanced by the end of the experiment.

Predict what would happen if Jenny added more glucose to solution **B** at the end of the experiment.

....

.... **[1]**

[Total: 3]

4 The table shows the melting points of some elements in Group 1.

element	**melting point in °C**
lithium	180
sodium	97
potassium	
rubidium	39

(a) Describe the pattern shown by the data in the table.

....

.... **[1]**

(b) Use the data in the table to predict the melting point of potassium.

Draw a ring around the correct answer.

15°C **39°C** **63°C** **75°C** **[1]**

(c) Erica searches on the internet to find out the melting point of potassium.

She finds data from an experiment in which the melting point of potassium was measured five times.

The five results are all different.

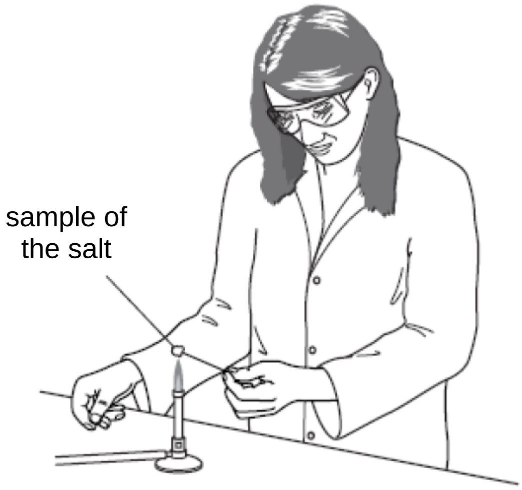
Put ticks (✓) in the boxes next to the **two** statements that explain this.

Websites are always wrong.	☐
We can never be sure that any measurement tells us the true value.	☐
The apparatus used to take the measurements must have been faulty.	☐
If we make several measurements of any quantity, these are likely to vary.	☐

[2]

[Total: 4]

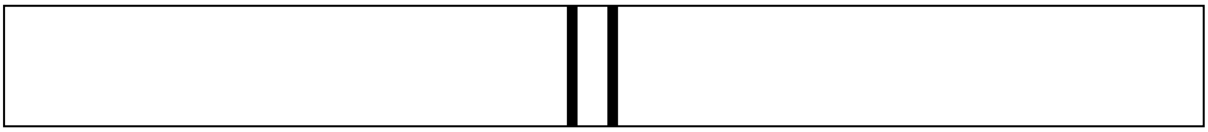
5 Eve tests some salts by doing a flame test.



Eve heats a sodium salt. She sees that it gives off a coloured light.

She looks at the spectrum of light through a spectroscope.

She sees some yellow lines.



yellow lines

Eve then heats a potassium salt and looks at the spectrum of light it gives off.

Write down one **similarity** and one **difference** between the two spectra that Eve sees.

....

....

....

.... **[2]**

[Total: 2]

6 The table shows information about some atoms.

name	**group in Periodic Table**	**electron arrangement**	**number of electrons in outer shell**
lithium	1	2.1	1
sodium	1	2.8.1	
fluorine	7	2.7	7
chlorine	7	2.8.7	7

(a) How many electrons does sodium have in its outer shell?

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

(b) Iodine is another element in Group 7.

(i) Suggest how many electrons iodine has in its outer shell.

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

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

....

....**[1]**

[Total: 3]

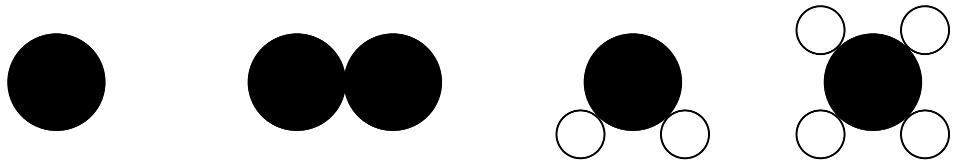
7 This question is about the Group 7 elements, known as the halogens.

(a) The symbol for a bromine molecule is

$$\mathbf{Br_2}$$

Which of the diagrams shows a bromine molecule?

Draw a ring around the correct answer.



[1]

(b) Hot sodium metal will react with halogens in the gas state**.**

(i) A piece of hot sodium metal is put into a jar of chlorine gas.

A fast reaction happens and a white solid salt forms.

