OCR
RECOGNISING ACHIEVEMENT

SPECIMEN   H

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

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	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

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x current

efficiency = $\dfrac{\text{energy usefully transferred}}{\text{total energy supplied}}$ x 100%

Explaining Motion

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

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

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

kinetic energy = $\dfrac{1}{2}$ x mass x [velocity]^2

Electric Circuits

power = voltage x current

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

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

Radioactive Materials

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

Answer **all** the questions.
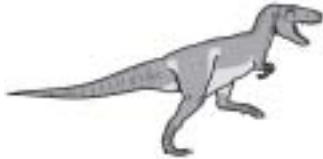
1 (a) Read the newspaper article.

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 *T. rex* fossil.			
Three proteins from *T. rex* were similar to the proteins found in chickens.			
Two proteins from *T. rex* 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?

data and observations	**(i)**
	.... **[1]**

new hypothesis or explanation

(ii) testable

....

[1]

experiments
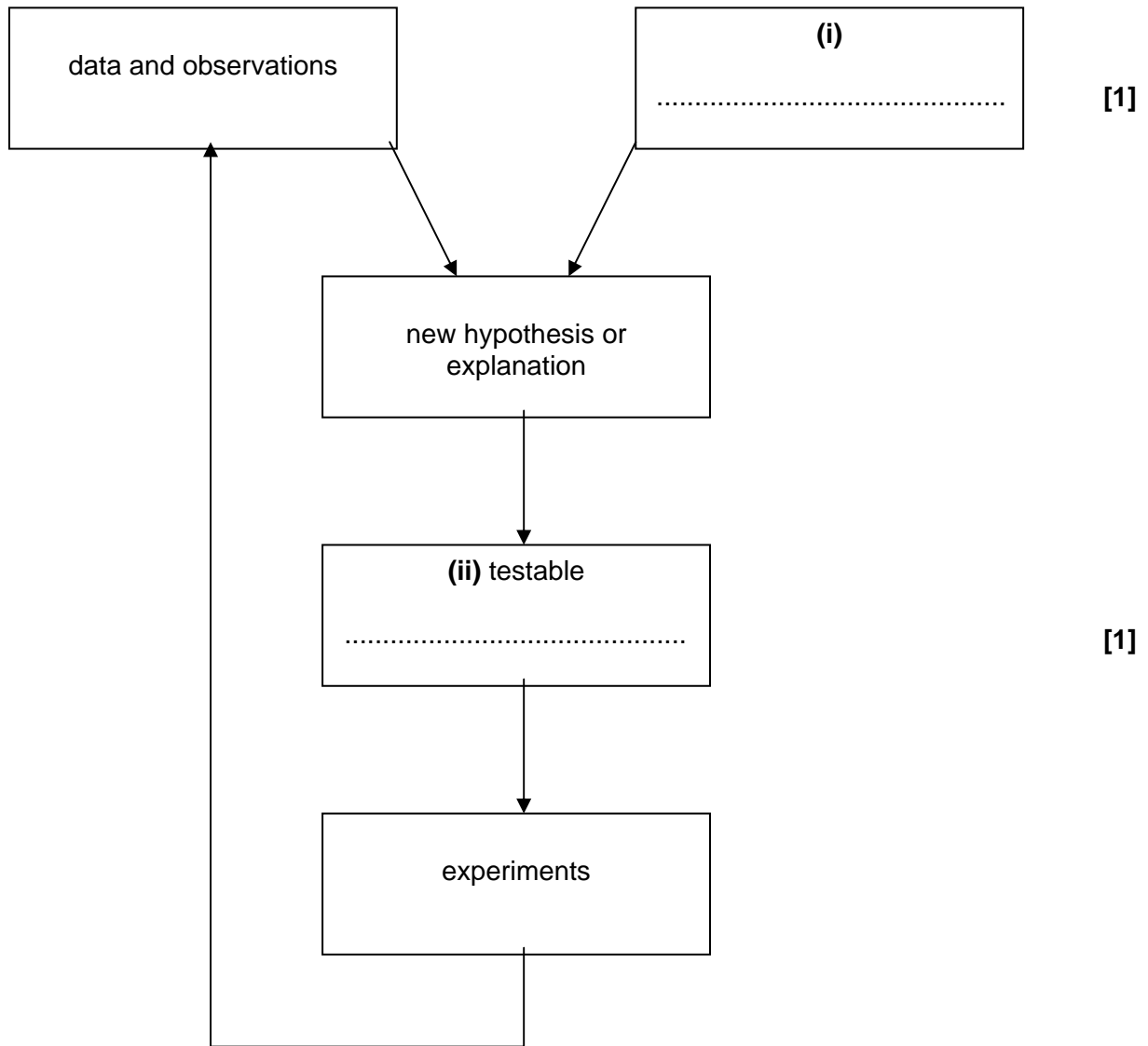
[2]

[Total: 3]

2 The Mexican tetra is a species of fish. It lives in rivers and is a silver colour.

Some populations of this fish have become trapped in caves where there is no light.

