OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) in Combined Science B (Twenty First Century Science)

H

J260/07 Physics (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.3

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in the question marked with an asterisk (*).
- This document consists of **20** pages.

Answer **all** the questions.

1* An island is struggling with the energy demand of its inhabitants and will need to produce more electricity in the future.

Information about the island's electricity production is given below.

Predicted electricity consumption in future	18 880 000 kWh
Current electricity production	16 000 000 kWh
Produced by burning oil and peat	100%
Produced by hydroelectricity	0%
Produced by nuclear	0%
Produced by wind	0%
Produced by waves/tides	0%
Oil imported	248.9 barrels/day
Peat used for fuel	13 000 tonne/year

The island is keen **not** to import any more oil.

What might the environmental minster advise as a plan for the island's future production of electricity?

Use the data in the table in your answer.

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

2 Here is a picture of a mountain bike. The rider makes the pedal turn in a circle, which results in the bike moving.

(a) **On the diagram** draw labelled arrows to show:

- the force that does work to make the bike move.
- the friction force that moves the bike forwards. **[2]**

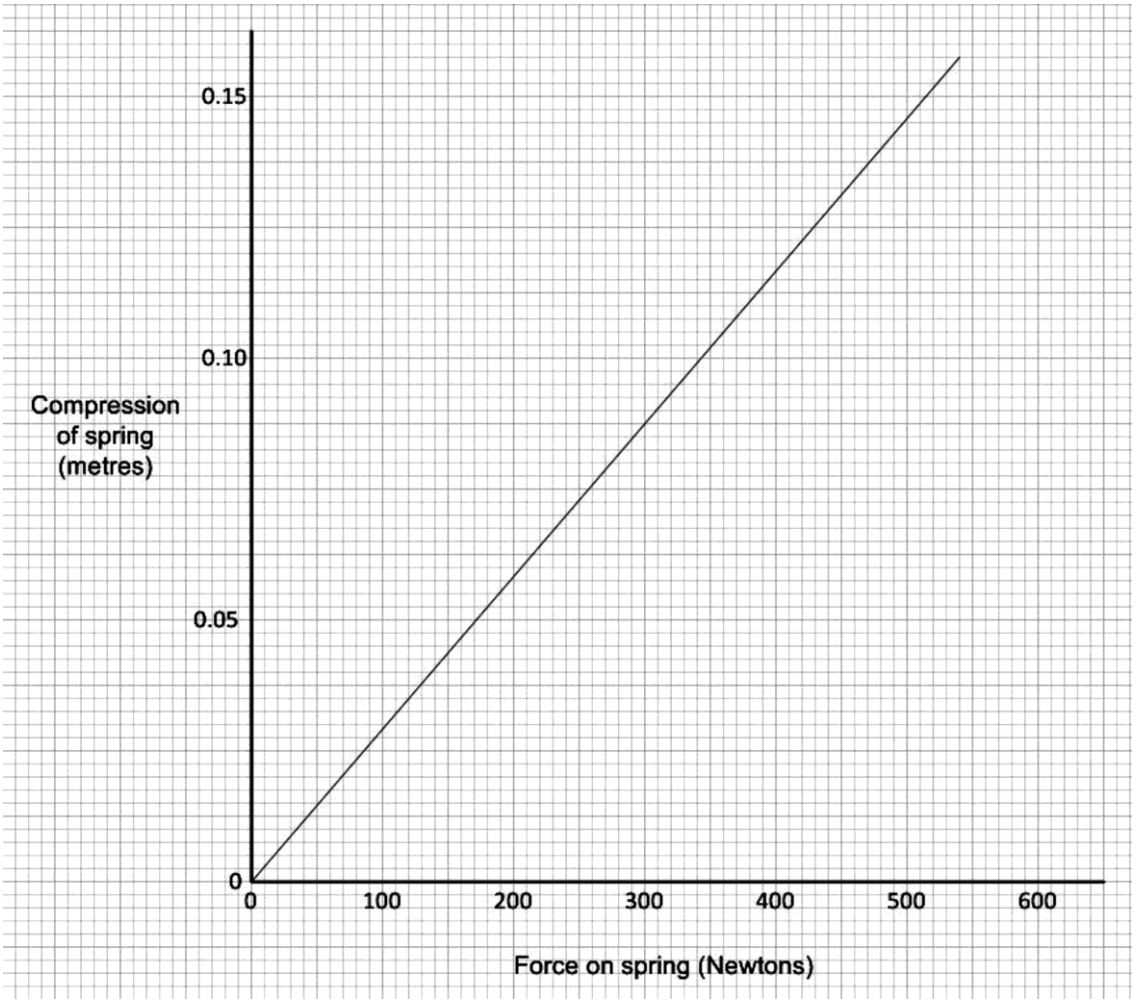
(b) There is a spring in the front wheel suspension fork.

