GCSE

WJEC GCSE Integrated Science (Single Award)

Approved by Qualifications Wales

Sample Assessment Materials

Unit 2: Science in a Changing World
Higher Tier

Teaching from 2026
For award from 2028



This Qualifications Wales regulated qualification is not available to centres in England.

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Ready for the world.

WJEC would like to thank the students and teachers of Fitzalan High School, Cardiff and Llanwern High School, Newport for their participation in the creation of these covers.

WJEC GCSE Integrated Science (Single Award)

Unit 2: Science in a Changing World

Higher Tier

External Sample Assessment Materials

For teaching from September 2026

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Surname	Centre number	Candidate number
First name(s)		0

GCSE

3450UB

Integrated Science (Single Award)
Unit 2: Science in a Changing World

Higher Tier

Time: 1 hour 30 minutes

SAMPLE ASSESSMENT MATERIALS

Additional materials

A calculator and a ruler.

Instructions to candidates

Use black ink or black ball-point pen. Do not use gel pen. Do **not** use correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Write your answers in the spaces provided in this booklet. If you need more space, use the additional page(s) at the back of this booklet. Number the question(s) correctly.

Answer **all** questions.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**13**	
3.	**10**	
4.	**13**	
5.	**9**	
6.	**8**	
7.	**7**	
8.	**7**	
Total	**72**	

Information for candidates

The number of marks is given in brackets at the end of each question or part-question.

The total number of marks available is **72.**

You should think carefully about how you use your time.

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Equations

$kgCO_2eq$ = global warming potential × mass of gas	$kgCO_2eq = GWP \times m$
weight = mass × gravitational field strength	$W = mg$
resultant force = mass × acceleration	$F = ma$
wave speed = frequency × wavelength	$v = f\lambda$
$\text{density} = \frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$

SI multipliers

Prefix	Symbol	Conversion factor	Multiplier
pico	p	divide by 1 000 000 000 000	1×10^{-12}
nano	n	divide by 1 000 000 000	1×10^{-9}
micro	μ	divide by 1 000 000	1×10^{-6}
milli	m	divide by 1000	1×10^{-3}
centi	c	divide by 100	1×10^{-2}

kilo	k	multiply by 1000	1×10^{3}
mega	M	multiply by 1 000 000	1×10^{6}
giga	G	multiply by 1 000 000 000	1×10^{9}
tera	T	multiply by 1 000 000 000 000	1×10^{12}

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Answer **all** questions.

Examiner only

1. The numbers of a species in a habitat can be investigated by using quadrats.

The results of an investigation into four different species of snail, A, B, C and D is shown below. The results were collected from two different habitats, X and Y.

Habitat X

Quadrat	Number of each species of snail			
	A	B	C	D
1	0	2	3	1
2	0	0	3	2
3	0	1	3	1

Habitat Y

Quadrat	Number of each species of snail			
	A	B	C	D
1	0	0	1	2
2	0	0	4	3
3	0	0	1	1

Use the results above to answer the following questions.

(a) Compare the distribution of snails of species **C** in both habitats. [2]

……

……

……

……

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(b) Habitat **Y** has an area equal to 15 quadrats.

Estimate the number of snails of species **D** you would expect to find in habitat **Y**. [2]

Number of snails = ……

(c) State **one** way the experiment could be improved so you have more confidence in your answer in (b). [1]

……

……

5

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2. The table below gives information about some of the planets in our Solar System.

Planet	Mean distance from Sun (AU)	Diameter (Mm)	Length of day (Earth days)	Length of year (Earth years)	Mean temperature (°C)	Content of atmosphere	Known moons	Rings
Mercury	0.4	5	59	0.2	427	none	0	no
Venus	0.7	12	243	0.6	480	carbon dioxide (96%), nitrogen (3.5%) thick clouds of sulfuric acid	0	no
Earth	1.0	13	1	1	14	nitrogen (77%), oxygen (21%)	1	no
Mars	1.5	7	1	2	-63	carbon dioxide (95%), argon	2	no
Jupiter	5.2	143	0.4	12	-130	hydrogen, helium	63	yes
Saturn	9.5	120	0.4	29	-130	hydrogen, helium	61	yes
Neptune	30.0	50	0.7	165	-200	hydrogen, helium, methane	13	yes

Use the information in the table to answer the questions that follow.