Over time the populations of fish living in caves have lost their ability to produce the protein that gives them their body colour. They now appear colourless.

The cave fish are also blind because they do not have developed eyes.

Suggest and explain the evolutionary processes through which these changes could have occurred.

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

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.... **[6]**
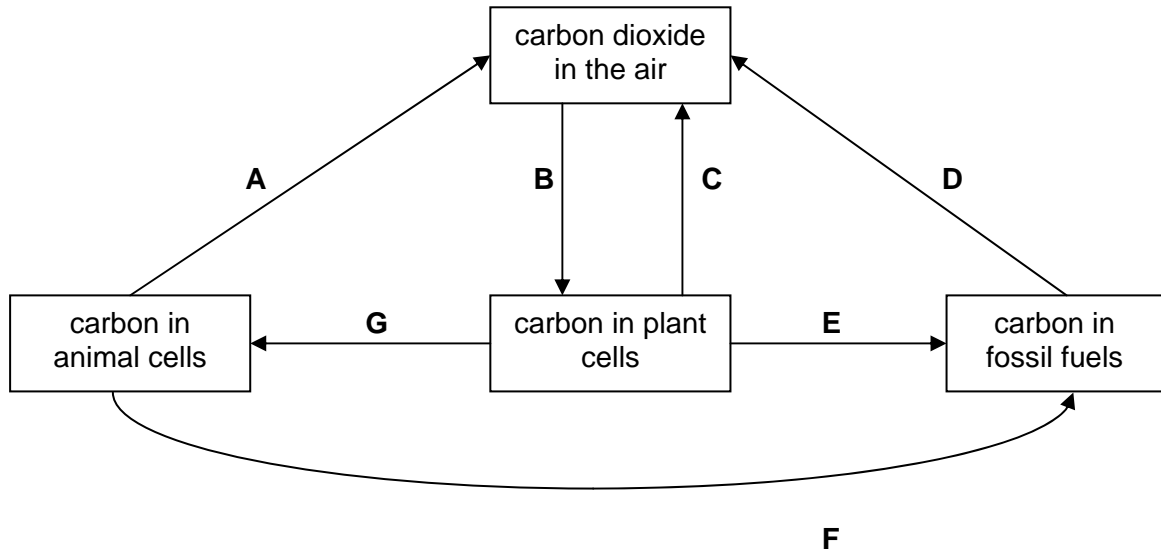
[Total: 6]

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?

arrows …………………………and .... **[1]**

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

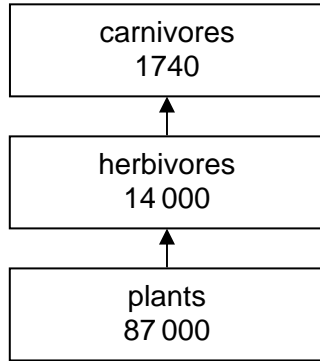arrow ....**[1]**

[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 kJ / m^3 / year.

```
        ┌─────────────┐
        │  carnivores │
        │     1740    │
        └─────────────┘
               ▲
        ┌─────────────┐
        │  herbivores │
        │    14 000   │
        └─────────────┘
               ▲
        ┌─────────────┐
        │    plants   │
        │    87 000   │
        └─────────────┘
```

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 kJ / m^3 / 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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....

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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.

....

....

....

....

.... **[2]**

(b) Many food companies add salt to improve the taste of their food. Salt is also a food preservative.

Food companies are being told to reduce the amount of salt in their products.

Explain why

- food companies **may not want** to lower the amount of salt in their food

- food companies **should be made** to lower the amount of salt in their foods.