The bike hits a tree stump and a force of 510 N compresses the spring by 15 cm.

Calculate the spring constant of the spring.

Spring constant = ……N/m **[4]**

(c) The graph shows the force and compression for the spring.



(i) Each time the cyclist pushes on the pedal the spring compresses by 6 cm.

Use the graph, or an alternative method, to find how much energy is stored in the spring each time the pedal is pushed down.

Stored energy = ……J **[2]**

(ii) Explain how you found your answer.

.....

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

(d) Explain why the bicycle will move more slowly **with** the spring than without the spring.

Use ideas about energy in your answer.

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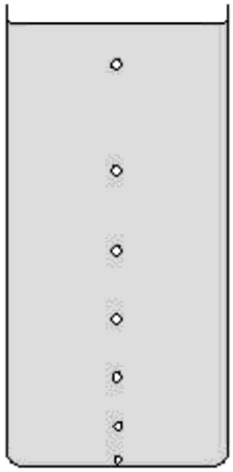
..... **[4]**

3 Ben observes a stream of bubbles rising in a glass of fizzy cola.

The bubbles are produced at a steady rate.



(a) Explain how evidence from the diagram shows that the bubbles are accelerating.

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.....

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

(b) **(i)** Recall the equation to calculate force.

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

(ii) In a stream of bubbles, each bubble has an acceleration of 0.175 m/s^2.

Assume that each bubble has a mass of 1×10^{-6} g.

Calculate the resultant force on each bubble.

Force = ...N **[3]**

(c) Name the **two** forces acting against the rise of the bubbles in Ben's glass.

1 .....

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

4 **(a)** An electric kettle has a power rating of 2.5 kW.

(i) How much energy is transferred each second by the kettle?

Energy transferred = ……J **[1]**

(ii) Recall the equation for calculating energy transferred in kWh.

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

(iii) The kettle takes 6 minutes to boil the water.

How much energy in kilowatt hours is transferred by the kettle to boil the water?

Energy transferred = ……kWh **[3]**

(b) When the water is boiling, liquid water is changing into steam.

Describe what is happening to the energy and temperature of the particles when water boils.

Use the particle model in your answer.

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

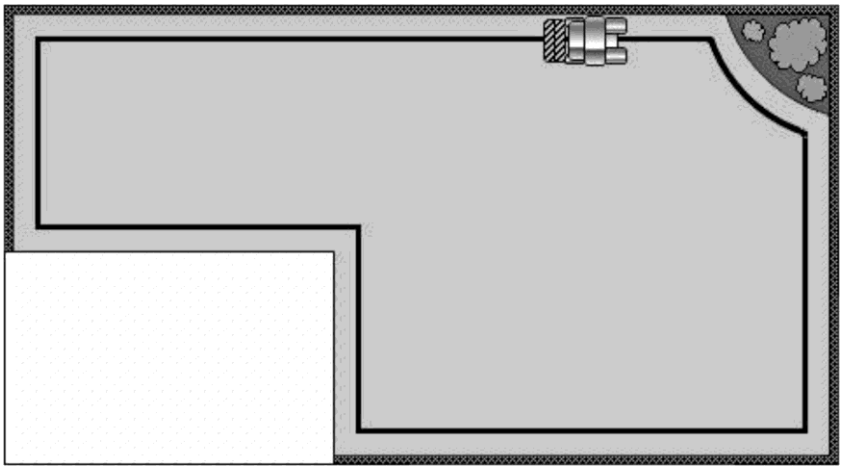
(c) Another kettle heats 1.0 kg of water from 20 °C to 100 °C and continues heating until half of the water has turned to steam.