Write a word equation for this reaction.

.... **[1]**

(ii) Sodium reacts with other halogens too.

The table shows what happens when hot sodium is put into jars containing different halogen gases.

halogen gas	**appearance of halogen gas at start**	**time for reaction to finish in seconds**	**appearance of product at end**
chlorine	pale green	5	white solid
bromine			
iodine	purple	15	white solid

Complete the table to describe what you would see when sodium is put into a jar containing bromine gas. **[2]**

(c) Alex makes some cards to show the properties of chlorine and bromine.

Chlorine

State: gas at room temperature and pressure
Boiling point: -35 °C
Hazard: Toxic
Notes:
Chlorine is a halogen. It is the **second** most reactive element in Group 7.

Bromine

State: liquid at room temperature and pressure
Boiling point: 59 °C
Hazard: Toxic and corrosive.
Notes:
Bromine is a halogen. It is the **third** most reactive element in Group 7.

Alex wants to use either chlorine or bromine in an experiment at school.

She wants to choose the safest chemical.

Discuss which of these chemicals Alex should choose. Give reasons for your choice.

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

....

....

....

....

....

....

....

.... **[6]**

[Total: 10]

8 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.

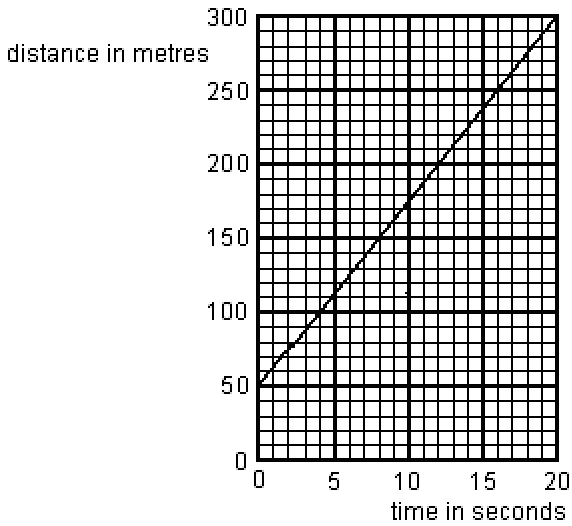
(i) Calculate the speed of the lorry, and decide whether the lorry is within the speed limit.

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.

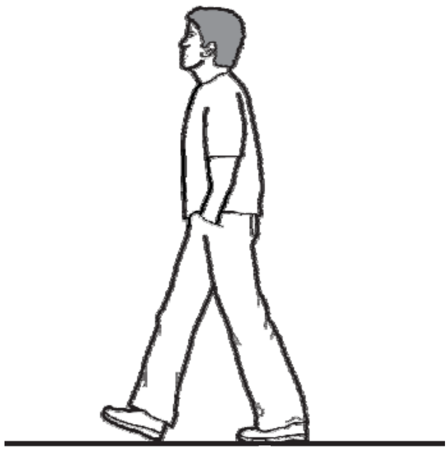
....

....

....**[2]**

[Total: 7]

9 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.

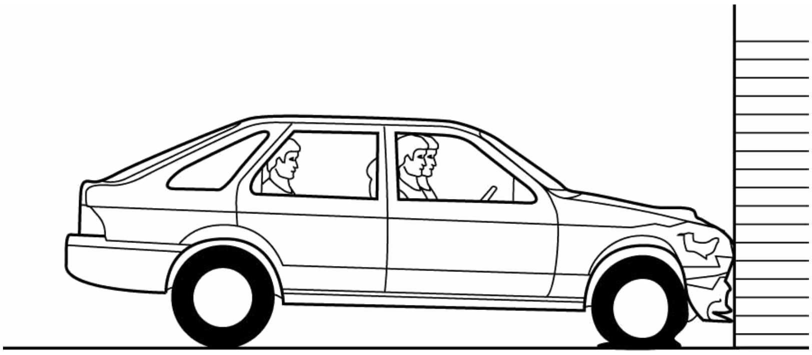
The foot does not slip because of ....