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

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.... **[6]**

[Total: 8]

7 Salt is found underneath the ground in some parts of the UK.

   It can be obtained by solution mining.

layer of mud and rocks

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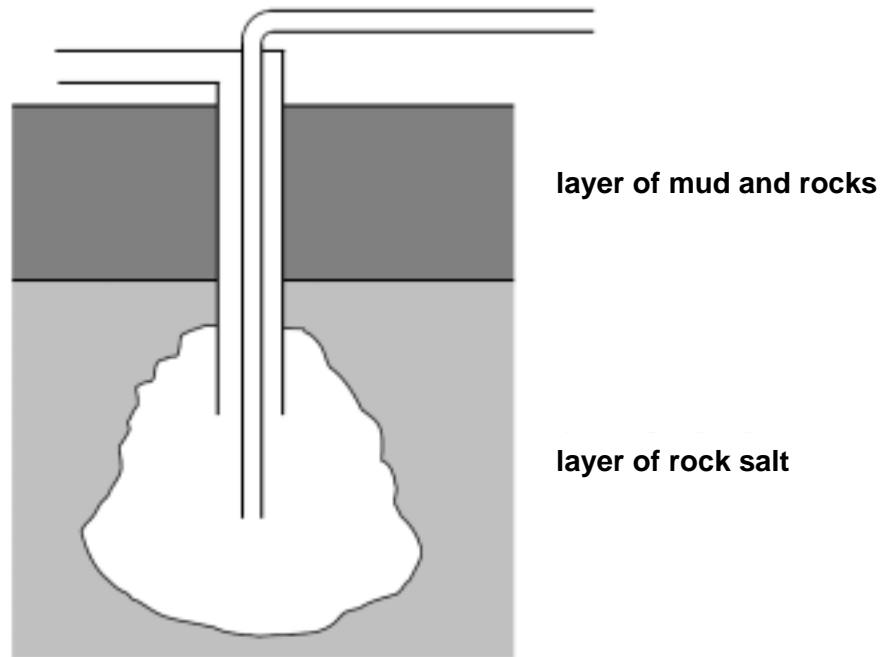
(a) The diagram shows part of the process for solution mining of salt.

   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

[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.

....

....

.... **[2]**

(b) The method of disposal of the bottle is one feature considered in its Life Cycle Assessment.

Write down **two** other features that should be considered in a Life Cycle Assessment, and for each feature suggest how it may be different for the two types of bottle.

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.... **[4]**

(c) Polyvinylchloride (PVC) can cause environmental problems when disposed of in landfill sites.

Explain why.

....

.... **[2]**

[Total: 8]

9 Generating and distributing electricity is not 100 % efficient.

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

heating due to
friction in turbine

5 units

hot gases from
chimney

15 units

energy
stored
in fuel

energy carried away
as heat by cooling water

45 units

energy wasted
in transmission

100
units

3 units

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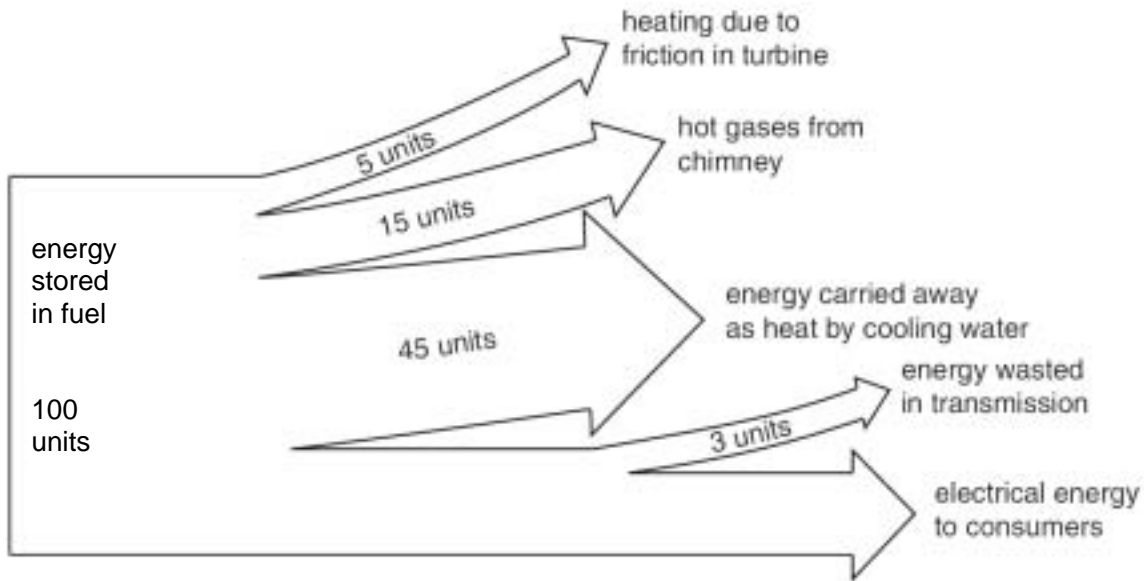
(a) How many units of electricity go to the consumers?