(a) Name the planet not included in the table. [1]

……..

(b) (i) Name the planet closest in size to Earth. [1]

……..

(ii) Name the planet which has a year twice as long as a year on Earth. [1]

……..

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(c) (i) Describe how the temperature on a planet depends on the distance from the Sun. [1]

……..……..

……..……..

(ii) Give one reason why Venus does not follow this trend. [1]

……..……..

……..……..

(d) Ceres is a dwarf planet found in the asteroid belt:

(i) **Estimate** its temperature. [1]

…… ^{o}C

(ii) **Estimate** the length of its year. [1]

……. Earth years

(e) The Perseverance Rover was sent to Mars as part of its 2020 mission.

(i) Calculate the closest distance between Earth and Mars in AU. [1]

Closest distance = …….AU

(ii) Sunlight takes 8.3 minutes to travel from the Sun to Earth.

It takes 13 minutes to reach Mars.

Calculate the time taken for an electromagnetic wave to travel from the Perseverance Rover on Mars to reach Earth when they are closest together. [1]

Time = …… minutes

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(iii) A one-way trip to Mars from Earth would take nine months but a return journey would be around three years.

State **two** factors that need to be considered so human life is supported on a long journey in space. [2]

1. ……

2. ……

(iv) The gravitational field strength on Mars is 3.7 N/kg.

The mass of the Perseverance Rover on Earth is 1025 kg.

Use an equation from page 2 to calculate its weight on Mars. [2]

Weight = …… N

13

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3. The South Wales Joint Scientific Investigation Unit is a forensic police unit that analyses evidence from crime scenes. They use biological and chemical testing to identify individuals linked to crime scenes.

(a) DNA profiling is commonly used in criminal investigations.

(i) Name the location of DNA in a human cell. [1]

……

(ii) There are 4 different bases in DNA.
Describe how these bases always pair up. [2]

……..

……..

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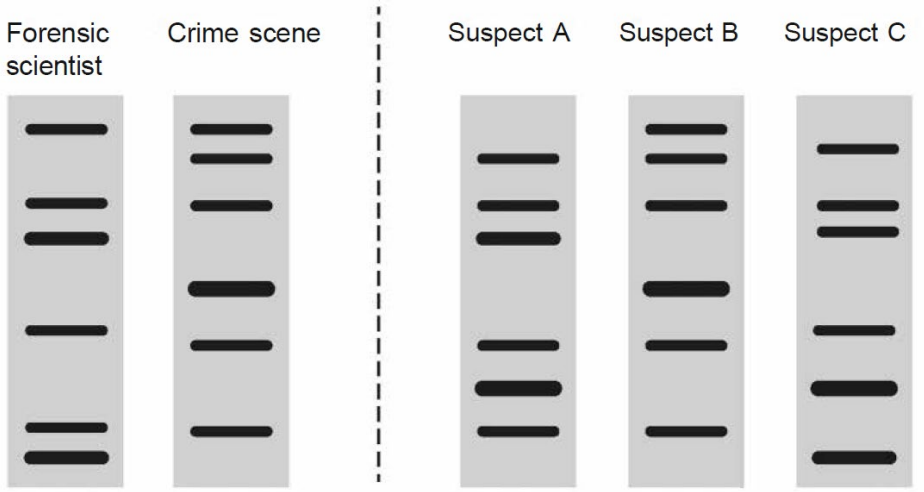
(iii) The forensic police unit analysed DNA found at a crime scene.

They compared a DNA profile produced from the crime scene with the DNA profiles of three suspects, A, B and C.

They also included a DNA profile from the forensic scientist who carried out the investigation.

