GCSE Combined Science: Trilogy (AQA 8464)

Higher Tier

Mark scheme

Introduction

The information provided for each question is intended to be a guide to the type of answers students may produce, but can be neither exhaustive nor prescriptive. Award marks according to your professional judgement for all appropriate responses.

Disclaimer

- These mark schemes and exemplar answer content are entirely the work of the question author and have not been produced by, reviewed by or endorsed by AQA.
- Where marks are suggested and levels mapped to particular styles or features of answers, these are intended for guidance only and cannot reflect the full examination marking process, which involves moderation and alignment of level boundaries across a full, national student cohort that cannot be determined from a standalone product such as this set of Practice Papers.
- Therefore, mark allocation, mark totals, suggested levels and overall assessments of performance as found in these Practice Papers and Mark Schemes represent only a limited guide to possible outcomes, and are not a reliable indicator of actual performance.

Information for teachers

1. General

The mark scheme for each question gives:

- the marks available for each part of the question
- the total marks available for the question
- the correct answer or, if multiple correct answers are possible, a typical correct answer with variations
- extra information to help with making decisions about how many marks to award
- the Assessment Objective(s) from the GCSE Specification that the part question is intended to cover.

The 'extra information' is aligned to the appropriate answer and is only intended for consideration with that particular part of the answer.

2. Marking of lists

For question parts where a set number of responses is requested, all possible correct answers are stated. Each correct response should be awarded a mark as indicated, up to a maximum for the question part as stated on the question paper and as written in this marks scheme.

If a student has provided more than the set number of responses requested, the principle to be followed is that 'right + wrong = wrong'. Each error or contradictory response negates each correct response. If the number of errors and contradictions equals or exceeds the number of correct responses, no marks can be awarded for that part of the question.

3. Use of symbols and formulae

If an accepted scientific symbol or formula is written instead of a required chemical name or unit, award full marks if the symbol or formula is correct and if, in the context of the question, the response is appropriate.

4. Calculations

Award marks for each correctly completed stage of a calculation, as students are instructed to show their working.

Full marks can be given for a correct numerical answer (including units), even though no working is shown.

5. Interpretation of 'it' and 'them'

Answers using the word 'it' or 'them' should be awarded marks only if it is clear that the 'it' or 'them' refers to the correct subject.

6. Errors carried forward

An error in the answers to a structured question should be penalised once only.

Allowances for errors carried forward are usually restricted to calculation questions. Where such allowances are permissible, the mark scheme includes a statement such as 'allow ecf'.

7. Phonetic spelling

The phonetic spelling of correct scientific terminology should be awarded marks unless there is a possible confusion with another technical term.

8. Brackets

(……) in this marks scheme indicates information that is not essential for a mark to be awarded, but is included to help you identify the sense of the required answer.

9. Ignore / insufficient / do not allow

'Ignore' or 'insufficient' are used in this marks scheme to indicate information that is irrelevant to the question or not enough to gain the mark. Further correct amplification could gain the mark.

'Do not allow' indicates that this is a wrong answer which, even if the correct answer is also given, still means that the mark should not be awarded.

'Level of response' marking instructions

'Level of response' mark schemes are broken down into levels, each of which is given a descriptor. The descriptor for a level shows the average performance for that level. There are marks allocated to each level.

Before applying the mark scheme to a student's answer, read through the answer and annotate it to show the qualities that are being looked for. Then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a 'ladder' to see whether the answer meets the qualities given in the descriptor for that level. If the answer meets the lowest level, move up to the next level and repeat the assessment until you find a match between the descriptors and the answer.

When assigning a level, you should look at the overall quality of the answer and not be distracted by small details of the answer where the student may not have performed quite as well as their overall performance. If an answer covers different aspects of different levels of the mark scheme, use a 'best fit' approach: for example, if a response is predominantly level 2 with a small amount of level 3 material, place it in level 2 but award a mark near the top of the level because of the level 3 content.

Step 2 Determine a mark

The descriptors within each level can help with this, along with the exemplar answers or extra information given. Indicative content is provided as a guide. It is not exhaustive and you should credit other valid points in the answer. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

Ignore any responses that are irrelevant. However, only award full marks if there are no incorrect or contradictory responses.

An answer that contains nothing of relevance to the question must be awarded no marks.

Read back through the full answer as you apply the mark scheme, so as to clarify points and assure yourself that the level and the mark are appropriate.

Paper 1

Question 01

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
01.1		mark by column, 1 mark per correct column	3	AO1/4.1.1.1 4.1.1.2
01.2	measure cell between A and B in mm convert to µm divide by 1000	award 2nd and 3rd marking points even if measurement is incorrect	1 1 1	AO2/2 4.1.1.5
01.3	mitochondria, provide energy for active transport folded membrane, increases surface area		1 1	AO2/2 4.1.1.3
TOTAL			8	

Table for 01.1:

Structure	Animal cell	Plant cell	Bacterial cell
Cell membrane	✓	✓	✓
Cell wall		✓	✓
Nucleus	✓	✓	
Chloroplast		✓	
Plasmids			✓

Question 02

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
02.1	translocation		1	AO1/4.1.1.2
02.2	Phloem is composed of tubes of elongated cells		1	AO1/1 4.2.3.2
	with pores in the end walls.		1	
	Cell sap can move from one phloem cell to the next.		1	
02.3	starch is insoluble	accept 'is not washed out of cells'	1	AO1/1 4.4.1.3
	does not affect osmosis		1	AO2/1 4.1.3.2
02.4	add iodine solution		1	AO2/2 4.2.2.1
	blue/black colour is the positive test result for starch		1	
TOTAL			**8**	

Question 03

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.1	**Level 3:** A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant techniques and procedures. The steps in the method are logically ordered. The method would lead to the production of valid results.		5–6	AO2/2 4.4.2.2
	Level 2: The bulk of the method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant scientific techniques and procedures. The method may not be in a completely logical order and may be missing some detail.		3–4	
	Level 1: Simple statements are made which demonstrate some understanding of some of the relevant scientific techniques and procedures. The response may lack a logical structure and would not lead to the production of valid results.		1–2	
	No relevant content.		0	

Indicative content To get resting pulse: • sit still for 5 minutes (or other stated length of time) • take pulse using 2 fingers at wrist/neck • count for 15 seconds and multiply by 4 to get beats per minute • record pulse rate and repeat until pulse rate is constant low value. During exercise: • ensure exercise is of same intensity throughout • use a running machine with settings / use a metronome to get steps regular, etc. • do not measure pulse rate during exercise. After exercise: • immediately after stopping exercise note the time • immediately after stopping take pulse using 2 fingers at wrist/ neck • count for 15 seconds and multiply by 4 to get beats per minute • record pulse rate and repeat until pulse rate is same as resting value • record the time at which the resting value is reached; this is the recovery time.	AO1/1 4.4.2.2 4.4.2.3 4.1.3.1 4.2.2.3

Marks continued on next page.