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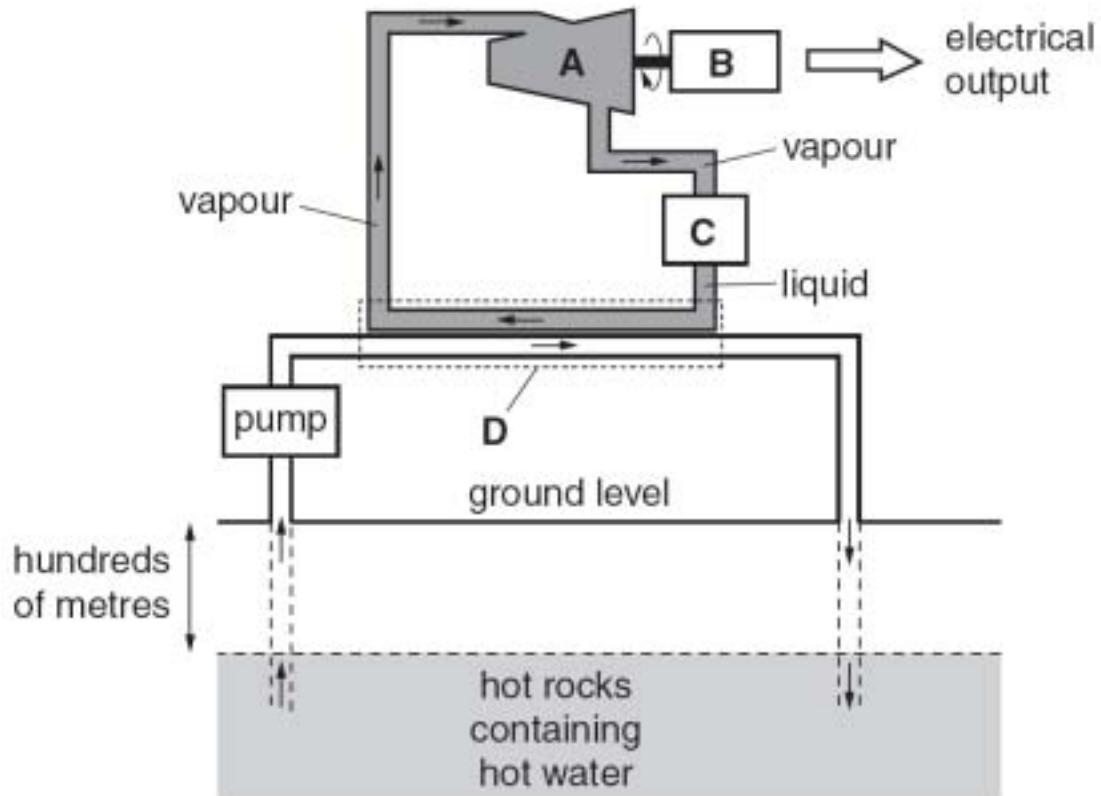
The following statements describe the energy flow in a geothermal power station.

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			

[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]

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11 A kettle transfers much more energy in a day than a light bulb, but both have the same mains voltage.

Explain how this is possible when the kettle is on for a few minutes only, while the light bulb is on for several hours.

....

....

.... **[2]**

[Total: 2]

12 One way of supplying electricity to the country is with nuclear power stations.

Some people are very concerned about the risk to the public from the waste produced in these power stations, while other people think the risk is very low.

The Government will have to make decisions on this, but these decisions may be controversial.

Explain why people have different views on the risk from nuclear waste, and why any decision made by the Government may be controversial.

