

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

A143/02

SCIENCE A

Unit A143: Modules B3, C3, P3 (Higher Tier)

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

OCR Supplied Materials:

None

Duration: 1 hour

Other Materials Required:

- Pencil
- Ruler (cm/mm)

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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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	3	
2	6	
3	4	
4	4	
5	3	
6	8	
7	4	
8	8	
9	2	
10	4	
11	2	
12	6	
13	6	
TOTAL	60	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

$$\text{distance} = \text{wave speed} \times \text{time}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Sustainable Energy

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

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

Explaining Motion

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

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

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

Electric Circuits

$$\text{power} = \text{voltage} \times \text{current}$$

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

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

Radioactive Materials

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

Answer **all** the questions.

1 (a) Read the newspaper article.

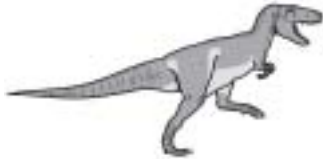

Are birds dinosaurs?

Tyrannosaurus rex (*T. rex*) is the most famous of all dinosaurs.

A 68-million-year-old fossil of a *T. rex* bone was found that still contained seven proteins.

Three of the proteins were very similar to proteins found in birds and chickens. Two others were similar to proteins found in different animals.

Some scientists have suggested that birds evolved from dinosaurs.

The article contains a hypothesis (a scientific explanation). The hypothesis suggests that birds evolved from dinosaurs.

Some observations in the article support the hypothesis.

Put a tick (✓) in each row to show whether the observation **increases confidence in the hypothesis**, **decreases confidence in the hypothesis** or **neither**.

observation	increases confidence in the hypothesis	decreases confidence in the hypothesis	neither
Seven proteins were extracted from a <i>T. rex</i> fossil.			
Three proteins from <i>T. rex</i> were similar to the proteins found in chickens.			
Two proteins from <i>T. rex</i> were similar to proteins found in other animals.			

[1]

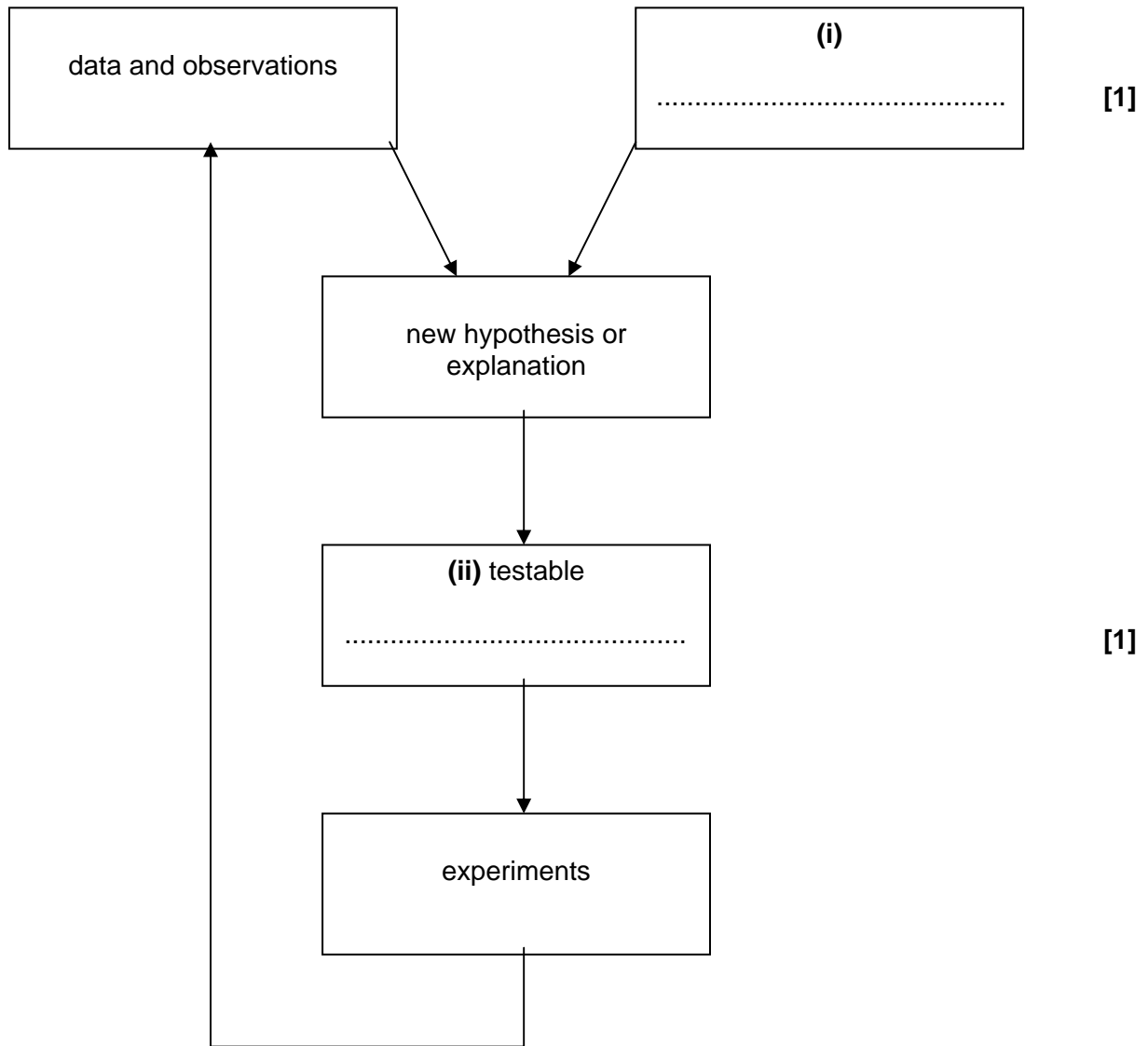
(b) The flow chart shows how science explanations change and develop.