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.2	during exercise some anaerobic respiration may occur	accept reference to oxygen debt	1	AO1/1 4.2.2.2
	lactic acid is produced		1	
	oxygen is needed to break down the lactic acid		1	
TOTAL			**9**	

Question 04

04.1	to stop the lamp heating the plant		1	AO2/2 4.4.1.2
04.2	to provide carbon dioxide		1	AO2/2 4.4.1.2
04.3	oxygen		1	AO2/4.1.2.5
04.4	number of bubbles	accept any suitable unit of time, e.g. seconds, minutes	1	AO3/3a
	time		1	4.4.1.2
04.5	$d^2 = 100$		1	AO2/2
	$\frac{1}{d^2} = 0.01$		1	4.4.1.2
04.6	light intensity		1	AO3/1a 4.4.1.2
04.7	carbon dioxide (concentration) is no longer a limiting factor		1	AO3/1a 4.4.1.2
TOTAL			**9**	

Question 05

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
05.1	To make sure all the cylinders were same width/same cross-sectional area		1	AO3/3a 4.1.3.2
05.2	plus means cylinder got longer and minus means it got shorter		1	AO2/2 4.1.3.2
05.3	$\frac{15}{51} \times 100$ **X** = +29.4(%)		1	AO2/2 4.1.3.2
05.4	to allow results to be compared *or* they had different lengths at start		1	AO2/2 4.1.3.2
05.5	plot concentration of sugar solution on *x*-axis plot percentage change in length on *y*-axis draw a line of best fit read off value on *x*-axis where line of best fit crosses it, i.e. where percentage change in length is zero		1 1 1 1	AO2/2 AO3/2a 4.1.3.2
05.6	**Level 2:** A detailed and coherent explanation is given, which logically links change in length with concentration of sugar solution using knowledge of osmosis.		3–4	AO1/1 AO2/1 AO3/2b 4.1.3.2
	Level 1: Relevant points made. Links may not be made.		1–2	
	No relevant content.		0	
	Indicative content • turnip has lost water • cells shrinking causes cylinder to get shorter • 0.8 mol/dm^3 sugar solution is more concentrated than cell sap • water moves from less concentrated solution to more concentrated solution • across cell membrane • by osmosis			
TOTAL			12	

Question 06

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
06.1	sexual contact	accept contaminated blood products	1	AO1/1 4.3.1.2
	drug users sharing needles		1	
06.2	overall increase from 0 in 1981 to 6000 in 2015	1 mark for general trend	1	AO2/2 4.3.1.2
	description of peaks using figures from graph	2 marks for more detail of changes in trend	1	
	description of levelling off using figures from graph		1	
06.3	Not everyone who gets HIV develops AIDS		1	AO2/2 4.3.1.2
	or			
	you can't get AIDS without having HIV first			
06.4	white blood cells are infected with HIV	accept more detailed answer	1	AO1/1 4.3.1.6
	so no longer work to produce antibodies to destroy bacteria		1	
TOTAL			**8**	

Question 07

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
07.1	body very thin so oxygen can diffuse in through surface		1	AO3/1a 4.1.3.1
	intestine branched so near to all cells so glucose can diffuse out and into cells		1	
07.2	**Level 3:** A detailed and reasoned description and explanation of how the structure of the human lungs allows efficient gas exchange.		5–6	AO1/1 4.1.3.1 4.2.2.2
	Level 2: Some description of structure but not always clearly linked to explanation of how this leads to efficient gas exchange.		3–4	
	Level 1: Discrete relevant points made but logic may be unclear.		1–2	
	No relevant content.		0	
	Indicative content General idea of rate of diffusion is increased if: • there is a large surface area • short diffusion distance • steep concentration gradient Large surface area achieved by: • many alveoli Short diffusion distance achieved by: • alveoli walls only 1 cell thick • capillary walls only 1 cell thick • red blood cells in contact with capillary walls Steep concentration gradient achieved by: • lungs are ventilated • carbon dioxide is breathed out • more oxygen is breathed in with air • blood flows past alveoli • oxygen is carried away in red blood cells • so maintaining concentration gradient			
TOTAL			**8**	

Question 08

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
08.1	mitosis		1	AO1/1 4.1.2.2
08.2	12–16 and 36–40		1	AO1/1
	the mass of DNA doubles		1	AO2/2 4.1.2.2
08.3	24 and 48		1	AO1/1
	mass of cell and mass of DNA per cell halves		1	AO2/2 4.1.2.2
08.4	2		1	AO1/1
	the mass of the cell and DNA doubles and halves twice		1	AO2/2 4.1.2.2
08.5	72 hours		1	AO2/2 4.1.2.2
TOTAL			**8**	

	Paper 2			
	Question 01			
QUESTION	**ANSWERS**	**EXTRA INFORMATION**	**MARK**	**AO / SPEC. REF.**
01.1	Kingdom *tigris*	ignore italics or underlining	1 1	AO1/1 4.6.4
01.2	weight/mass of animals available for the tiger to eat		1	AO2/1 4.7.2.1
01.3	20		1	AO2/1 4.7.1.1
01.4	**Level 2:** A detailed and coherent explanation is provided. Logical links between clearly identified, relevant points explain how the population of tigers is affected by deforestation.		3–4	AO1/1 4.7.1.1 4.7.3.1
	Level 1: Simple statements made, but not precisely. The logic is unclear.		1–2	AO2/2 4.7.1.3
	No relevant content.		0	
	Indicative content • loss of habitat for tigers • loss of habitat for prey animals • loss of food sources for prey animals • so fewer prey animals • increased competition between tigers and/or other predators for prey • as less prey then fewer tigers in the forest • increased competition between tigers for mates as fewer tigers			
TOTAL			**8**	