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

[3]

[Total: 5]

10 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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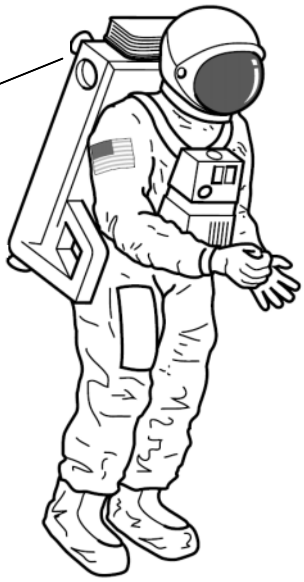
....**[6]**

[Total: 6]

11 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]

[Paper Total: 60]

END OF QUESTION PAPER

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Periodic Table

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

SPECIMEN **F**

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

Unit A151: Modules B4, C4, P4 (Foundation Tier)

A151/01

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
<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

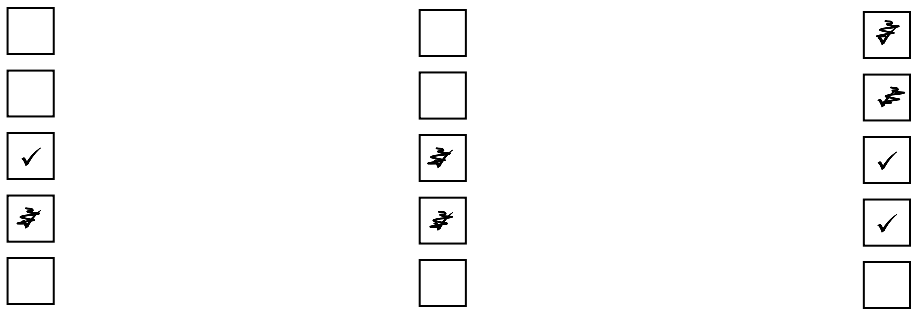
5. Annotations:
   The following annotations are available on SCORIS.

✓	=	correct response
✗	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt <u>**not**</u> 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)	**any three from:** the enzyme has <u>permanently</u> stopped working because the <u>active site</u> has changed shape (due to the high temperature), so hydrogen peroxide no longer fits so the enzyme cannot break down hydrogen peroxide to produce oxygen gas / the reaction cannot occur	[3]	**ignore** references to experimental error **credit** "the enzyme has been denatured"
		(ii)	so that she could obtain repeatable/reproducible results and could say for certain that temperature was causing the change in results because only the temperature varied	[2]	**ignore** reference to fair test
	(b)	(i)	6	[1]	**reject** "14 to 20"
		(ii)	the range is smaller than the differences between the mean results at 20°C and 30°C / the range does not overlap with the (mean) result at 30°C which increases confidence in the conclusion	[2]	**accept** confidence is decreased because the range is large compared to the (mean) result at 30°C / owtte for maximum of 1 mark

Question			Expected answers	Marks	Additional guidance
	(c)		**[Level 3]** Answer correctly predicts that no gas will be collected and uses details of the 'lock and key' model in the correct order to explain why, with correct explanation of substrate/active site specificity. 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 correctly predicts that no gas will be collected and describes some details of the 'lock and key' model, but may omit some details and/or not make the correct order clear. Substrate specificity may be mentioned but not clearly explained. 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]** Answer correctly predicts that no gas will be collected and may reference the 'lock and key hypothesis' by name or simply state that starch "will not fit" but does not explain any of the details. 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:** • she will not collect any gas • because catalase has an active site • and only the hydrogen peroxide (molecule) is the correct shape to fit into the active site • starch will not fit, so will not form an enzyme-substrate complex • so the reaction will not occur / starch will not be broken down • and no oxygen gas will be formed • this is the 'lock and key' model
			Total	**[14]**	

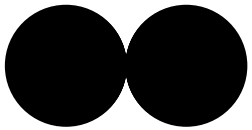
Question			Expected answers	Marks	Additional guidance
2	(a)	(i)	contains enzymes for the reactions in aerobic respiration	[1]	**accept** site of aerobic respiration
		(ii)	where enzymes are made for respiration / contains enzymes used in anaerobic respiration	[1]	**accept** site of anaerobic respiration
	(b)		ethanol	[1]	**accept** phonetic spellings
	(c)		The blood does not supply enough glucose to the muscle cells. ☐ Too much blood reaches the muscle cells. ☐ The blood removes too much carbon dioxide from the muscle cells. ☐ The blood supplies too much lactic acid to the muscle cells. ☐ The blood does not supply enough oxygen to the muscle cells. ✓ The blood removes too much water from the muscle cells. ☐	[1]	
			Total	**[4]**	