Complete the flow chart by writing the answers to questions **(i)** and **(ii)** in the correct places.

Write the answers in the empty boxes in the flow chart.

(i) What is needed to produce an explanation, other than data and observations?

(ii) What does the new explanation give that can be tested by an experiment?



[2]

[Total: 3]

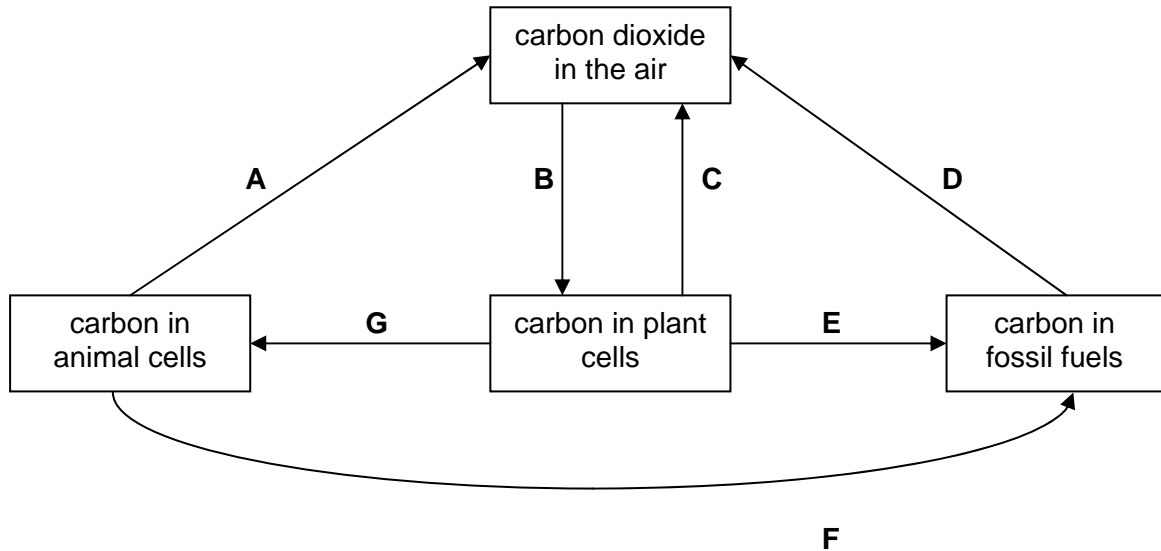
3 (a) The amount of carbon dioxide in the atmosphere has increased during the past 200 years. Which of the following changes would slow down the increase of carbon dioxide in the atmosphere?

Put a tick (✓) in the box next to the **two** correct answers.

- Stop burning forests to clear the land.
- Plant more grassland for cattle and sheep.
- Cut back on the use of fossil fuels as a source of energy.
- Use wind power instead of nuclear power to generate electricity.
- Find new sources of oil and gas to replace the ones that are running out.