Calculate the total increase in internal energy of the water and state the units.

- Specific heat capacity of water = 4200 J/kg/°C
- Specific latent heat of water vaporisation = 2260 kJ/kg

Total increase in internal energy = …… units .....**[5]**

5 Nina has a robot lawnmower.



A wire carrying an electric current marks the edge of the lawn.

(a) The lawnmower can detect an electric current of 0.5 amps or more in the wire.

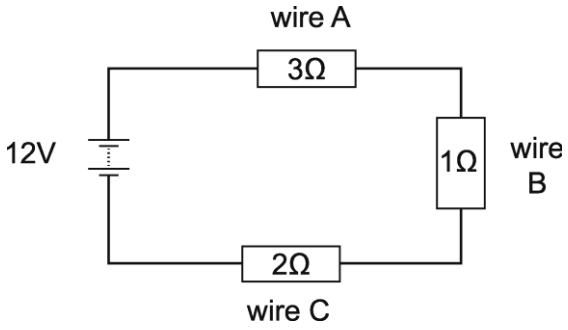
The power supply for the wire is 12 volts.

The resistance of the wire is 50 milliohms per metre.

Calculate the maximum length of wire that the lawnmower can detect the current in.

Length = ……m **[5]**

(b) Nina is planning to join three wires together to mark the edge of the lawn.



The total potential difference across the three wires is equal to the potential difference across the power supply.

Explain this statement using the idea of work done.

.....

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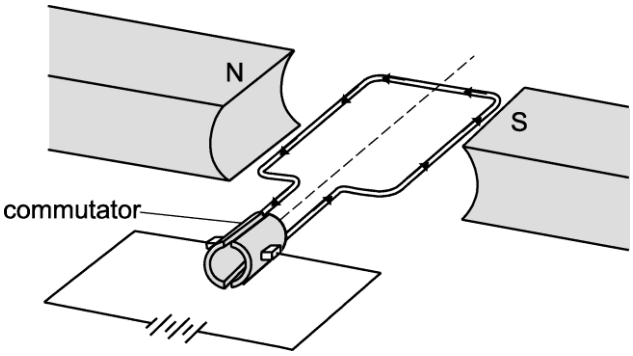
..... **[2]**

(c) The lawnmower moves using an electric motor.

The arrows show the direction of current in the coil.



Complete the sentences about the motor.

Use terms from the list.

anticlockwise clockwise first finger left right second finger thumb

Because the force on the right of the coil is shown by the .....

in Fleming's .....-hand rule, we know the coil

of wire will spin in a ..... direction. **[3]**

6 The chart in **Fig. 6.1** shows some stopping distances for an average car.

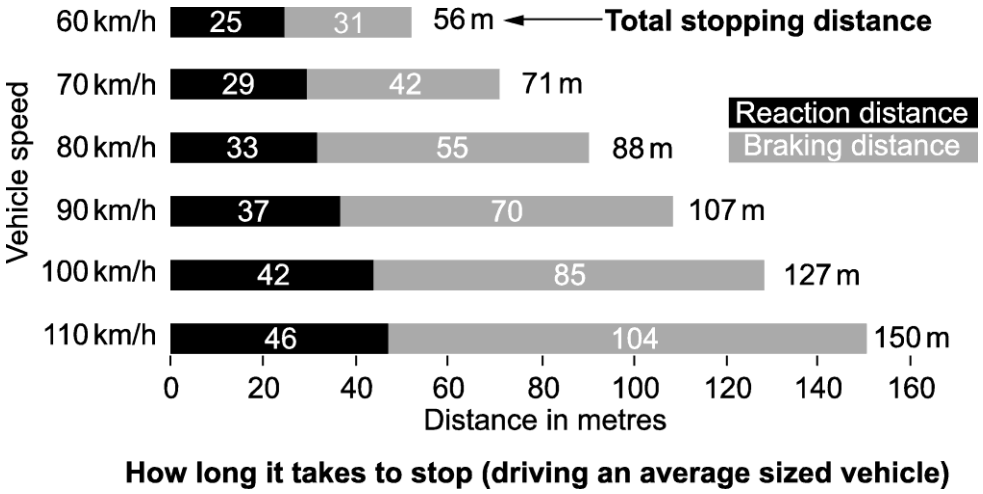


Fig. 6.1

(a) Describe the relationship between vehicle speed and the **reaction** distance.