They are all shown in the image below.



Identify the suspect linked to the crime scene by the DNA profiles and explain your choice of suspect. Suggest why DNA from the forensic scientist was also included in the investigation. [2]

……

……

……

……

(iv) Give **one other** use of DNA profiling. [1]

……

……

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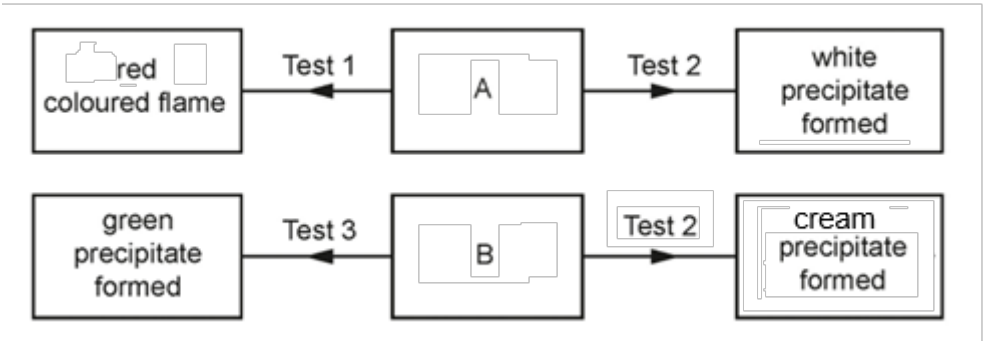
(b) Powders **A and B** are collected at a crime scene.

They are dissolved in water and the following tests are used to identify them.

Test	Action
1	Flame test
2	Add silver nitrate solution
3	Add sodium hydroxide solution

The results of the tests are given below.



Identify **A** and **B**. [4]

A .....

B .....

10

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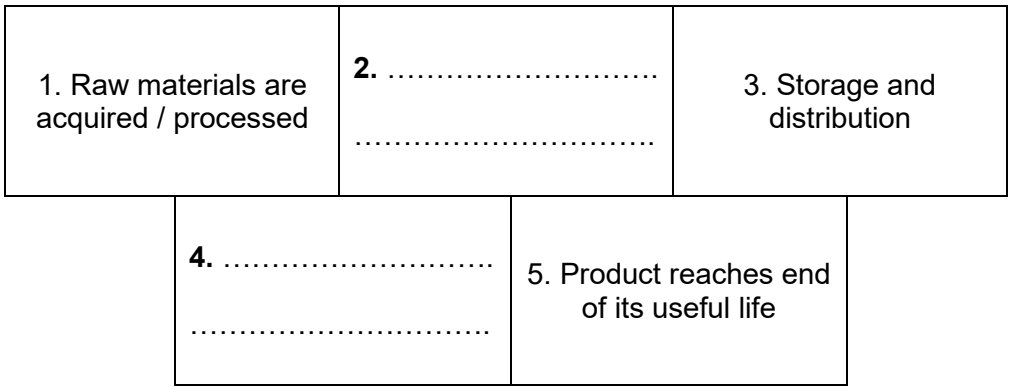
4. The Welsh Government produced a document called Beyond Recycling in 2020. It referred to Life-cycle assessments (LCA). This is a process of evaluating the effects that a product has on the environment over the entire period of its life.

(a) **Complete the stages** of an LCA. [2]



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(b) The table shows a life cycle assessment of using PVC or wood to make window frames of a certain size.

The data can be used to decide which is the better option to use.

Factor	Wood	PVC
Raw materials	Trees	Oil
Total energy used in production	9150 MJ	9713 MJ
Coal and oil used in production and/or painting	5.37 kg	18.23 kg
Natural gas consumption in replacing heat lost through the window	169 kg	183 kg
Water eutrophication effect (grams of phosphate)	67	1.6
Disposal when replaced	Can be used as fuel	Difficult to recycle – non biodegradable
Waste materials after use (excluding glass)	11.5 kg	13.2 kg
Cost (£ per m^3)	£420	£160
Density (kg/m^3)	150	60

(i) Give the **two** factors which should not have been included in the LCA. [2]

1. ……..