[2]

(b) The diagram shows part of the carbon cycle.



(i) Which **two** arrows from **A, B, C, D, E, F** and **G**, show respiration?

arrowsand [1]

(ii) Which arrow, **A, B, C, D, E, F** or **G**, shows combustion?

arrow [1]

[Total: 4]

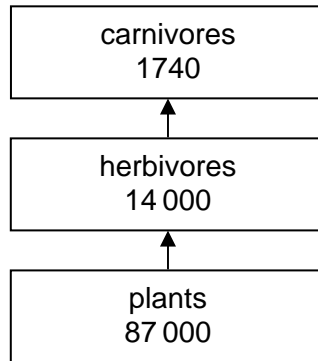
4 A scientist studied food chains in a river system in Florida, USA.

She calculated the energy in three feeding levels that she identified

- plants
- herbivores
- carnivores.

She was unable to find evidence for the existence of any further feeding levels.

The values she calculated for each feeding level are shown in the diagram in $\text{kJ} / \text{m}^3 / \text{year}$.



A study 10 years earlier had identified the presence of a fourth feeding level in this river system. This was due to the presence of a small population of top carnivores.

The percentage of the energy in the carnivores that was transferred to the top carnivores was only just enough to allow the top carnivores to survive. The energy in the top carnivores was $300 \text{ kJ} / \text{m}^3 / \text{year}$.

The scientist concluded from the data in her current study that it was very unlikely that the top carnivores were still present in the river system.

Discuss whether this conclusion is valid. You may use calculations in your answer.

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[4]

[Total: 4]

5 Scientists are studying an island in the Pacific Ocean.

Several years ago, an area of forest on the island was chopped down. A palm oil plantation was created in place of the forest.

The palm oil plantation is an example of a monoculture.

The table gives information about the island before and after the palm oil plantation was created.

	before plantation was created	after plantation was created
number of bird species	460	432
number of mammal species	194	186
number of plant species	9 562	8 134
number of reptile species	217	217
unemployment (% of total population)	14	9
income to the island (million dollars per year)	132	156

The Government is considering whether to create two more palm oil plantations on the island.

Should the extra plantations be created? Justify your answer.

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..... [3]

[Total: 3]

6 A website gives information about salt in the diets of children.

The daily maximum amount of salt for children depends on their age.		
1 to 3 years	-	2 g salt per day
4 to 6 years	-	3 g salt per day
7 to 10 years	-	5 g salt per day
11 years old and over	-	6 g salt per day

(a) John is 5 years old.

For his dinner he eats

- one 200 g hamburger, which contains 1.89 g salt
- 225 g baked beans, which contain 2.98 salt.

What advice would you give to John’s mother about his salt intake? Justify your answer.

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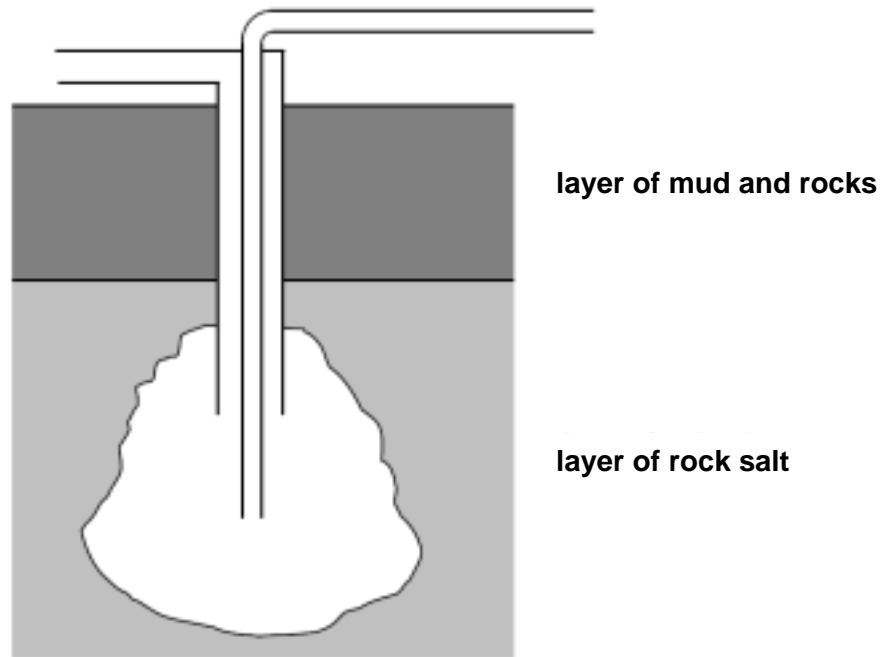
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..... [2]

- 7 Salt is found underneath the ground in some parts of the UK.
It can be obtained by solution mining.