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.....

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

(b) At 100 km/h the kinetic energy of an averaged sized vehicle is 675 kJ.

Estimate the average force (in kN) applied by the brakes to stop the car from this speed, over the braking distance.

Use your knowledge and information in the chart (**Fig. 6.1**).

Average force = ...kN **[4]**

(c) State **one** factor, other than speed, that will affect the **braking distance** of the car.

.....

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

7 X-Rays are used to take images inside teeth at the dentist.

(a) When an X-ray image is taken of a tooth, there is usually a dentist and a dental nurse who wait outside the room while the patient is in the room.

One risk from X-rays is cancer.

Suggest another risk.

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

(b) **(i)** The X-rays are produced by firing particles at a metal target. The metal emits X-rays.

What happens in the metal to produce the X-rays?

.....

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

(ii) Different materials absorb different amounts of X-rays.

Generally, denser materials in the teeth absorb more X-rays than less dense materials.

Explain why a denser material will absorb more X-rays.

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

(c) Jamal is training to be a dentist.

- He has read that X-rays are dangerous and might cause cancer.
- He asks each person on a cancer ward if they have ever had an X-ray picture taken.

Here are his results:

	Male	**Female**
Had an X-ray	15	7
Never had an X-ray	0	1

Jamal thinks that this information shows that X-rays cause cancer.

Is Jamal correct?

Justify your answer.

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

8 During the sixteenth century, measurements were made with compasses that allowed William Gilbert to publish a book describing the Earth's magnetic field.

(a) **(i)** Explain how a magnetic compass could be used to find the shape of the Earth's magnetic field.

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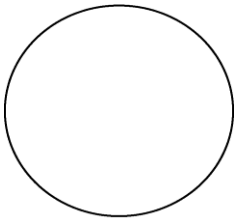
..... **[2]**

(ii) Sketch the likely results for the magnetic field around the Earth.

North Pole



South Pole **[2]**

(b) Sarah is an architect designing a football stadium for a country near the equator.

Wires are used to transmit electricity from the ground to the top of a floodlight tower.

She knows that the wires will experience a force due to the Earth's magnetic field.

- The floodlight tower is 20 m high.
- The wire carries an average current up the wire of 15 A.
- The Earth's magnetic field strength is 40 μT.

(i) Calculate the force on the wire.

Force = ……N **[3]**

(ii) In which direction will the force act? Draw a ring around the correct answer.

North East South West Up Down [1]

(iii) How does this force compare with the force due to gravity acting on the 20 m long wire?

- The density of the wire is 0.01 kg/m^3.

Justify your answer.

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

9 In 2013, nuclear power stations contributed about 20% of the electricity generated in the UK.

(a) Hydroelectricity is a renewable source in which water flowing downhill is used to generate electricity.

Compare how electricity is generated in a nuclear and a hydroelectric power station.

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..... **[4]**

(b) Some nuclear power stations use a chain reaction involving uranium.

In a chain reaction one nuclear reaction leads to more reactions.

This equation shows one step in the chain reaction.

$$ {}^{1}_{0}n \;+\; {}^{235}_{92}U \;\rightarrow\; {}^{85}_{36}Kr \;+\; {}^{\cdots\cdots}_{\cdots\cdots}Ba \;+\; 3\,{}^{1}_{0}n $$

(i) Write the mass number and atomic number for Ba **in the spaces in the equation** above. **[2]**

(ii) Explain how this equation can lead to a chain reaction.

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

(c) The terms half-life and random decay are used when describing radioactivity.

(i) Explain the concept of half-life.

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

(ii) Why is radioactive decay described as random?