Question 02

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
02.1	meiosis halves chromosome number, but cannot halve 33		1	AO2/1 4.6.1.1
02.2	seeds are formed when gametes (pollen and egg cells) fuse	look for the idea that without gametes there can be no fertilisation	1	AO2/1 4.6.1.1
02.3	suckers produced by mitosis all cells will be genetically identical *or* no meiosis so no genetic variation in cells	look for idea that without sexual reproduction there will be a lack of genetic variation	1 1 or 1 1	AO2/1 4.6.1.1
02.4	**Level 2:** A detailed and coherent explanation is provided. The student makes logical links between clearly identified, relevant points that explain how resistant plants can be produced from plant meristem tissue.		3–4	AO1/1 AO2/2 4.1.2.3
	Level 1: Simple statements are made, but not precisely. The logic is unclear.		1–2	
	No relevant content.		0	
	Indicative content: • all the stem cells from the meristem of the resistant plant will have resistance genes • meristem tissue from plants divides by mitosis • meristem tissue in plants can differentiate into any type of plant cell • clones of the resistant plant can be produced quickly • all the plants will be genetically identical • all the plants will be resistant to the disease.			
TOTAL			**8**	

Question 03

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.1	Type 1 diabetics do not produce insulin		1	AO1/1 4.5.3.2
	Type 2 diabetics do produce insulin but cells do not respond to it		1	
03.2	points plotted accurately	reject line of best fit	1	AO2/2 4.5.3.2
	points joined with straight lines		1	
03.3	fasting blood glucose level is high		1	AO2/2 4.5.3.2
	blood glucose level rose and stayed high		1	
03.4	**Level 2:** A detailed and coherent explanation is given. Logical links between clearly identified relevant points are made to explain glucose levels are controlled.		3–4	
	Level 1: Discrete relevant points are made. The logic may be unclear.		1–2	
	No relevant content.		0	
	Indicative content: • blood glucose levels rise in first 30 minutes, up to 6.5 mmol/dm^3 • as glucose is absorbed from the gut into bloodstream • high blood glucose triggers release of insulin (from the pancreas) • insulin causes glucose to move from blood into cells • so lowering blood glucose concentration back to fasting glucose level (4.5 mmol/dm^3) • as cells use glucose for respiration blood glucose concentration falls • below fasting glucose levels (4.0 mmol/dm^3) • low blood glucose concentration triggers release of glucagon (from pancreas) • glucagon causes glycogen (in liver cells) to be converted to glucose and released into blood • blood glucose concentration rises again.			
TOTAL			**10**	

Question 04

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
04.1	pancreas		1	AO1/1 4.5.3.2
04.2	plasmid		1	AO3/1a 4.6.2.4
04.3	cheaper no need to kill animals less problem with allergy or rejection of animal insulin	accept other reasonable answers	1 1 1	AO2/2 4.6.2.4
TOTAL			**5**	

Question 05

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
05.1	use a tape measure across the field		1	AO1/1 4.7.2.1
	use quadrats at each metre		1	
	record number and species of buttercup in 1 m^2		1	
05.2	One suitable abiotic factor, for example: • wind • light • pH • temperature	reject moisture as this is in the question reject carbon dioxide concentration as this is likely to be the same on ridge and in furrows	1	AO2/1 4.7.1.2
05.3	Two suitable factors, for example: • same number of seeds per pot • same temperature • same light intensity • same soil • same amount of fertiliser	reject moisture as this is in the question look for the idea of keeping the factor constant	2	AO3/3a 4.7.1.2
05.4	A = *Ranunculus repens* B = *Ranunculus bulbosus*		1	AO3/2b 4.7.1.2
05.5	try to breed species A with species B		1	AO2/1 4.6.2.2
	if same species they will produce fertile offspring *or* if separate species will not produce fertile offspring		1	
TOTAL			**9**	

Question 06

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
06.1	pituitary gland insulin —— pancreas adrenaline —— adrenal gland testosterone —— ovary testes	1 mark for each correct line deduct a mark for any additional lines	3	AO1/1 4.5.3.1 4.5.3.3 4.5.3.6
06.2	high level detected by hypothalamus pituitary gland releases less TSH thyroid gland releases less thyroxine	accept no TSH and no thyroxine	1 1 1	AO3/1a 4.5.3.6
06.3	when the level of thyroxine changed it was detected and a response brought it back to normal levels		1	AO2/1 4.5.3.6
TOTAL			7	

Question 07

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
07.1	animal cells do not have a cell wall		1	AO2/1 4.1.1.2
07.2	a change in the order of the bases in DNA	accept description of addition, deletion or substitution mutations	1	AO1/1 4.6.2.1
07.3	bacteria with resistance gene survive when exposed to antibiotic and pass on the resistance gene		1	AO1/1 4.6.3.4
07.4	strain X increases in number until penicillin is added		1	AO2/2 4.6.3.4
	strain X number decreases after penicillin added until none left		1	
	strain Y increases in number even after addition of penicillin		1	
07.5	strain Y		1	AO3/2b 4.6.3.4
07.6	So all bacteria are killed. If some remained, they would be those with some resistance to the antibiotic.		1	AO1/1 4.6.3.4
TOTAL			8	

Question 08

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
08.1	4 = tt		1	AO1/1
	3 = Tt		1	4.6.1.4
08.2	both parental genotypes are Tt	no marks for parental genotype and phenotype	1	AO2/2
	both parental phenotypes are tasters	allow error carried forward		
	gametes correct T, t	allow 75% or 3 in 4 or 3 : 1	1	AO3/2b
	correct derivation of offspring		1	4.6.1.4
	TT and Tt circled as tasters			
	probability = 0.75		1	
TOTAL			**6**	

Question 09

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
09.1	pituitary (gland)		1	AO1/1 4.5.3.3
09.2	LH peaks	ignore reference to FSH	1	AO3/1a 4.5.3.3
09.3	as oestrogen increases in concentration FSH falls	look for evidence from graph look for explanation	1	AO3/1a 4.5.3.3
	oestrogen inhibits FSH so no eggs can mature		1	AO3/2b 4.5.3.4
09.4	progesterone increases to prepare uterine lining for implantation of embryo/ fertilised egg		1	AO1/1
	decreases because fertilisation did not occur		1	AO3/2b 4.5.3.3
09.5	FSH stimulates follicle to develop		1	AO3/2b 4.5.3.3
	developing follicles release oestrogen which inhibits FSH production		1	
	without inhibition by oestrogen FSH continues to be produced (leading to high levels in blood)		1	
TOTAL			**9**	