- (a) The diagram shows part of the process for solution mining of salt.

Here are some statements about solution mining of salt.

Not all of the statements are correct, and they are in the wrong order.

- A Water dissolves the salt.
- B Water is pumped down the inner and outer pipes.
- C Water is pumped down the outer pipe.
- D Salt solution is pumped to the chemical plant when required.
- E Salt solution is stored above the ground.
- F Rock salt is dug out of the cavern.
- G Pressure pushes salt solution up to the surface.

Choose the correct steps and then fill in the boxes to show the right order.

One has been done for you.

				D
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[2]

(b) Describe ways that solution mining can affect the environment near the mine.

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[2]
[Total: 4]

- 8 Some people have milk delivered to their houses. The milk is contained in glass bottles. When the glass bottles are empty they are collected, cleaned and re-used. Other people buy milk in plastic bottles from the supermarkets. When the milk has been used the plastic bottles are thrown away.



glass bottle



plastic bottle

The table gives information about the energy used to make glass bottles and plastic bottles. It also gives information about the energy used in washing, filling and delivering the bottles.

	energy used in MJ	
	re-usable glass bottle	non-reusable plastic bottle
manufacturing the bottle	7.2	4.7
washing, filling and delivering the bottle	2.5	2.2

- (a) Show that using a re-usable glass bottle **twice** needs less energy than using **two** non-reusable plastic bottles.

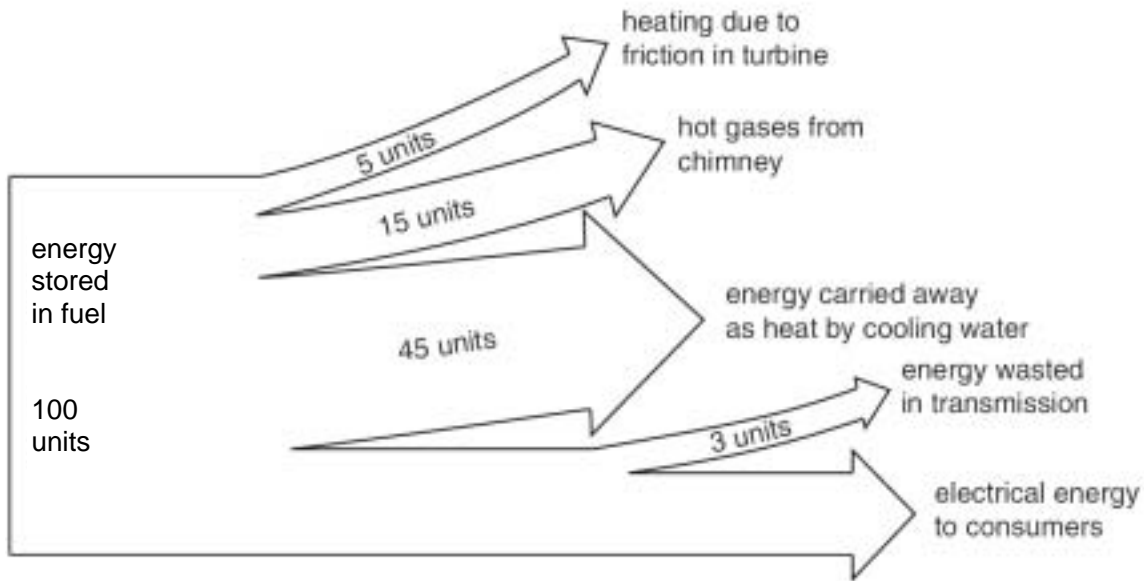
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..... [2]

9 Generating and distributing electricity is not 100 % efficient.

Look at this diagram for electricity generation by a fossil fuel power station.



(a) How many units of electricity go to the consumers?

answer units [1]

(b) What is the efficiency of the power station?

Put a **ring** around the correct answer.