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

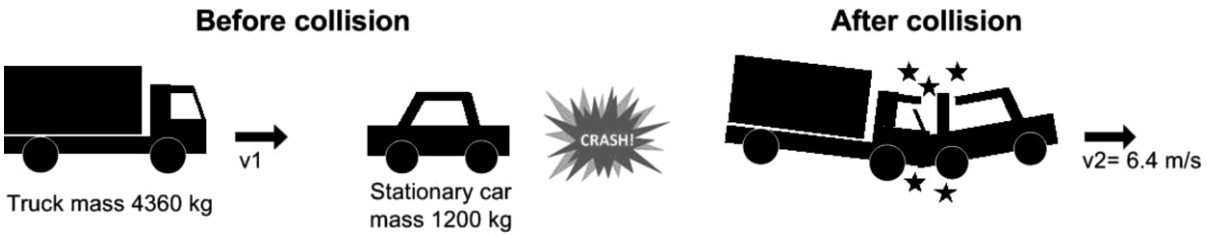
10 In a crash test centre, a truck of mass 4 360 kg collides with a stationary car of mass 1 200 kg.

The two vehicles stick together and move off together.

The apparatus used in the test showed that the truck was travelling at a velocity of 10 m/s before the crash.

- The technician in the centre thinks that the 10 m/s reading may be wrong.
- He knows that the two vehicles together moved at 6.4 m/s after the collision.

The stages during this collision are shown below.



Use calculations to find out whether the apparatus was working correctly when recording the velocity reading of 10 m/s.

Compare your answer with the velocity recorded by the test centre.

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

END OF QUESTION PAPER

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Summary of updates

Date	Version	Details
December 2021	2.3	Updated copyright acknowledgements.

OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/07 Physics (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 45 minutes

MAXIMUM MARK 95

This document consists of 20 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this component. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.
The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.
The communication statement determines the mark within a level.

Level of response question on this paper is **1.**

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9–1) in Combined Science B:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

Question			Answer	Marks	AO Element	Guidance
1 *			*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** A minimum of 3 energy resources are considered. **AND** The energy resources are linked to an interpretation of the data in the table. **AND** The interpretation of the data is used to draw conclusions. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A minimum of 2 energy resources are considered. **AND** The energy resources are linked to an interpretation of the data in the table. **AND/OR** The interpretation of the data is used to draw conclusions. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A minimum of 2 energy resources are considered. **AND** Minimal interpretation of the data of the table **AND/OR** Generic conclusions which may or may not be specifically linked to energy resources included in the candidates answer.	**6**	**1.1 x 2** **3.1a x 1** **3.2b x 3**	**Indicative scientific points may include:** **AO1.1 use knowledge of energy resources** **For example:** • wind - little environmental cost/renewable • waves/tidal - little environmental cost/renewable • nuclear - well established technology/small amounts of fuel needed • oil - high cost/CO_2 pollution from burning • nuclear - safety issues/disposal of radioactive waste - very high set up costs **AO3.1a Analyse data to interpret** **For example:** • energy consumption to increase by 2880000 in the future • oil - high energy density/already established **AO3.2b Analyse data to draw conclusions** **For example:** • all oil is imported, this is expensive but system already in place • currently no renewable resources being used on the island therefore these resources should be considered • peat is being used up quickly and should be reduced for a small island • a wind farm can be installed offshore to increase amount of energy produced by wind

Question			Answer	Marks	AO Element	Guidance
			There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** No response or no response worthy of credit.			• waves/tidal should be possible on an island • nuclear possible • comparison of running costs of renewable vs non-renewable • wind - high set up costs • waves/tidal - technology still undeveloped/high set up costs • hydro - no evidence to say whether possible or not

Question			Answer	Marks	AO Element	Guidance
2	(a)		Arrow downwards from pedal ✓ Arrow to right from the bottom of either wheel ✓	2	2.1	
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE. If answer = 3400 (N/m) award 4 marks** Recall: F=kx or k = f ÷ x ✓ Converts 15 cm into 0.15 m ✓ 510 (N) ÷ 0.15 (m) ✓ 3400 (N/m) ✓	4	1.1 1.1 2.1 2.1	correct substitution gains first 2 marks (if equation is missing)
	(c)	(i)	Calculation showing area under the graph (0.06 x 204) ÷ 2 ✓ 6.12 (J) ✓	2	2.2	**ALLOW** between 6.0 and 6.3 inclusive
		(ii)	Idea of finding area under the graph ✓	1	2.2	
	(d)		Energy input to turn pedal ✓ Transferred to kinetic energy ✓ Some energy transferred to spring, not available as kinetic energy. ✓ Less kinetic energy results in less speed ✓	4	2.1	