2. …….

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(ii) Use the data to give **three** reasons why the wooden option is more sustainable. [3]

1. ……..

2. ……..

3. ……..

(iii) Use the data to explain why using wood will have a greater effect on water animals. [3]

……..

……..

……..

……..

……..

……..

(iv) A wooden window frame has the same mass as a PVC frame. Compare the volumes of each material used to make the frames. [3]

……..

……..

……..

……..

……..

……..

Examiner only

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5. The grey squirrel is an invasive non-native species in the UK. Red squirrel populations have decreased in numbers since the introduction of the grey squirrel.

(a) State **two** reasons why the red squirrel population has decreased. [2]

1 ……

……

2 ……

……

(b) The Red Squirrel Trust Wales was set up to protect areas threatened by grey squirrels.

Anglesey is an island connected to the North Wales coast by two bridges. This made it an ideal site for a project to conserve the red squirrel. In 1998, red squirrels were only found in two forests on the island.

One of these was a 244 hectare (ha) forest where grey squirrels were controlled by trapping.

(i) One method of estimating the number of squirrels involves counting the number of nests.

Number of red squirrels per ha = number of nests per ha $\times$ 0.26

Number of grey squirrels per ha = number of nests per ha $\times$ 0.74

The mean number of red squirrel nests per ha is 0.48 and the mean number of grey squirrel nests per hectare is 1.2.

Calculate the difference in population in this forest. [4]

Difference in population = …….

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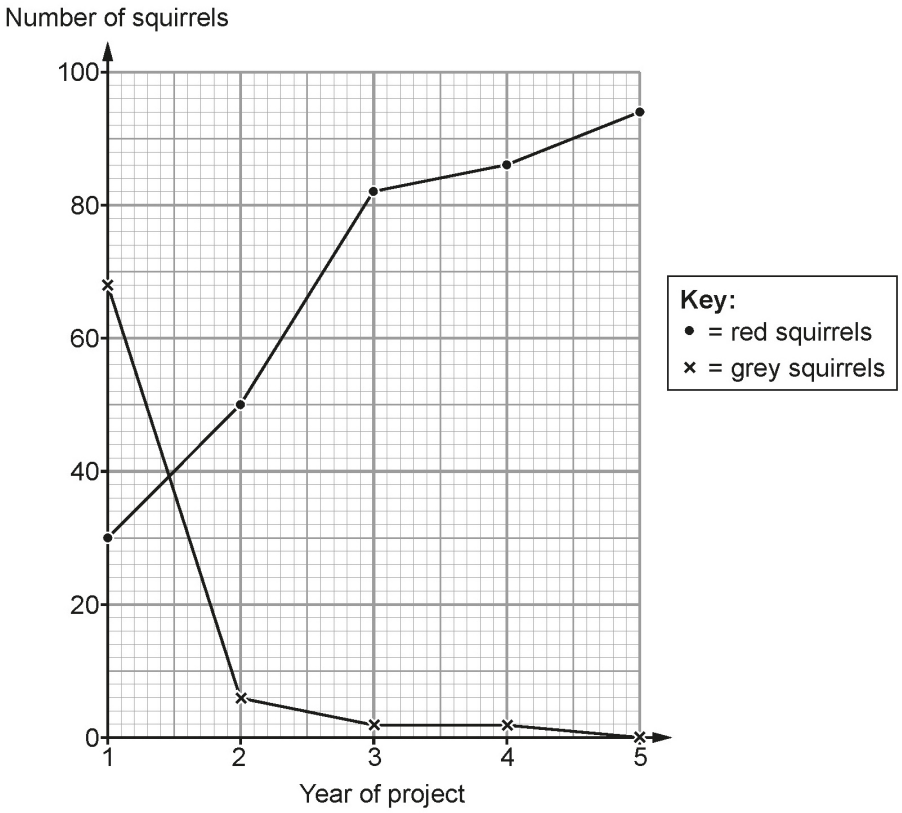
(ii) The results of a trial designed to control grey squirrel numbers by trapping over five years in a different forest are shown in the graph.