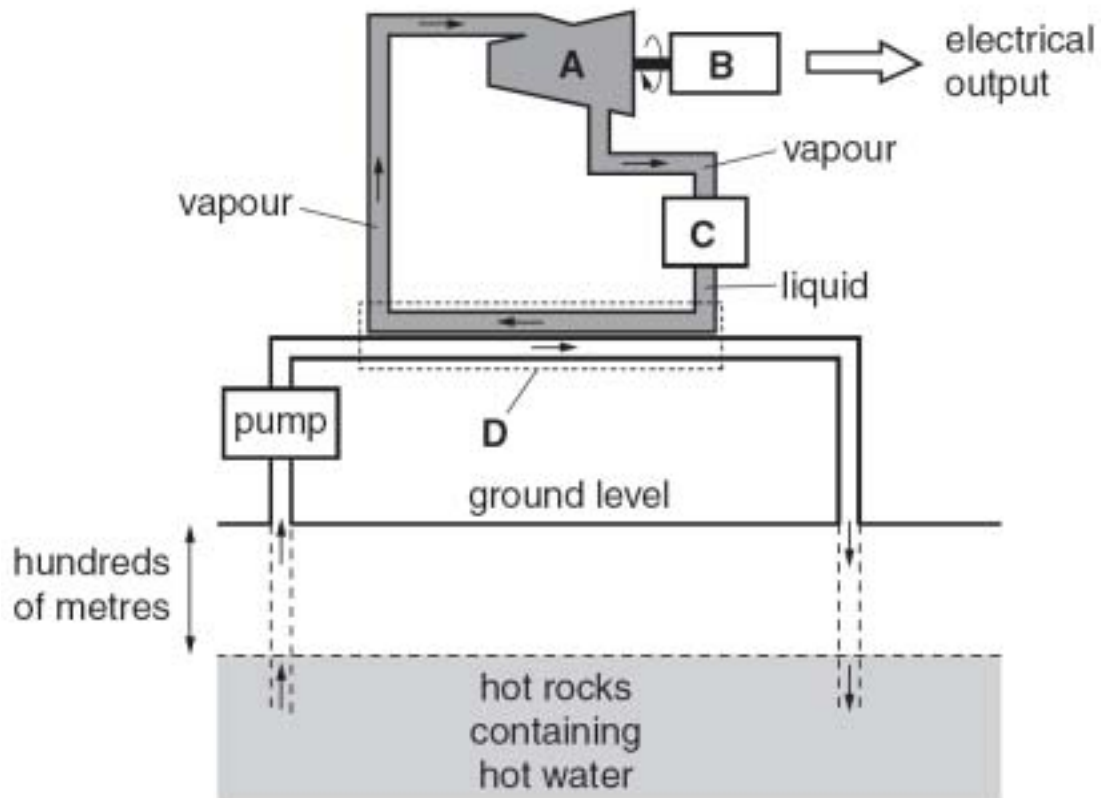
- 3 % 35 % 45 % 54 % 65 %

[1]

[Total: 2]

10 (a) The diagram shows one type of geothermal power station.

The power station gets its energy from hot rocks deep underground.



The following statements describe the energy flow in a geothermal power station.

They are not in the correct order, and they are not all correct.

- V A condenser, **C**, turns vapour into a liquid.
- W A magnet rotates inside the turbine, producing a voltage across a coil of wire.
- X Vapour turns a turbine, which turns a generator.
- Y Hot water passes along pipes into a heat exchanger, **D**, where it boils an organic liquid.
- Z Water is pumped from hot rocks deep underground.

Choose the correct statements and write the letters in the correct order in the boxes below.

Z			
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[1]

(b) The government is planning to build a new power station.



The table gives some information about three different types of power station.

type of power station	efficiency	cost of generating electricity per kWh in pence	environmental factors
coal	38%	2 to 3	produces carbon dioxide
nuclear	34%	2 to 2.5	produces radioactive waste
wind	35%	4 to 5.5	can damage local wildlife eg birds

Which type of power station would you recommend building?

Justify your choice, using **only** information from the table.