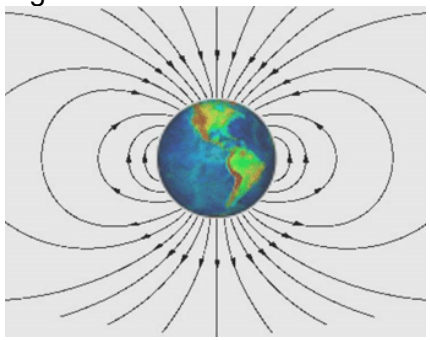
Question			Answer	Marks	AO Element	Guidance
3	(a)		Bubbles are further apart at the top than at the bottom of the glass/stream ✓ Time interval between bubbles is constant/the same ✓ Greater distance travelled in same time = greater velocity/speed therefore there is a change in velocity over time which implies an acceleration ✓	3	3.1a	**ORA**
	(b)	(i)	Recall: F=ma ✓	1	1.1	
		(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 1.75 x 10^{-9} (N) award 3 marks** Converts 1 x 10^{-6} g to 1 x 10^{-9} kg ✓ 1 x 10^{-9} kg x 0.175 m/s^2 ✓ = 0.175 x 10^{-9} (N) ✓	3	1.1 2.1 2.1	Correct answer 3 marks 0.00000175 or 1.7 x 10^{-6} gains 2 marks
	(c)		Gravity/weight ✓ Friction/(fluid)drag/viscosity/ fluid resistance ✓	2	2.1 2.1	**Ignore** resistance or any reference to air

Question			Answer	Marks	AO Element	Guidance
4	(a)	(i)	2.5 kJ or 2500 J ✓	1	1.1	
		(ii)	Recall: Energy transferred (J,kWh) = power (W, kW) x time (s, h) ✓	1	1.1	
		(iii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 0.25 (kWh) award 3 marks** 6 minutes = 0.1 Hours ✓ 2.5 kW x 0.1 h ✓ = 0.25 (kWh) ✓	3	 1.1 2.1 2.1	
	(b)		Particles move apart and move freely ✓ Energy stored increases as particles move apart ✓ No change in temperature ✓	3	 1.1	**ALLOW** PE of particles increases / latent heat used to push particles apart **Ignore** particles move faster **ALLOW** stays at 100°C **ALLOW** Kinetic energy of particles stays the same as temperature stays the same
	(c)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 1466,000 J or 1466 kJ award 5 marks** Temperature rise: Select and apply: ΔE = m x c x ΔT = 1 x 4200 x 80 = 336,000 J or 336 kJ ✓ Select and apply ΔE = m × L Boiling tray water turns to steam therefore m = 0.5 ×1kg✓ = 0.5 × 2260,000 = 1130,000 J or 1130 kJ ✓ Total energy change = 336,000 + 1130,000 (J) = 1466,000 J or 1466 (kJ) ✓ Units: joules or kilojoules ✓	5	 2.1 2.1 2.1 1.2 1.1	If units not given award 4 marks for an answer of 1466,000 or 1466

Question			Answer	Marks	AO Element	Guidance
5	(a)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 480 (m) award 5 marks**	5		correct substitution gains first 3 marks (if equation is missing)
			Convert milliohms to ohms = 0.05 Ω ✓		1.2	
			Recall: potential difference = current x resistance ✓		1.1	
			maximum resistance = V ÷ I = 12 V ÷ 0.5 A ✓		2.1	
			= 24 Ω| ✓		2.1	
			maximum length = 24 ÷ 0.05 = 480 (m) ✓		2.1	
	(b)		The work done on each unit of charge by the battery ✓ Must equal the work done by it on the circuit components. ✓	2	1.1	**ALLOW** work done by the battery is the same as the work done by all the components for one mark.
	(c)		Thumb ✓	3	1.2	
			Left ✓		1.2	
			Clockwise ✓		1.2	

