OCR
Oxford Cambridge and RSA

Higher

GCSE

Chemisty B Twenty First Century Science

J258/04: Depth in Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2024

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

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 RM Assessor 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 RM Assessor 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 RM Assessor **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 RM Assessor 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 questions on this paper are **5c** and **8**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
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

13. **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**.

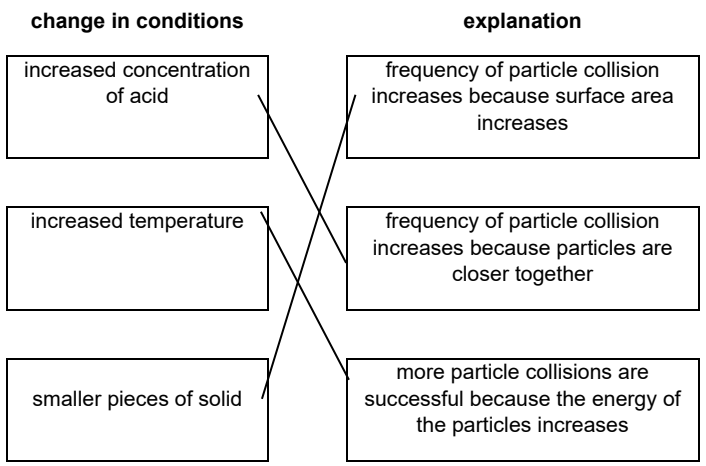
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry 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	(a)		carbon dioxide causes the greenhouse effect/is a greenhouse gas/climate change/global warming ✓ which makes ice caps or glaciers melt / sea level rise / crops fail / extinctions / extreme weather events ✓ benefits outweigh the risk/cost / idea of long term benefits but short term costs ✓	3	2 x 2.1 3.2a	**IGNORE** references to layers of carbon dioxide /ozone layer / use of fossil fuels **IGNORE** natural disasters/tsunamis **IGNORE** indirect effects e.g. habitat loss/damage to ecosystems **ALLOW** examples of extreme weather e.g. tornadoes/droughts/wildfires
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 816 (millions of tonnes) award 3 marks** Substitution: 49 = (400÷mass added) x 100 ✓ shows evidence of rearranging formula e.g. (400/49) x 100 ✓ Ans = 816 (millions tonnes) ✓	3	2.2	**ALLOW** 2 or more sig figs from 816.32653…. **ALLOW** 2 marks for (400/49) x 100 seen in answer (MP1 and MP2) **IGNORE** incorrect unit conversion for MP1 and MP2 e.g. **ALLOW** 2 marks for 816 000 000 / 81 600 **DO NOT ALLOW** MP3 if there is a unit conversion Use of 51 rather than 49 loses MP1 only **e.g. ALLOW** 2 marks for 784 million tonnes (answer based on 51%)
	(c)	(i)	> 2.3 x 10^4 millions tonnes ✓	1	3.2b	
		(ii)	demand for transport/cars/vehicles/(domestic) heating/manufacturing / use of renewables / use of other fuels e.g. hydrogen/biogas/fuels from waste. ✓	1	1.1	**IGNORE** demand for fuels/energy alone / cost **ALLOW** demand for fuel for specified use/petrol **IGNORE** population growth / supply of fossil fuels/ efficiency arguments / limits on emissions

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	Shows upside down measuring cylinder in container with delivery tube entering bottom of cylinder ✓ at least two correct apparatus labels ✓ apparatus and water level appropriate to collect gas (water in container, end of measuring cylinder below level of water, tube in measuring cylinder) ✓	3	2 x 1.2 3.3a	**IGNORE** gas syringe **DO NOT ALLOW** MP1 if tube is shown joined to cylinder **Appropriate labels are:** measuring cylinder, (delivery) tube and trough/beaker/bowl/container/tray… etc **IGNORE** small gaps only
		(ii)	use a gas syringe / use a burette ✓	1	3.3b	
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.47 (cm^3/s) award 3 marks** Shows (132-48) OR (21 x 4) OR 84 in working ✓ Shows (210-30) OR 180 in working ✓ 84/180 = 0.47 (cm^3/s) ✓	3	 2.2	**ALLOW** 2 or more sig figs from 0.466666… seen anywhere in answer **ALLOW MP3 ECF** on incorrect readings but substitution must be correct **For MP3** answer must be given to 2 or more significant figures seen anywhere. **ALLOW** answer on **ECF** to 1dp if calculation computes exactly to 1dp **ALLOW** 0.46 if 84 and 180 are shown in working
		(ii)	The rate of reaction at 120s	1	3.1b	

	(c)			**2**	**1.2**	All correct = 2 marks 1 or 2 correct = 1 mark **IGNORE** any box if two lines are shown