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..... [3]

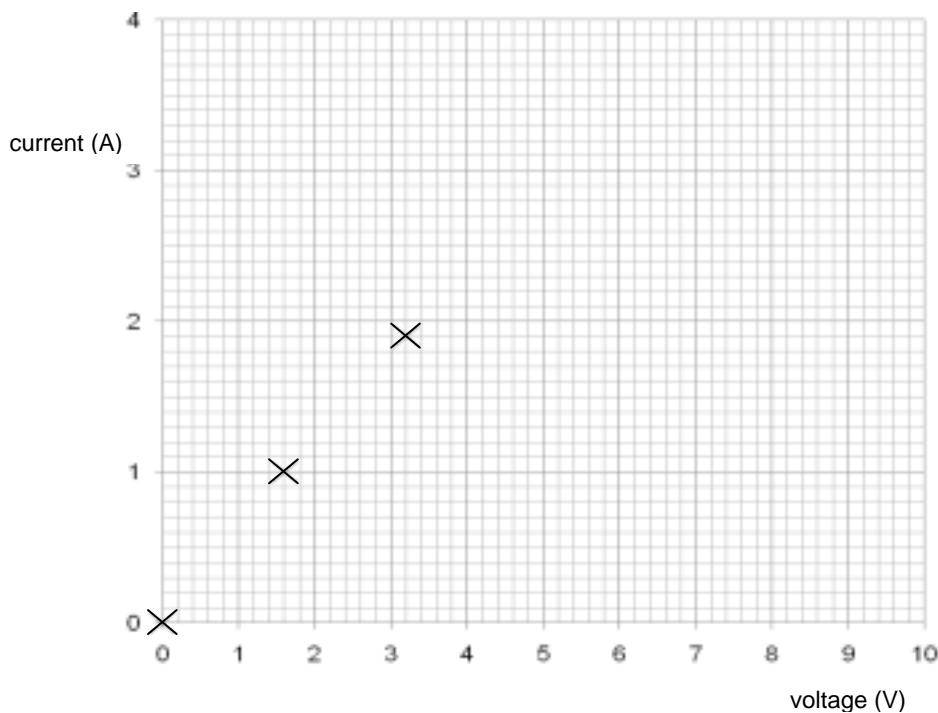
[Total: 4]

13 Mary and John are doing an experiment to measure the power in a wire.

They measure the electrical current through a wire at different voltages.

voltage in V	0	1.6	3.2	6.2	8.0	9.4
current in A	0.0	1.0	1.9	3.0	3.3	3.4

(a) Plot the data onto the graph. The first three points have been plotted for you.



[1]

(b) Draw a best fit curve for the data, and describe the pattern shown.

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..... [3]

(c) Use your graph to find the electrical power of the lamp when the voltage is 5 V.

power = W [2]

[Total: 6]

[Paper Total: 60]

END OF QUESTION PAPER

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TWENTY FIRST CENTURY SCIENCE

SCIENCE A

A143/02

Unit A143: Modules B3, C3, P3 (Higher Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

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

E.g. 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.

E.g.

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

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth 0 marks.

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth one mark.

Put ticks (✓) in the two correct boxes.

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

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.

E.g. 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	✓	x	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	x		✓		✓	✓		✓	
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)	<table border="1"> <thead> <tr> <th>observation</th> <th>increases</th> <th>decreases</th> <th>neither</th> </tr> </thead> <tbody> <tr> <td>seven</td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>three</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>two</td> <td></td> <td>✓</td> <td></td> </tr> </tbody> </table>				observation	increases	decreases	neither	seven			✓	three	✓			two		✓		[1]	three correct indications of choice and the other six boxes blank for this mark
observation	increases	decreases	neither																				
seven			✓																				
three	✓																						
two		✓																					
	(b) (i)	imagination				[1]	accept synonyms or paraphrases, eg creativity, insight, intuition, thinking outside the box, innovation, (new) ideas accept aspects of training eg knowledge reject evidence, data, measurements or the like																
	(ii)	predictions				[1]	accept synonyms or paraphrases, eg saying what you expect to happen accept theory here also (predictions are an aspect of a theory) reject hypothesis, model, new ideas. must imply predictions as part of the idea.																
		Total				[3]																	

Question	Expected answers	Marks	Additional guidance
2 	<p>[Level 3] Correctly uses ideas about natural selection to clearly explain how these changes could have occurred. 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)</p> <p>[Level 2] Some aspects of natural selection correctly described, but only some are used to provide an explanation of the changes. 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)</p> <p>[Level 1] Aspects of natural selection correctly described, but not clearly used to explain the changes. 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)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>valid points include:</p> <ul style="list-style-type: none"> • (random) mutations cause fish to not make pigment and/or not develop eyes • in caves there is no (or little) light, so fish would not be able to see, would not be able to be seen, and would not need protection from (strong) sunlight • therefore lack of eyes and pigment give no disadvantage • can save resources by not producing pigment / eyes • these resources can be used for growth/movement etc • this is an advantage <ul style="list-style-type: none"> • idea that advantage = fitness • fitness allows each form to survive / breed more successfully / increase in number • this is natural selection <ul style="list-style-type: none"> • over time, blind form only in caves / normal form only in rivers
	Total	[6]	