Question			Answer	Marks	AO Element	Guidance
6	(a)		Refers to both vehicle speed and reaction distance ✓ A correlation / is proportional/ has a linear relationship ✓	2	3.1b	
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 7 or 8 or 9 (kN) award 4 marks** Recall: Force = work done ÷ distance ✓ Uses table to find braking distance travelled at 100km/hr = 85 m ✓ 675 kJ ÷ 85 m ✓ Estimate as 7 or 8 or 9 ✓	4	1.1 3.1a 2.1 2.1	**Ignore** a calculated answer to more than one significant figure.
	(c)		Any **one** from: mass of car / condition of brakes / weather conditions ✓	1	1.1	**ALLOW** reference to condition of tyres / condition of road or reduced braking force applied to pedal

Question			Answer	Marks	AO Element	Guidance
7	(a)		Risk is damage to cells / DNA ✓	1	1.1	
	(b)	(i)	Electrons <u>in atoms</u> ✓ Lose energy ✓	2	1.1	
		(ii)	A denser material will have more mass/matter/atoms in the same volume ✓ X-rays are absorbed by electrons in atoms ✓ Hence more atoms means more absorption ✓	3	2.1	
	(c)		**Any 3** Bias in sample/samples not matched/no control group e.g. all had cancer ✓ Small sample size ✓ Apparent <u>correlation</u> ✓ Idea that there is a mechanism for the X-rays causing cancer ✓	3	3.3a	

Question			Answer	Marks	AO Element	Guidance
8	(a)	(i)	Held horizontally held vertically ✓ At various places on the earth's surface ✓	2	1.2	
		(ii)	Lines as around a bar magnet ✓ Arrows on field lines pointing from south to north ✓	2	2.1	e.g. 
	(b)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE. If answer = 0.012 N award 3 marks** Select and Apply: Force = magnetic flux density x current x length of conductor 40 μT = $40x10^{-6}$ ✓ $40x10^{-6}$ x 15 x 20 ✓ Correct answer = 0.012 N ✓	3	 1.2 2.1 2.1	
		(ii)	West ✓	1	2.2	
		(iii)	Stated comparison e.g. much smaller ✓ Calculation or estimate of mg for wire 20 x 0.01 x 10 = 2 N ✓	2	1.1 2.1	**ALLOW** ecf from part b(i)

Question			Answer	Marks	AO Element	Guidance
9	(a)		Nuclear energy used to heat water into steam ✓ Steam used to turn turbine ✓ Hydroelectric, water drives turbine directly ✓ Both use turbine to drive generator to produce electricity ✓	4	1.1	
	(b)	(i)	148 ✓ 56 ✓	2	1.2	
		(ii)	One neutron required for fission reaction ✓ 3 more neutrons produced ✓ New neutrons can cause further fission reactions with different uranium nuclei / critical mass ✓	3	1.2 2.1 2.1	**ALLOW** maximum of two marks if answer correct but not quantitative
	(c)	(i)	The average time it takes ✓ for the number of nuclei of an isotope in a sample to halve ✓	2	1.1	
		(ii)	(Idea that) it is not possible to predict when an individual atom will decay	1	1.1	

Question			Answer	Marks	AO element	Guidance
10			**FIRST CHECK ANSWER ON ANSWER LINE. If answer = 8.16 (m/s) award 5 marks**	**6**		
			Combined mass after collision = 4360 kg + 1200 kg = 5560 kg ✓		**1.2**	
			Recall Momentum = mass x velocity ✓		**1.1**	
			= 5560 kg x 6.4 m/s = 35584 kg m/s ✓		**2.1**	
			After collision (momentum conserved)			
			Rearrange equation to get Velocity = momentum ÷ mass ✓		**1.2**	
			= 35584 kg m/s ÷ 4360 kg = 8.16 (m/s) ✓		**2.1**	
			Statement to say the apparatus is wrong and that the actual initial velocity of the lorry is less. ✓		**3.2a**	

Summary of updates

Date	Version	Change
May 2018	2	We've reviewed the look and feel of our papers through text, tone, language, images and formatting. For more information please see our assessment principles in our "Exploring our question papers" brochures on our website
October 2019	2.1	Question 2(c)(i) - There has been a change to the answer of this question. Correct answer: Calculation showing area under the graph for 0.06 (6cm) Correct reading from graph as 204 (0.06 x 204) ÷ 2 6.12 (J) Question 8 (b)(i) - Mark scheme amend - Correction from field strength to flux density.

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