	Question		Answer	Marks	AO element	Guidance
3	(a)	(i)	Two electron shells shown with 2 electrons in the first shell ✓ Completely correct electron arrangement 2.3 ✓	2	2.1	**DO NOT ALLOW** if shells are not drawn
		(ii)	protons are positively charged/have charge of +1 AND have a (relative) mass of 1 AND are in the nucleus ✓ neutrons are neutral/have no charge AND have a relative mass of 1 AND are in the nucleus ✓ electrons are negatively charged/ have a charge of -1 AND have negligible mass AND are found in (electron) shells ✓	3	1.1	**If 3 marks are not awarded ALLOW MAX 2 for** all charges correct = 1 mark all masses correct = 1 mark all locations correct = 1 mark **ALLOW** mass of protons and/or neutrons as +1 **ALLOW** no mass / allow values e.g. 0.0005 or 1/2000 or 1/1820 etc **ALLOW** orbitals for 'shells' / orbits / energy levels **IGNORE** surrounds the nucleus / outside the nucleus
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 500(m) award 2 marks** Shows $0.5 \times 1 \times 10^5$ OR $5 \times 100\,000$ OR 5×10^4 OR 50000 ✓ divides by 100 to give answer 500 (m) ✓	2	2.2	
	(c)	(i)	Metals: A and C Non-metal: B ✓✓	2	2.1	3 correct = 2 marks 2 correct = 1 mark
		(ii)	Idea that metals have fewer than 4 electrons in their outer shell / non-metals have 4 or more electrons in their outer shell (to a maximum of 8) ✓	1	1.1	**IGNORE** need to gain/lose electrons **Answer must refer to number of electrons in the outer shell** **ALLOW** A and C have 1 or 2 electrons in the outer shell and so are metals / B has 6 electrons in the outer shell and so is a non-metal. **IGNORE** number of electrons in the outer shell relates to the Group number

Question			Answer	Marks	AO element	Guidance
4	(a)		**Atmosphere formation:** (early) atmosphere and volcano gases a contain carbon dioxide and nitrogen and hydrogen / volcano gases contain the same gases present in the atmosphere ✓ (graph) (early) atmosphere and volcanoes gases contain more carbon dioxide than other gases (hydrogen and nitrogen) ✓ **Ocean formation:** there are large amounts/92% of water vapour in volcano gases but not in the early atmosphere ✓	3	3.1a 2 x 3.1b	**Note:** For all MPs answer must refer to both (early) atmosphere ('the graph') and volcanoes ('the table') **IGNORE** references to oxygen / photosynthesis / respiration / development of the atmosphere / comparison to composition of atmosphere today **ALLOW** carbon dioxide has the second highest percentage composition in volcano gases and the highest in the (early) atmosphere **AW**
	(b)	(i)	plants appeared/carbon dioxide dissolves in the oceans ✓ carbon dioxide has fallen and oxygen has increased ✓ photosynthesis uses carbon dioxide and/or produces oxygen ✓	3	2.1 2 x 1.1	Plants=algae/phytoplankton/photosynthetic organisms/photosynthetic bacteria /cyanobacteria **ALLOW** 2 marks (MP2 and MP3) for photosynthesis uses carbon dioxide and produces oxygen **IGNORE** correct references to respiration **DO NOT ALLOW** MP3 if stated that respiration produces oxygen / uses carbon dioxide
		(ii)	animals (and plants) use oxygen (for respiration) ✓ rate of oxygen and/or carbon dioxide being used up is equal to the rate of production / same amount of carbon dioxide and/or oxygen is produced and used ✓	2	1.1 2.1	 **IGNORE** 'equilibrium' **ALLOW** rate of photosynthesis = rate of respiration

Question			Answer	Marks	AO element	Guidance
5	(a)		improved properties / harder / stronger / more corrosion resistant ✓	1	1.1	**IGNORE** more malleable/ductile/melting point/brittleness/hardwearing/durability/takes more weight **ALLOW** does not rust
	(b)	(i)	Shows (97.8/0.12) = 815 (which is more than 800)	1	1.2	**ALLOW** 800 x 0.12 = 96 % (which is less than 97.8%) OR ratio is 800:0.98 (which is less than one)
		(ii)	mole ratio is <u>smaller because</u> iron has a higher relative atomic mass / carbon has a lower relative atomic mass / quotes 56 or 55.8 and 12 ✓✓	2	2.1	**ALLOW** for 1 mark: (relative) atomic mass of iron (56 or 55.8) and carbon (12) are different **ALLOW** mass number **DO NOT ALLOW** molecular mass / M_r / relative formula mass / RFM