Question		Expected answers	Marks	Additional guidance
3	(a)	<p>Stop burning forests <input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p>Cut back on the use of fossil fuels <input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>	[2]	one mark for each correct tick three ticks deduct one mark four or five ticks = 0 marks
	(b) (i)	A <u>and</u> C	[1]	both required, any order
	(ii)	D	[1]	
Total			[4]	
4		<p><i>Conclusion is <u>valid</u> because:</i></p> <p>calculation to show that % of energy in plants transferred to herbivores is around 16%</p> <p>calculation to show that % of energy in herbivores transferred to carnivores is around 12%</p> <p>assume that % of energy in carnivores transferred to top carnivores likely to be 12% or less (because it decreases with each transfer up the food chain)</p> <p>if 12% transferred (which is best case scenario), energy in top carnivores would be around 209 kJ / m³ / year, which is not enough to allow them to survive</p>	[4]	no mark for saying valid
Total			[4]	

Question	Expected answers	Marks	Additional guidance
5	<p>Yes: any three from: unemployment would be (further) reduced; income to island would be (further) increased; loss of species not significant / only small reductions / some species (ie lizards) not affected at all; benefits (to humans) outweigh costs to biodiversity;</p> <p>No: any three from: importance of maintaining biodiversity; first plantation caused loss of species, more plantations could cause even more loss; some species lost may be unique to the island, hence loss = extinction; gains in employment and income do not outweigh losses in biodiversity.</p>	[3]	no marks for "yes" or "no"
	Total	[3]	

Question		Expected answers	Marks	Additional guidance
6	(a)	salt eaten = $1.89+2.98 = 4.87$ g = more than the daily maximum for a five year old (1) John's salt intake should be reduced / choose foods lower in salt / owtte (1)	[2]	
	(b) 	<p>[Level 3] Answer clearly considers (perceived) risks versus (perceived) benefits in the argument <i>against</i> lowering salt, and in the argument <i>for</i> lowering salt. 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)</p> <p>[Level 2] Answer for the most part considers (perceived) risks and (perceived) benefits on both sides of the argument. 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 may be occasional errors in grammar, punctuation and spelling. (3 - 4 marks)</p> <p>[Level 1] Answer shows a limited consideration of (perceived) risks and (perceived) benefits, but may not address both sides of the argument. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling may be intrusive. (1 – 2 mark)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <p>Food companies may not want to lower the amount of salt in their food because</p> <ul style="list-style-type: none"> • (the companies think) the cost of reformulating recipes / cost of removing salt / risk of decreased sales (due to poorer taste / shorter shelf life) outweighs benefits to health • (the companies think) the benefits of taste and preservative outweigh (perceived) risk(s) to health. <p>Food companies should be made to lower the amount of salt in their foods because</p> <ul style="list-style-type: none"> • Too much salt in a diet increases the risk of high blood pressure, heart disease and strokes • risk / cost of ill health outweighs benefits of adding salt • benefit to population outweighs, risk / cost, to food companies.
		Total	[8]	


Question		Expected answers	Marks	Additional guidance
7	(a)	C A G E	[2]	C A in correct place = 1 mark G E in correct place = 1 mark
	(b)	land collapses into mine (1) subsidence affects buildings / structures / habitats (1)	[2]	
Total			[4]	

Question		Expected answers	Marks	Additional guidance
8	(a)	glass bottle used twice uses $7.2 + 2.5 + 2.5 = 12.2\text{MJ}$ 2 plastic bottles use $2(4.7 + 2.2) = 13.8\text{MJ}$	[2]	
	(b)	any two pairs from: environmental impact of obtaining raw materials ; suggestion of how this will be different for glass and plastic bottles ; making and using the product ; suggestion of how this will be different for glass and plastic bottles ; using resources (including water) ; suggestion of how this will be different for glass and plastic bottles ;	[4]	credit any reasonable suggestion credit any reasonable suggestion credit any reasonable suggestion
	(c)	because plasticizers (1) can leach out into the surrounding ground (1)	[2]	For full marks the marking points must be coherently linked
Total			[8]	