	Paper 3			
	Question 01			
QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
01.1	Rubidium		1	AO1 5.1.2.5
01.2	Radium		1	AO1 5.1.2.1
01.3	Helium		1	AO1 5.1.2.4
01.4	Krypton		1	AO1 5.1.2.4
01.5	Fluorine		1	AO1 5.1.2.6
TOTAL			**5**	
	Question 02			
02.1	masses		1	AO1 5.1.2.2
02.2	properties		1	AO1 5.1.2.2
02.3	groups		1	AO1 5.1.2.2
02.4	he left them for undiscovered elements that fitted the properties of the group		1 1	AO2 5.1.2.2
02.5	iodine would have been in group 6 but similar elements (fluorine, chlorine and bromine) were in group 7	accept iodine would be in a group with different properties accept tellurium would have been in group 7	1	AO2 5.1.2.2
02.6	air is a mixture, not an element		1	AO1 5.1.2.2
TOTAL			**7**	

Question 03

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.1	30 °C	the actual boiling point is 36 °C	1	AO1 5.7.1.3
03.2	Liquid		1	AO1 5.2.2.1
03.3	there are stronger forces between the particles	accept molecules or atoms accept there are stronger intermolecular forces	1	AO2 5.2.2.4
TOTAL			**3**	

Question 04

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
04.1	energy absorbed by breaking bonds: $(2 \times 436) + 498 = 1370$ energy released by forming bonds: $4 \times 464 = 1856$ overall energy change $= 1370 - 1856$ $= -486$ kJ/mol	(+)486 gets 2 marks	1 1 1	
04.2	Exothermic	accept endothermic if the answer given in 04.1 is positive	1	
TOTAL			**4**	

Question 05

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
05.1	neutron	accept proton	1	AO1 5.1.1.3
05.2	The plum pudding model has an even distribution of mass throughout it. Result 1 suggests that there is a large amount of mass concentrated in one point. Result 2 suggests that most of an atom has no mass.	For result 1, accept that if an atom had the plum pudding model, the particles would all pass through/all deflect in the same way. For result 2, accept there is space between the nucleus and the electrons. Accept atoms have a nucleus. Accept that if an atom had the plum pudding model, the alpha particles would not deflect so much as the mass would not be as concentrated.	1 1 1	AO2 5.1.1.3 WS 1.1 WS 3.6
TOTAL			**4**	

Question 06

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
06.1	$\dfrac{(54 \times 6.0) + (56 \times 92.0) + (57.0 \times 2.0)}{100}$ $= 55.9$		1 1	AO3 5.1.1.6
06.2	they have different masses they might be radioactive	accept different densities	1 1	AO2 6.4.1.2
TOTAL			**4**	

Question 07

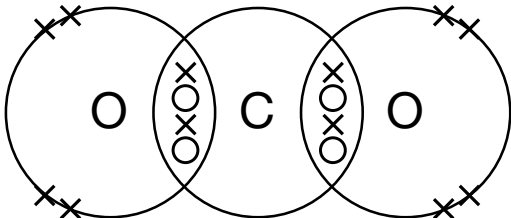| QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
07.1	$(23 \times 2) + 32 + (16 \times 4)$ $= 142$	allow 1 mark for evidence of $(23 \times 2) + 32 + (16 \times 4)$	1 1	AO2/1 5.2.1.4 5.3.1.2
07.2	mass of sodium sulfate $= 0.5 \times 142$ $= 71$ g volume of water in dm^3 $= \frac{2500}{1000} = 2.5$ dm^3 concentration of sodium sulfate in water is $\frac{71}{2.5} = 28.4$ g/dm^3	accept error carried forward for the M_r of sodium sulfate	1 1 1	AO2 5.3.2.5 MS3b
TOTAL			5	

Question 08

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
08.1	(1) WO_3 (s) + 3 H_2 (g) → (1) W (s) + 3 H_2O (g)	accept multiples	1	AO2 5.4.1.3
08.2	It forms a compound with the tungsten		1	AO1 5.4.1.3
TOTAL			2	

Question 09

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
09.1	One of: • wear safety spectacles • wear an apron		1	AO1 5.1.1.2
09.2	One of: • put the evaporating dish in a hot water bath • stop heating when the salt is at the point of crystallisation • evaporate in a flat-bottomed Petri dish	accept heat water in a beaker with the evaporating dish on top	1	AO3 5.1.1.2
09.3	distillation		1	AO1 5.1.1.2
TOTAL			**3**	

Question 10

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
10.1	It does not show the electrons.		1	AO3 5.4.1.4
10.2		needs to show two shared pairs of electrons between each C and O and four other electrons on each O	2	AO2 5.2.1.4
10.3	there are only weak forces between the molecules	accept there are weak intermolecular forces	1	AO2 5.2.2.4
	these weak forces do not require much energy to break		1	
	this gives the small molecules low melting points		1	
TOTAL			**6**	

Question 11

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
11.1	all points plotted correctly suitable line drawn	all points within +/− 1/2 a small square if 7–8 points are plotted correctly, 1 mark	2 1	AO2 5.5.1.1
11.2	the reaction had finished		1	AO2 5.6.1.1 MS4b
11.3	Any **one** from: • could use a polystyrene cup • could put a lid on the beaker • could stir the liquid		1	AO3 5.5.1.1
11.4	the temperature increases		1	AO2 5.5.1.1
TOTAL			**6**	

Question 12

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
12.1	chlorine (gas)		1	AO1 5.8.2.4
	bleaches damp litmus paper		1	
12.2	hydrogen (gas)		1	AO1 5.8.2.1
	pops when added to a lit splint		1	
12.3	sodium hydroxide		1	AO1 5.4.3.4
12.4	Any **one** from: • wear goggles • ventilate the room • do the practical in a fume cupboard		1	AO1 5.4.3.4 WS 2.4
12.5	it reduces the melting point		1	AO1 5.4.3.3
12.6	aluminium ion is Al^{3+}	accept multiples	1	AO3 5.4.3.1
	$Al^{3+} + 3e^- \rightarrow Al$	allow error carried forward from the charge on the aluminium ion $(Al^{x+} + xe^- \rightarrow Al)$	1	
12.7	the carbon reacts with the oxygen to make carbon dioxide gas and so the electrodes are burned away		1	AO1 5.4.3.3
TOTAL			**10**	