Question			Expected answers	Marks	Additional guidance
3	(a)	(i)	2 and 4	[1]	
		(ii)	the amount of diffusion is greater when the concentration difference is greater	[1]	
	(b)		glucose <u>molecules</u> would <u>diffuse</u> across into solution **A** until they balance / reach equilibrium	[1]	
			Total	**[3]**	

4	**(a)**		melting point decreases down the group	**[1]**	
	(b)		**63°C**	**[1]**	
	(c)		Websites are always wrong. ☐ We can never be sure that any measurement tells us the true value. ✓ The apparatus used to take the measurements must have been faulty. ☐ If we make several measurements of any quantity these are likely to vary. ✓	**[2]**	
			Total	**[4]**	

Question			Expected answers	Marks	Additional guidance
5			the similarity is that they will both have lines the difference is that the lines will be different colours / the lines will be in different places / the lines will be in a different pattern	[2]	
			Total	**[2]**	

6	(a)		1	[1]	
	(b)	(i)	7	[1]	
		(ii)	the group number and the number of electrons in the outer shell of an atom are the same	[1]	
			Total	**[3]**	

7	(a)			[1]	
	(b)	(i)	**sodium + bromine → sodium bromide** equation shown fully correct	[1]	
		(ii)	orange gas at start and white solid at end reaction takes 8-12 s / slower than iodine but faster than chlorine	[2]	

<table>
<tr><th colspan="3">Question</th><th>Expected answers</th><th>Marks</th><th>Additional guidance</th></tr>
<tr><td>7</td><td>(c)</td><td>✎</td><td>[Level 3]
Answer clearly compares all relevant properties of the two chemicals and how these properties impact on safe use, and indicates a clear choice logically linked to this comparison. All information in the 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 compares some of the properties of the two chemicals and how these properties impact on safe use, and indicates a choice. 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]
Answer compares one property of the chemicals and indicates a choice OR answer compares one or more of the properties but does not reach a conclusion. 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)</td><td>[6]</td><td>relevant points include:

comparison of states/boiling points
• chlorine will be a gas (at room temperature/pressure)
• so chlorine may
be (more) difficult to contain/use
need to used in a fume cupboard
escape/be inhaled
• bromine , will be a liquid (at room temperature/pressure) / has a higher boiling point
• so bromine may
be easier to contain/use
be used without a fume cupboard
be spilt on skin/clothes

comparison of hazards
• both are toxic
• bromine is also corrosive

comparison of reactivity
• bromine is less reactive

ignore references to both of the chemicals being halogens</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[10]</td><td></td></tr>
</table>

Question			Expected answers	Marks	Additional guidance
8	**(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]**	

9	**(a)**		reaction friction	**[2]**	
	(b)		backwards friction forwards	**[3]**	
			Total	**[5]**	

Question			Expected answers	Marks	Additional guidance
10		✎	**[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
11			kinetic energy work	**[2]**	
			Total	**[2]**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)(i)		3		**3**
1(a)(ii)		2		**2**
1(b)(i)		1		**1**
1(b)(ii)		1	1	**2**
1(c)✎	2	4		**6**
2(a)(i)	1			**1**
2(a)(ii)	1			**1**
2(b)	1			**1**
2(c)	1			**1**
3(a)(i)		1		**1**
3(a)(ii)			1	**1**
3(b)			1	**1**
4(a)		1		**1**
4(b)		1		**1**
4(c)	2			**2**
5	1	1		**2**
6(a)	1			**1**
6(b)(i)	1			**1**
6(b)(ii)	1			**1**
7(a)		1		**1**
7(b)(i)	1			**1**
7(b)(ii)	1	1		**2**
7(c)✎		4	2	**6**
8(a)(i)		1		**1**
8(a)(ii)			2	**2**
8(b)(i)	1			**1**
8(b)(ii)		1		**1**
8(b)(iii)	1	1		**2**
9(a)	2			**2**
9(b)		3		**3**
10✎	5	1		**6**
11	2			**2**
Totals	**25**	**28**	**7**	**60**

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