Question		Expected answers	Marks	Additional guidance				
9	(a)	32	[1]					
	(b)	35 %	[1]					
Total			[2]					
10	(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>(Z)</td> <td>Y</td> <td>X</td> <td>V</td> </tr> </table>	(Z)	Y	X	V	[1]	all correct for the mark
(Z)	Y	X	V					

Question		Expected answers	Marks	Additional guidance
	(b)	<p><i>coal:</i> because it is the most efficient (1) and has one of lowest costs / is cheaper than wind power (1) and these benefits outweigh the disadvantage/environmental cost of producing carbon dioxide (1)</p> <p>OR</p> <p><i>nuclear:</i> because it has the lowest cost / is cheaper than coal and wind power (1) and this benefit outweighs the disadvantage/ environmental cost of producing radioactive waste (1) and outweighs the low efficiency (1)</p> <p>OR</p> <p><i>wind:</i> because it is more efficient than nuclear (1) highest costs / expensive to produce but does not significantly harm the environment / is least damaging to the environment (1) and these benefits outweigh the high cost of generation (1)</p>	[3]	<p>candidates may choose any type of power station; no marks are awarded for the choice itself, only for the justification of the choice</p> <p>ignore references to any factors not described in the table (eg carbon capture in coal power stations, production of radioactive materials for medical use in nuclear power stations, wind turbines being a 'blot on the landscape', etc.)</p>
		Total	[4]	

Question		Expected answers	Marks	Additional guidance
11		<p>the power of the kettle must be much greater than light bulb (1) because energy transferred depends on power and time / $E = Pt$ (1)</p>	[2]	accept reference to larger current through kettle (as power = current x voltage)
		Total	[2]	

Question	Expected answers	Marks	Additional guidance
12 	<p>[Level 3] Most relevant points are present. A balanced argument is provided recognising the different points of view of local people, environmentalists and energy providers. The difference between real risk and perceived risk is discussed. 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)</p> <p>[Level 2] A balanced discussion is attempted, but significant aspects of the 'pros' or cons' in the views of different groups, and the difference between real and perceived risk, may be omitted. May confuse chemical and radioactive poisoning. 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)</p> <p>[Level 1] Recognises that waste is hazardous, but does not explain why. A balanced answer is not attempted. 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)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>Relevant points include:</p> <ul style="list-style-type: none"> • uranium/nuclear fuel is a non-renewable energy source • waste is radioactive • radiation can cause cell damage / cancer • remains radioactive for a very long time • large amounts of energy from little fuel • little CO₂ produced • small environmental impact (compared to coal / oil etc) • Government responsible for regulation • perceived risk may seem high to people near waste sites • real risk may seem low to people far away • radiation is 'invisible' <p>accept hazards of terrorist attack waste can contaminate water supplies / soil / etc. must be kept securely for a long time in eg deep secure sites</p> <p>ignore arguments based on safety of power stations (Chernobyl, Japan etc)</p> <p>reject explosion or other confusion with nuclear bomb</p>
	Total	[6]	

Question		Expected answers	Marks	Additional guidance
13	(a)	points at (6.2, 3.0), (8.0, 3.3) & (9.4, 3.4)	[1]	all within one minor scale division along each axis for the mark
	(b)	best fit curve current increases <u>non-uniformly</u> as voltage increases increase in current becomes less and less as voltage increases	[3]	by eye; should be smooth with no inflections 'current increases' is not enough second and third marking points could be earned in a single statement.
	(c)	current = 2.6 (A) power = 2.6 A × 5.0 V = 13 W	[2]	consistent with candidate's own graph ecf own current reading
Total			[6]	

Assessment Objectives (AO) Grid

(includes quality of written communication )

Question	AO1	AO2	AO3	Total
1(a)		1		1
1(b)(i)	1			1
1(b)(ii)	1			1
2		6		6
3(a)	2			2
3(b)(i)	1			1
3(b)(ii)	1			1
4		2	2	4
5		1	2	3
6(a)		1	1	2
6(b)	2	2	2	6
7(a)	1	1		2
7(b)	2			2
8(a)		2		2
8(b)	2	2		4
8(c)	2			2
9(a)		1		1
9(b)		1		1
10(a)		1		1
10(b)			3	3
11	1	1		2
12	4	2		6
13(a)		1		1
13(b)	1	2		3
13(c)	1	1		2
Totals	22	28	10	60

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