Question 13

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
13.1	**Level 3:** A detailed and coherent explanation is given, which demonstrates a broad understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links. A conclusion is reached.	5–6		AO3 5.4.2.5 5.4.2.2
	Level 2: An explanation is given which demonstrates a reasonable understanding of the key scientific ideas. A conclusion may be reached but the logic used may not be clear or linked to bond energies.	3–4		
	Level 1: Simple statements are made which demonstrate a basic understanding of some of the relevant ideas. The response may fail to make logical links between the points raised.	1–2		
	No relevant content.			
	Basic ideas: • ethanoic acid does not dissociate fully • hydrochloric acid dissociates fully • carbonate ions/CO_3^{2-} react with hydrogen ions/H^+ Linking statements: • ethanoic acid produces fewer hydrogen ions/H^+ than hydrochloric acid • so there is a lower concentration of hydrogen ions in ethanoic acid compared to the same concentration of hydrochloric acid Conclusion: • ethanoic acid will react at a slower rate than hydrochloric acid	Accept $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$ Accept $HCl \rightarrow H^+ + Cl^-$ Accept the converse in all cases.		
TOTAL			**6**	

Question 14

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
14.1	62 g – 46 g = 16 g		1	AO2 5.3.1.1
14.2	$\frac{46}{23}$ = 2 moles of sodium $\frac{16}{32}$ = 0.5 moles of O_2 $\frac{62}{62}$ = 1 mole of Na_2O	accept error carried forward from question 14.1	1	AO2 5.3.2.3 MS3b MS3c
	divide all numbers by 0.5, which gives 4 moles of sodium 1 mole of O_2 2 moles of Na_2O		1	
	$4Na + O_2 \rightarrow 2Na_2O$ add state symbols		1	
	$4Na\ (s) + O_2\ (g) \rightarrow 2Na_2O\ (s)$		1	
TOTAL			**5**	

Paper 4

Question 01

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
01.1	Hydrogen		1	AO1 5.8.2.1
01.2	It makes limewater cloudy		1	AO1 5.8.2.3
TOTAL			**2**	

Question 02

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
02	Increase the pressure Decrease the temperature		1 1	AO1 5.6.2.7 5.6.2.6
TOTAL			**2**	

Question 03

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.1	Butane, C_4H_{10}		1	AO1 5.7.1.3
03.2	Methane, CH_4		1	AO1 5.7.1.3
03.3	Sulfur dioxide Nitrogen oxides		1 1	AO1 5.9.3.2
TOTAL			**4**	

Question 04

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
04.1	102 °C		1	AO1 5.8.1.1
TOTAL			**1**	

Question 05

QUESTION	ANSWERS		MARK	AO / SPEC. REF.
05.1	An in-depth description to describe all the changes in the Earth's atmosphere along with clear explanations on how it changed.		5–6	
	An attempt to describe most of the events that changed the Earth's atmosphere along with explanations that may be unclear.		3–4	
	Simple statements made about some of the gases. The logic is unclear.		1–2	
	No relevant content.		0	
	Indicative content: • Water vapour decreased • because as the Earth's temperature cooled, water vapour became liquid and formed oceans. • Oxygen increased due to algae forming • this is because algae underwent photosynthesis which produces oxygen. • Carbon dioxide decreased dues to oceans forming. • As oceans got larger, more carbon dioxide dissolved in them. • Carbon dioxide decreased as rocks formed. • Carbon dioxide reacted with metal oxides to form carbonate rocks. • Carbon dioxide decreased when algae formed • this is because algae underwent photosynthesis which absorbs carbon dioxide. • Volcanoes produced nitrogen gas. • Ammonia decreased in the Earth's atmosphere • because it reacted with oxygen produced by algae to make nitrogen and water. • Accept $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$ or word equation. • Methane decreased in the Earth's atmosphere • because it reacted with oxygen produced by algae to make carbon dioxide and water. • Accept $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ or word equation.			AO3 5.9.1.2 WS 3.5
TOTAL			**6**	

Question 06

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
06.1	Two of: • the surface area of the marble chips • the temperature of the acid • the amount of acid • the amount of marble chips	ignore different type of acid (hydrochloric acid is already given)	2	AO1 5.6.1.3
06.2	volume of acid = 45 cm^3 time taken = 70 s $\frac{45}{70}$ = 0.6428571… = 0.643 cm^3/s		1 1 1 1	AO2 5.6.1.1
06.3	all points correct suitable line drawn	all points need to be within +/– 1/2 a small square 8–10 correct points gets 1 mark	2 1	AO2 5.6.1.1
06.4	line increases at a steeper rate than the 0.75 mol/dm^3 and 0.5 mol/dm^3 lines line levels off at the same height as the 0.75 mol/dm^3 and 0.5 mol/dm^3 lines		1 1	AO2 5.6.1.2
TOTAL			**11**	

Question 07

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
07.1	$\frac{1.75 \times 10^{12}}{3.5 \times 10^{10}}$ = 50 (years)	$\frac{1.75 \times 10^{12}}{3.5 \times 10^{10}}$ obtains 1 mark	2	AO2 5.7.1.1 MS 3d
07.2	Any **two** from: • have a funnel under the flame • put test tube A in cold water • put cobalt chloride paper in test tube A • have a pump to pump the air through the system		2	AO3 5.7.1.3 WS 2.3
TOTAL			**4**	

Question 08

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
08	Any **four** from: • recycling saves energy • because you do not need to spend energy doing mining or electrolysis • recycling saves aluminium • aluminium is not renewable • recycling produces less CO_2 than mining • because you do not need to use fuel mining or producing electricity for electrolysis		4	AO3 5.10.2.2
TOTAL			**4**	

Question 09

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
09.1	(1) C_7H_{16} (l) + 4 O_2 (g) → 7 C (s) + 8 H_2O (g)	2 or 3 correct numbers for 1 mark	2	AO2 5.7.1.3
09.2	Health: Any **one** of: • it causes lung problems • it causes lung cancer Environmental: • it causes global dimming		1 1	AO1 5.9.3.2
TOTAL			**4**	

Question 10

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
10.1	Any **two** from: • produces less CO_2 • produces less SO_2 • does not destroy habitats		2	AO1 5.10.1.4
10.2	iron is higher than copper in the reactivity series iron displaces the copper in the leachate		1 1	AO2 5.4.1.2
TOTAL			**4**	