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

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.... **[6]**

[Total: 6]

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.
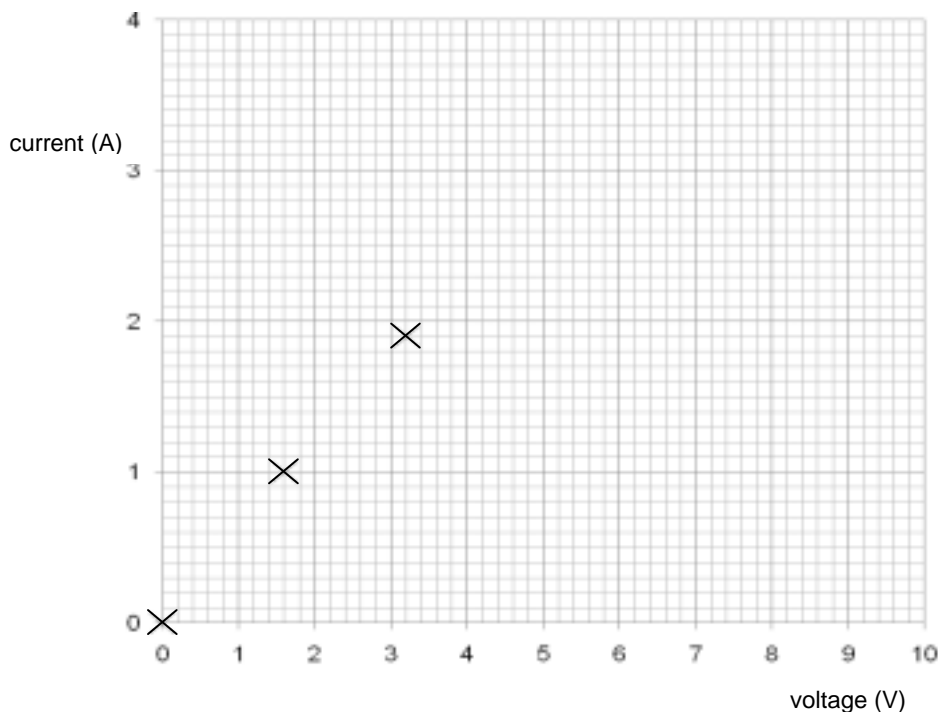
[1]

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

....

....

.... **[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

SPECIMEN

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GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

SCIENCE A   **A143/02**

Unit A143: Modules B3, C3, P3 (Higher 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
<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.	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.

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	✓	×	✓	✓	✓				✓	
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)		<table><tr><td>observation</td><td>increases</td><td>decreases</td><td>neither</td></tr><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></table>	[1]	three correct indications of choice and the other six boxes blank for this mark
	(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	✎		**[Level 3]** Correctly uses ideas about natural selection to clearly explain how these changes could have occured. 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]** 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) **[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) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**valid points include:** • (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 • idea that advantage = fitness • fitness allows each form to survive / breed more successfully / increase in number • this is natural selection • over time, blind form only in caves / normal form only in rivers
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
3	(a)		Stop burning forests ✓ ☐ Cut back on the use of fossil fuels ✓ ☐ ☐	**[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 | | | *Conclusion is <u>valid</u> because:*

calculation to show that % of energy in plants transferred to herbivores is around 16%

calculation to show that % of energy in herbivores transferred to carnivores is around 12%

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)

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 | **[4]** | no mark for saying valid |
| | | | **Total** | **[4]** | |

Question			Expected answers	Marks	Additional guidance
5			*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; *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.	**[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) ✎		**[Level 3]** Answer clearly considers (perceived) risks versus (perceived) benefits in the argument *against* lowering salt, and in the argument *for* 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) **[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) **[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) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** Food companies may not want to lower the amount of salt in their food because • (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. Food companies should be made to lower the amount of salt in their foods because • 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 = 12.2MJ 2 plastic bottles use 2(4.7 + 2.2) = 13.8MJ	[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]**	

Question	Expected answers	Marks	Additional guidance
10 (a)	(Z) | Y | X | V	[1]	all correct for the mark

Question			Expected answers	Marks	Additional guidance
	(b)		*coal:* 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) **OR** *nuclear:* 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) **OR** *wind:* 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)	**[3]**	candidates may choose any type of power station; no marks are awarded for the choice itself, only for the justification of the choice **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.)
			Total	**[4]**	

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

Question			Expected answers	Marks	Additional guidance

12	✎		**[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)
			
			[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)
			
			[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)
			
			[Level 0]
			Insufficient or irrelevant science. Answer not worthy of credit.
			(0 marks)
				[6]	**Relevant points include:**
					• 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 CO_2 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'
					
					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
					
					ignore arguments based on safety of power stations (Chernobyl, Japan etc)
					
					reject explosion or other confusion with nuclear bomb

			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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