Use the graph to explain whether the trial was a success. [2]

……

……

……

……

(iii) State **one** method, other than trapping, that can be used to protect biodiversity. [1]

……

……

9

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6. Food self-sufficiency means that a country produces enough food to feed all of its people without having to import food from other countries.

(a) Students investigated the effect of NPK fertiliser when growing plants.

Rice plants were treated with solutions of different concentrations of an NPK fertiliser.

They were treated each day for five weeks.

Plant growth was measured. The results are shown in the table below.

Concentration of NPK fertiliser (units)	Plant growth after **5 weeks** (mm)				
	Trial 1	Trial 2	Trial 3	Trial 4	Mean
0.2	27	29	32	28	29
0.4	55	57	58	62	58
0.6	65	67	68	72	68
0.8	70	72	73	77	73

(i) Calculate the difference in mean plant growth **per week** for the plants treated with 0.2 and 0.6 units of NPK fertiliser. [3]

Difference = ……. mm/week

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(ii) John suggests that growth **always** doubles if the concentration of fertiliser is doubled.

Use data from the table to explain to what extent you agree with him. [3]

……..

……..

……..

……..

……..

……..

(b) Hydroponics is used to grow plants under controlled conditions. Describe **two** differences between hydroponics and traditional methods of growing plants. [2]

1. ……

……

2. ……

……

8

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7. (a) Define the term carbon footprint. [1]

Examiner only

……

……

(b) The table gives information about some common gases present in the atmosphere.

Gas	Lifetime (years)*	Global warming potential (over time)	
		20 years	100 years
Carbon dioxide	300 to 1000	1	1
Water vapour	9 days*	1×10^{-3}	1×10^{-3}
Methane	12	84	28
Nitrous oxide	120	264	265

There is a debate around whether methane should be trapped and burned or just released into the atmosphere.

The reaction occurring when methane is burnt is represented in the word equation below.

16 kg methane + 64 kg oxygen → 44 kg carbon dioxide + 36 kg water

Dylan said we should trap and burn methane because it has a higher global warming effect than carbon dioxide.

Carys said we should not because the mass of carbon dioxide produced is much higher and water vapour is also produced.

Explain who you agree with. Use an equation from page 2 and information from the table for a 100 year period. [4]

……

……

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(c) One farmer supplies 5000 kg of beef to the food industry every year. Another farmer supplies 5000 kg of poultry. Use the information in the table below to calculate the difference in carbon footprint of the two farming methods. [2]

Food source	$kgCO_2eq$ per kg of product
beef	13.3
poultry	3.5
eggs	1.9
milk	0.9

Difference in carbon footprint = …….. kgCO2eq

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8. The Falcon is a rocket used to place satellites in orbit around the Earth. The first stage of a Falcon rocket is reusable, but the second stage is not.

(a) One type of Falcon rocket has a take-off mass of 480 000 kg and weight of 4 800 000 N. It produces a thrust of 6 000 000 N.

(i) As the rocket rises its mass decreases as fuel is burned and the thrust remains the same.

Ali says less fuel means the rocket's acceleration will decrease.
Explain whether you agree with Ali. [2]

……

……

……

……

(ii) The first stage of the Falcon returns to Earth. It free falls through the atmosphere. When close to the ground, boosters fire to reduce the speed to zero at landing.

Explain how the acceleration of the first stage changes during its return to Earth. [2]

……

……

……

……

(b) When the satellites are placed in orbit they communicate with ground stations on Earth using microwaves of frequency 8 GHz travelling at a speed of 3×10^8 m/s.