Question 11

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
11.1	$\frac{5.0}{7.5}$ = 0.67	$\frac{5.0}{7.5}$ gets 1 mark	1 1	AO2 5.8.1.3
11.2	7.5×0.2 = 1.5 cm	7.5×0.2 gets 1 mark	1 1	AO2 5.8.1.3
TOTAL			**4**	

Question 12

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
12.1	pure water contains just water and no other chemicals potable water is fit to drink, but will contain other substances		1 1	AO1 5.10.1.2
12.2	they cause small particles to clump together so that they can be more easily removed	accept flocculant	1	AO1 5.10.1.2
12.3	kills bacteria/microorganisms		1	AO1 5.10.1.2
12.4	heat the salty water the water boils collect and condense the water vapour the salt remains in the reaction vessel		1 1 1 1	AO1 5.10.1.2
TOTAL			**8**	

Question 13

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
13.1	(very) high temperature catalyst	allow temperatures of 500 °C or more allow named catalyst, e.g. zeolite, Al_2O_3, silica, ceramic, porous pot	1 1	AO1 5.7.1.4
13.2	C_9H_{20}		1	AO2 5.7.1.4 5.1.1.1
13.3	Any **four** per substance from: Ethene • has a carbon–carbon double bond (accept is unsaturated) • has fewer hydrogens (accept converse for ethane) • turns bromine water colourless (accept any other halogen) • can be turned into polymers • can be hydrogenated to make ethane • burns with a slightly smoky flame Ethane • has all single bonds (accept is saturated) • does not react with bromine water • does not react with hydrogen • does not form polymers • burns with a clean flame	If only one molecule is mentioned, 3 marks maximum	4	AO2 5.7.1.4
TOTAL			**7**	

Question 14

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
14	Any **four** from: • carbon dioxide levels are correlated with temperature changes • carbon dioxide levels have increased significantly since the 1800s (accept since industrial revolution) • the global climate is a complex system • carbon dioxide levels are a simplified model • correlation does not mean causation	If there are only points for or against (but not both), maximum 3 marks.	4	AO3 5.9.2.2
TOTAL			**4**	

Question 15

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
15.1	mass of copper $= 15.6 - 6.3 = 9.3$ $\frac{9.3}{15.6} \times 100$ $= 60(\%)$	$\frac{6.3}{15.6} \times 100 = 40\%$ gets 2 marks 59.6 gets 2 marks 40.38 or 40.4 gets 1 mark	1 1 1	AO2 5.10.1.4 MS 1c MS 2a
15.2	$\frac{56 + 57 + 60}{3}$ $= 58$	accept error carried forward accept 57.7 or 57.67 correct answer without working gets 2 marks	1 1	AO2 5.10.1.4 MS 2b
TOTAL			**5**	

Paper 5				
Question 01				
QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
01.1	**Level 3:** detailed method with details of sources of errors and how to minimise them		5	AO3 6.3.1.1
	Level 2: detailed method with some omissions (e.g. no discussion of potential sources of error)		3–4	
	Level 1: some relevant points made to outline a simple procedure		1–2	
	No relevant content		0	
	Indicative content: • set scale to zero before measuring mass of rods • measure diameter of rods in at least two different points and calculate a mean • use ruler to measure length of rod • calculate volume of rod • discuss potential difficulties in obtaining accurate readings, e.g. rods may be slightly bent, etc.			
01.2	correct use of standard form density $= \frac{0.1788}{0.000\ 02}$ $= 8940$		1 1 1	AO2 6.3.1.1
01.3	5.24 mm		1	AO1/6.3.1.1
TOTAL			**9**	

■SCHOLASTIC

Question 02

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
02.1	$\Delta E = m\,c\,\Delta\theta$ or word equation		1	AO2 6.3.2.2
	$\Delta\theta = 36.7 - 21.4 = 15.3\ °C$		1	
	$\Delta E = 0.000\ 61 \times 140 \times 15.3$		1	
	$= 1.3\ J$		1	
02.2	as the thermometer is in contact with the body, there is a temperature difference between the body and the mercury in the thermometer		1	AO3 6.3.2.1
	this causes an energy transfer between the body and the mercury		1	
	the atoms of mercury begin to move faster		1	
	the mercury expands and climbs along the capillary tube in the thermometer		1	
TOTAL			8	

Question 03

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.1	4		1	AO1/6.4.1.1
03.2	Atoms that have different mass number, but the same atomic number		1	AO1 6.4.1.2
03.3	7 protons		1	AO1 6.4.1.2
	7 electrons		1	
	16 – 7 = 9 neutrons		1	
TOTAL			5	

Question 04

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
04.1	A nucleus of helium (two protons and two neutrons)		1	AO1/6.4.2.1
04.2	Beta particles or gamma rays		1	AO1/6.4.2.1
04.3	Any of them		1	AO1/6.4.2.1
04.4	$^{90}_{39}Y$		2	AO2/6.4.2.2
TOTAL			**5**	

Question 05

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
05.1	When the spring is fully compressed the elastic potential energy store **is full**. When the toy has reached its highest point the **gravitational potential** energy store is full and the **elastic potential** energy store has emptied. Some of the initial energy has increased the **thermal** energy store associated with the surroundings.		4	AO1 6.1.1.2
05.2	convert 3 cm to 0.030 m $E_e = \frac{1}{2}ke^2$ $= \frac{1}{2} \times 70 \times 0.030^2$ $= 0.0315$ J		1 1 1 1	AO2 6.1.1.2
05.3	convert 6 g to 0.006 kg use $E_p = mgh$ $= 0.006 \times 9.8 \times 0.48$ $= 0.0282$ J		1 1 1 1	AO2 6.1.1.2
05.4	efficiency $= \frac{0.0282}{0.0315}$ $= 0.90$ (or 90%)	allow error carried forward	2	AO2 6.1.2.2
TOTAL			**14**	

Question 06

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
06.1	correctly labelled scales data plotted correctly curve of best fit drawn	remove one mark for each incorrect plot	1 2 1	AO2 6.4.2.3
06.2	The time it takes for the number of nuclei of the isotopes in a sample to halve		1	AO1 6.4.2.3
06.3	accept 7 or 8 years	accept correct reading from own graphs if incorrect plots	1	AO2 6.4.2.3
06.4	results will be more accurate because the sample of data has increased and the curve will become smoother		1 1 1	AO3 6.4.2.3
TOTAL			**9**	

Question 07

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
07.1			1	AO1 6.2.1.1
07.2	10.5 kΩ to 36 kΩ	accept 10 kΩ also accept from 10.5 kΩ upwards i.e. with no upper limit	1 1	AO1 6.2.1.1
07.3	38 °C generates a resistance of 6 kΩ in the thermistor rearrange to $I = \frac{V}{R}$ $I = \frac{3}{6000}$ = 0.0005 A (= 0.5 mA)		1 1 1 1	AO2 6.2.1.3
07.4	50 °C–70 °C	accept 46 °C–70 °C	1	AO2/6.2.1.1
TOTAL			8	

Question 08
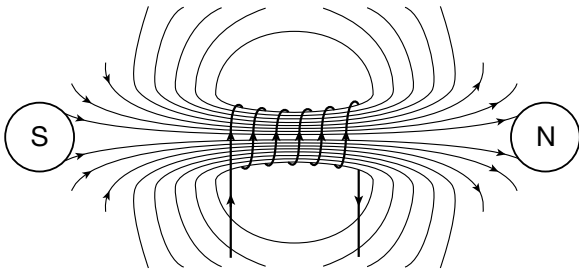
QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
08.1	convert 63 mA to 0.063 A $R_1 + R_2 = 230 + 45 = 275$ Ω $I_1 = \frac{V}{R_1 + R_1} = \frac{6}{275} = 0.022$ A $I_2 = 0.063 - 0.022 = 0.041$ A $R_3 = \frac{V}{I_2} = \frac{6}{0.041} = 146$ Ω		1 1 1 1 1	AO3 6.2.2
TOTAL			5	

Question 09

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
09.1	$E_p = 5.5 \times 9.8 \times 52$ $= 2803$ J	accept 2800 J or 2.8 kJ	1 1	AO2 6.1.1.2
09.2	$E_p = E_k = \frac{1}{2}mv^2$ $2803 = \frac{1}{2} \times 5.5 \times v^2$ $v = \sqrt{\frac{2 \times 2803}{5.5}}$ $= 32$ m/s		1 1 1 1	AO3 6.1.1.2
09.3	No energy was wasted due to air resistance		1	AO3 6.5.4.1.5
TOTAL			**7**	

Paper 6
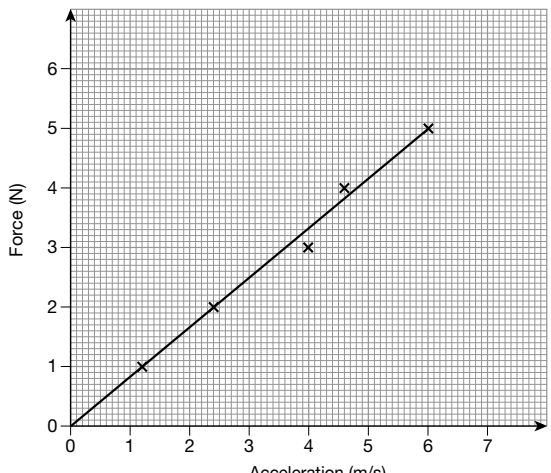
Question 01

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
01.1	the needle (on the compass) will move / be deflected		1	AO3 6.7.2.1
	when a current flows through a wire it produces a magnetic field		1	
	the magnetic field of the wire affects/ attracts/repels the plotting compass (pointer)		1	
01.2	field lines must be parallel or close to parallel inside the coil	field lines are similar to a bar magnet	2	AO1 6.7.2.1
	direction of field lines from north to south (arrow heads must be present)	award 2 marks for all three points		
	lines must be present, starting on north and ending on south pole	award 1 mark for one or two points		
01.3	more turns in the solenoid		1	AO2 6.7.2.1
	put an iron core inside the coil		1	
TOTAL			**7**	

Question 02

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
02.1	work done = force × distance $W = F \times s$	penalise incorrect use of upper or lower case in the symbol equation	1	AO1 6.5.2
02.2	N m or newton metre	penalise incorrect use of upper or lower case in the symbol depiction of the unit	1	AO1 6.5.2
02.3	$W = m \times g$ $W = 50 \times 10 = 500$ (N)	correct numerical answer required unit not required	1	AO2 MS3a,c,d 6.5.1.3
02.4	$W = F \times s$ $W = 500 \times 0.9$ $W = 450$ (J)	neither unit nor workings are required	1	AO2 6.5.2 MS 1a MS3a,c,d
02.5	work done = 8 × 450 = 3600 J $P = \dfrac{E}{t}$ $P = \dfrac{3600}{60}$ = 60 W	working not required as long as 3600 J seen in answer correct use of equation and correct conversion of 1 minute into 60 s correct answer alone for 2 marks unit required for final mark, accept W or J/s	1 1 1	AO2 6.2.4.2 MS3a,c,d
TOTAL			**7**	

Question 03

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
03.1	choosing suitable scale points plotted correctly line of best fit correctly drawn 	use at least half of each axis 5 points correctly plotted, +/− one small square line must be a straight line and should not pass through 3 N or 4 N reading	1 1 1	AO2 6.5.4.1.5 MS4c
03.2	reading taken at 3 N	accept 4.0 m/s^2	1	AO3 6.5.4.1.5
03.3	Any **one** from: • take repeat readings to calculate a mean • take repeat readings to discard anomalies	or words to that effect	1	AO3 6.5.4.1.5 WS2.7
03.4	force is (directly) proportional to acceleration	accept 'if force increases then acceleration increases' for 1 mark	2	AO3 6.5.4.1.5 WS3.5 4.5.6.2.2
TOTAL			**7**	

Question 04

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
04	**Level 3:** A detailed and coherent explanation is provided. The student gives examples that argue a strong case and demonstrate deep knowledge. The student makes logical links between clearly identified, relevant points for all three sets of measurements.	5–6	6	AO1 AO2 AO3 6.6.1.2
	Level 2: An attempt to explain the description of the experiment using sensible reasoning. The student makes logical links between clearly identified, relevant points concerning at least two sets of measurements. The logic used may not be clear.	3–4		
	Level 1: Simple statements are made about the experiment concerning at least one set of measurements. The response may fail to make logical links between the points raised.	1–2		
	No relevant content	0		
	Indicative content: Measuring wavelength: • generate continuous straight waves • set vibrating beam to oscillate at low speed to generate ripples/waves of long wavelength (and low frequency) • freeze the wave pattern using a stroboscope • find the wavelength by measuring several wavelengths (say ten) on the paper on the floor and calculating an average. Measuring frequency: • for lower frequencies, count the number of vibrations in a given time interval • let a thin piece of paper just touch the spindle of the vibrator, to make audible sounds • calculate the number of audible sounds in a second (this should not slow the motor much) • calculate the number of waves per second • for higher frequencies, the rotation of the motor can be observed using a hand stroboscope. Alternative could be to mark a point on the paper and count the number of waves that pass that point in a given time interval. Divide the number by the time interval to calculate frequency.			