Use an equation from page 2 to calculate the wavelength of these microwaves. [3]

Wavelength = ……. m

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END OF PAPER

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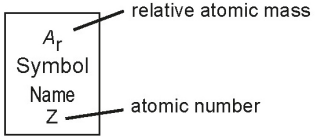
THE PERIODIC TABLE

1	2	Group										3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key



Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
	…… ……

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INTEGRATED SCIENCE (SINGLE AWARD)

UNIT 2: SCIENCE IN A CHANGING WORLD

Higher Tier

MARK SCHEME

Guidance for examiners

Generic marking principles

- Marks awarded are always whole marks (not half marks, or other fractions).
- Answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.
- Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
- Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Positive marking

It should be remembered that candidates are writing under examination conditions and credit should be given for what the candidate writes, rather than adopting the approach of penalising candidates for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based, the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

Mark schemes often list points which may be included in candidates' answers. The list is not exhaustive. The inclusion of *'Credit any other valid response.'* (or similar instruction) within mark schemes allows for the possible variation in candidates' responses. Credit should be given according to the accuracy and relevance of candidates' answers.

Appropriate terminology is reflected in exemplar responses in mark schemes. However, unless there is a specific requirement within a question, candidates may be awarded marks where the answer is accurate but expressed in their own words.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

ecf = error carried forward
bod = benefit of doubt

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Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Enquiry
1.	(a)	More common in X (1) and evenly distributed in habitat X (1) OWTTE		2		2		2
	(b)	Mean of 2 per quadrat (1) 15 × 2 (ecf) = 30 (1)		2		2	1	2
	(c)	Take more quadrat samples			1	1		1
		Question 1 total	**0**	**4**	**1**	**5**	**1**	**5**

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Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry
2.	(a)	Uranus		1			1		
	(b)	(i)	Venus			1	1		
		(ii)	Mars			1	1		
	(c)	(i)	As distance increases, temperature decreases		1		1		
		(ii)	Highest % of carbon dioxide in the atmosphere		1		1		
	(d)	(i)	Between -64 and -129 [°C]			1	1		
		(ii)	Between 3 and 11 [years]			1	1		
	(e)	(i)	0.5 [AU]		1		1		
		(ii)	4.7 [minutes]		1		1	1	
		(iii)	**Any 2 × (1) from:** Food supply (1) Oxygen supply (1) Water supply (1) Effect of low gravity (1)	2			2		
		(iv)	1025 × 3.7 (1) subs = 3792.5 [N] (1)	1	1		2	2	
Question 2 total				**4**	**5**	**4**	**13**	**3**	**0**

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Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry
3.	(a)	(i)	In the nucleus Accept mitochondria	1			1		
		(ii)	C – G (1) A – T (1)	2			2		
		(iii)	Suspect B + Same {banding pattern/ bands/ pattern/ DNA profile/ genetic profile} (as crime scene)/ {DNA/ lines} match (up) (1) In case DNA from the forensic scientist has contaminated the crime scene (1)			2	2		
		(iv)	Paternity tests / identify genetic diseases	1			1		
	(b)		A – lithium (1) chloride (1) B – iron(II) (1) bromide (1)		4		4		4
			Question 3 total	**4**	**4**	**2**	**10**	**0**	**4**

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Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry
4.	(a)		<table><tr><td>2. Manufacturing process</td><td>4. Product used by consumer</td></tr></table> 2 × (1)	2			2		
	(b)	(i)	Cost (1) Density (1)		2		2		
		(ii)	**Any 3 × (1) from:** Unlimited wood supply / oil is a limited supply (1) Total energy used in production is less (1) natural gas consumption in replacing heat lost through the window is less (1) Less coal and oil used in production and/or painting		3		3		
		(iii)	Water eutrophication effect is greater for wooden windows (1) causes excessive growth of algae in water (1) depletes the water of oxygen causing the death of fish (1)	 1 1	1		 3		
		(iv)	Volume= $\frac{\text{mass}}{\text{density}}$ (1) Density of PVC is smaller (1) Therefore volume of PVC used is greater. (1)		3		3		
			Question 4 total	**4**	**9**	**0**	**13**	**0**	**0**