Marks continued on the next page.

Question 04

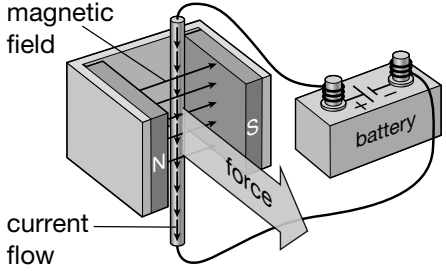| QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
04	Measuring/ calculating velocity: • mark a line of known length on the piece of paper under the tank • mark points A and B on the line • measure the distance between A and B • measure the time it takes for one wave to move between points A and B • calculate speed using speed = $\frac{distance}{time}$			
TOTAL			6	

Question 05

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
05.1	for contact forces, the objects are (physically) touching for non-contact forces, the objects are (physically) separated	both statements are required	1	AO1 6.5.1.2
05.2	gravitational force electrostatic force	accept gravity or gravitational pull	1 1	AO1 6.5.1.2
05.3	**two** of: • air resistance • tension • normal (contact) force		2	AO1 6.5.1.2
05.4	a scalar has magnitude a vector has both magnitude and direction		1 1	AO1 6.5.1.1
05.5	a vector		1	AO1 6.5.1.1
TOTAL			8	

Question 06

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
06.1	Any **two** of: • transfer energy not matter • all are transverse waves • can be reflected • can be refracted • can be absorbed • can be transmitted • wave speed can be calculated using $v = f \times \lambda$		2	AO1 6.6.2.2
06.2	$\lambda = \frac{v}{f}$ $\lambda = \frac{3.0 \times 10^8}{198 \times 10^3}$ $\lambda = 1515$ m $\lambda = 1.5$ km or 1.52 km	correct equation and rearrangement correct substitution correct answer correct rounding and conversion to km	1 1 1 1	AO2 6.6.1.2 MS 1c, 3b, c
TOTAL			6	

Question 07

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
07.1	current labelled pointing down	conventional current on the diagram from positive to negative	1	AO2
	force labelled pointing out of the page	force is perpendicular to the magnetic field	1	6.7.2.1 6.2.1.2
	direction of magnetic field lines from north to south	more than three magnetic field lines must be shown; all must contain arrows	1	6.2.1.3
	magnetic field / S / battery / N / force / current flow			
07.2	ammeter, connected in series	both pieces of information are required	1	AO3
		do not accept 'ampmeter'		6.2
07.3	the metal rod has a magnetic field (induced by the current flowing through it)	A detailed explanation of the fields can also be awarded 2 marks, as follows.	1	AO2 6.7.2.1
	the magnetic field of the magnet repels/ exerts a force on the wire	'On one side of the rod the fields are in the same direction causing a strong field; on the other side the fields are in opposite direction causing a weaker field.	1	6.7.2.2
		This causes a force pushing the rod in the direction of the weaker field.'		
07.4	$F = B \times I \times l$	correct cm conversion	1	AO1
	$F = 0.06 \times 0.1 \times 0.2$	correct mA conversion	1	6.7.2.2
	$= 0.0012$	correct substitution and answer; answer alone correctly calculated scores 3 marks	1	MS 1c, 3b, c
	unit given as N	accept newtons in words	1	
TOTAL			10	

Question 08

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
08.1	ideas needed are: • food contains water (molecules) • water (molecules) absorb microwaves • water molecules are vibrated by microwaves gain kinetic energy • this leads to an increase in temperature • energy is transferred via conduction and convection to remaining parts of food	a coherent explanation that links idea of water (molecules) absorbing microwaves and increasing the thermal store of all the food	2	AO3 6.6.2.4
08.2	transmission absorption refraction	2 marks for 3 correct 1 mark for 2 correct 0 marks for 1 correct	2	AO1 6.6.1.2
08.3	radio waves have long wavelengths and are reflected by the ionosphere/ part of the Earth's atmosphere microwaves have short wavelengths and pass through the ionosphere/ the Earth's atmosphere		1 1	AO3 6.6.2.2
TOTAL			**6**	

Question 09

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
09.1	left-hand triangle $\frac{1}{2} \times 5 \times 6 = 15$ m central rectangle $4 \times 6 = 24$ m right-hand triangle $\frac{1}{2} \times 3 \times 6 = 9$ m total distance = 48 m	if final answer is incorrect, award 1 mark for stating formulae for area of triangle and area of rectangle award 4 marks if final answer correct without workings shown	1 1 1 1	AO1 AO2 MS5c MS4a WS3.2 6.5.4.1.5
09.2	acceleration = $\frac{\text{velocity}}{\text{time}}$ $a = \frac{6}{3} = 2$ unit is m/s^2	working not required ignore – or +	1 1	AO1 AO2 6.5.4.1.5
TOTAL			**6**	

Question 10

QUESTION	ANSWERS	EXTRA INFORMATION	MARK	AO / SPEC. REF.
10.1	labelled as 'down' on the left-hand side, 'up' on the right-hand side		1	AO2 6.7.2.3
10.2	anticlockwise		1	AO2 6.7.2.3
10.3	the split ring commutator reverses the current direction every half turn		1	AO1 6.7.2.3
	because the sides change each half turn the coil rotates continually in the same direction		1	
10.4	the brushes are made of metal or graphite		1	AO1 6.7.2.3
	and provide a contact between the wires and the split ring commutator		1	
	or			
	they ensure current flows from the battery to the split ring commutator into the coil			
10.5	swap the magnets	both are required	1	AO2 6.7.2.3
	reverse the current/voltage direction			
TOTAL			**7**	