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Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry
5.	(a)		**Any 2 × (1) from:** Less successful at competing for food / water (1) Less successful at nesting / habitats / shelter (1) More predation (1) Spread of disease (1) Poorer camouflage (1)	2			2		
	(b)	(i)	Number of red squirrels per ha = 0.48 × 0.26 = 0.1248 (1) select and sub Number of grey squirrels per ha = 1.2 × 0.74 = 0.888 (1) select and sub Difference/ha = 0.888 – 0.1248 = 0.7632 (1) Difference in forest = 0.7632 × 244 = 186(.2) (1)		4		4	4	
		(ii)	Rapid decrease of grey squirrels in second year and has dropped to zero (1) Rapid increase of red squirrels in early years but increase has declined (1) so yes, the trial was a success.			2	2		
		(iii)	Captive breeding (of red squirrels) / introduce predator (to grey squirrel)	1			1		
			Question 5 total	**3**	**4**	**2**	**9**	**4**	**0**

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Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry
6.	(a)	(i)	$\frac{29}{5}$ = 5.8 (1) $\frac{68}{5}$ = 13.6 (1) Difference = 7.8 (mm/week) (1) OR 68 – 29 (1) = 39 (1) 39 / 5 = 7.8 (1)		3		3	2	3
		(ii)	0.2 to 0.4 g increase from 29 to 58 (1) 0.4 to 0.8 g increase from 58 to 73 (1) only doubling from 0.2 to 0.4 so do not agree (1)			3	3	2	3
	(b)		**Any 2 × (1) from:** Hydroponics involves growing plants in which the soil has been replaced with a solution (but traditional methods involves oil) (1) The solution contains minerals (but traditional methods have minerals in/added to the soil) (1) The solution is {pumped / moved} around the plant roots (but traditional methods involve static media) (1)	2			2		
			Question 6 total	**2**	**3**	**3**	**8**	**4**	**6**

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Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Enquiry
7.	(a)	Carbon footprint is the total equivalent amount of carbon dioxide generated by our activity.	1			1		
	(b)	The GWP of water vapour is negligible and is ignored (1) CO_2eq of 44 kg of carbon dioxide over 100 y = 44 kg (1) CO_2eq of 16 g of methane over 100 y = 16 × 28 (1) = 448 [kg] (1) Dylan is correct Conclusion must be present for full marks.			4	4	2	
	(c)	13.3 – 3.5 = 9.8 (1) 9.8 × 5000 = 49 000 kgCO_2eq (1) OR Carbon footprint of beef = 5000 x 13.3 = 66 500 Carbon footprint of poultry = 5000 x 3.5 = 17 500 (1 mark for either) Difference = 66 500 – 17 500 = 49 000 (1)		2		2	1	
		Question 7 total	**1**	**2**	**4**	**7**	**3**	**0**

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Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry
8.	(a)	(i)	Weight decreases (1) so resultant force increases as does acceleration (1) so disagree with Ali.			2	2		
		(ii)	As first stage speeds up during its fall the acceleration decreases to zero (1) As the boosters fire there is a deceleration which decreases to zero (1)		2		2		
	(b)		$3 \times 10^8 = 8 \times 10^9 \times$ wavelength (1) subs and conversion Wavelength = $\frac{3 \times 10^8}{8 \times 10^9}$ (1) manipulation = 0.04 or 0.038 or 0.0375 m (1)		3		3	3	
			Question 8 total	**0**	**5**	**2**	**7**	**3**	**0**

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HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	ENQUIRY
1	0	4	1	5	1	5
2	4	5	4	13	3	0
3	4	4	2	10	0	4
4	4	9	0	13	0	0
5	3	4	2	9	4	0
6	2	3	3	8	4	6
7	1	2	4	7	3	0
8	0	5	2	7	3	0
TOTAL	**18**	**36**	**18**	**72**	**18**	**15**

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