	(c)*		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)** Explains how all three coatings work **AND** discusses the effects of damage to at least two coatings, including zinc. *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)** identifies both types of rust prevention **OR** explains how both types of coating work **OR** identifies one type of rust prevention and explains how a different type of coating works **OR** identifies or explains one type of coating and discusses effect of damage for one type of coating *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)** Identifies one type of rust prevention **OR** explains how one of the coatings on the bike works *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.*	**6**	**2 x 1.1** **4 x 2.1**	**AO2.1 Identifies type of rust prevention** • painting/oiling are <u>barrier</u> methods • zinc is a <u>sacrificial protection</u> method **AO1.1 Explains how coatings on the bike work** • painting/oiling stops oxygen/air and water from making contact with the iron • zinc is more reactive and corrodes/oxidises instead of iron • zinc reacts with oxygen to form zinc oxide layer **AO2.1 Discuses effects of damage to coatings** • oil or paint damage allows corrosion • oil or paint damage allows oxygen/air <u>and</u> water to reach iron • damage to zinc does not allow corrosion • damaged zinc will continue to react in place of iron / will reform zinc oxide layer At levels 1 and 2, omission of air and/or water compromises the line of reasoning **IGNORE** references to displacement Note galvanising = zinc coating wear away = damage

Question			Answer	Marks	AO element	Guidance
6	(a)		A mixture that contains definite proportions of substances. ✓	1	1.1	
	(b)		Tap water contains (dissolved) substances / contains chlorine ✓ Distilled water contains only water / contains no other substances ✓	2	1.1	**ALLOW** minerals / calcium / magnesium / elements / salts / compounds / ions **IGNORE** tap water contains impurities / distilled water contains no impurities / distilled is pure. **DO NOT ALLOW** tap water contains undissolved or solid substances. **IGNORE** microorganisms/bacteria etc.
	(c)	(i)	stationary phase: (chromatography) paper (alone)✓ mobile phase: water/solvent (alone) ✓	2	2.2	**DO NOT ALLOW** additional substances e.g. Dots on paper / solvent front
		(ii)	**more** soluble substances travel **further** ORA ✓✓	2	1.2	**ALLOW** for 2 marks more soluble substances have higher R_f values **ALLOW** for 2 marks more soluble substances travel faster **ALLOW** for 1 mark substances have **different** solubilities / distance travelled depends on solubility of the substance **IGNORE** different substances have different R_f values
		(iii)	leave the experiment for a longer time / allow the solvent front to travel further / use a different solvent / use a longer chromatography paper ✓	1	3.3b	**IGNORE** use more/use more concentrated/stronger solvent/substance **IGNORE** higher temperature **ALLOW** named different solvent e.g. propanone/acetone/alcohol/ethanol/methanol
	(d)		Impure substances: B, D and E ✓ Impure substances melt over a range of temperatures / do not have a sharp/definite/exact/fixed melting point ✓	2	3.1a	**IGNORE** references to boiling points **ALLOW** RA e.g. pure substances have sharp (etc) melting points

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	completes vertical axis scale correctly ✓ points correctly plotted ✓ best fit line✓	3	2.2	Major gridlines labelled in intervals of 20 up to (at least) 80 **DO NOT ALLOW** MP2 if scale is non-linear but allow **ECF** for MP3 **ALLOW** MP3 **ECF** on incorrectly plotted points Line must be straight and drawn with a ruler **DO NOT ALLOW** broken, feathered, wobbly, sketched or overly thick line Points should be spread evenly either side of the line
		(ii)	Allow stated values from -50 to -40 (°C) ✓	1	1.2	Must have sign. **IGNORE** units **ALLOW ECF** on incorrectly plotted line +/-1
	(b)	(i)	C_2H_5 ✓	1	2.2	
		(i)	already in simplest ratio / empirical formula shows simplest ratio ✓ no common factors of 3 and 8 / cannot be divided by the same number / cannot have a formula that involves a decimal place ✓	2	2.2	 **ALLOW** 3 cannot be divided by 2. **ALLOW** number of carbon atoms cannot be divided further / 3 is a prime number

Question			Answer	Marks	AO element	Guidance
8*			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)** Gives a correct order of reactivity, including copper and justifies using temperature changes from reactions with both iron ions and copper ions. *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)** Gives a correct order for at least three metals and justifies using temperature changes. *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)** Makes a statement to link order of reactivity to size of temperature change. *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.*	**6**	**2 x 3.2b** **4 x 2.2**	**AO3.2b Gives an order of reactivity** • (uses data from reaction with Fe ions) to give order of reactivity Ca Mg and Zn • gives complete order Ca, Mg, Zn, Fe, Pb and Cu (may omit copper up to Level 2) **AO2.2 Justifies using temperature changes** • highest temperature change shows highest reactivity • links size of temperature change correctly to reactivity for at least two metals • explains reactivity of iron and lead cannot be decided from iron ions reaction • states that lead does not react with iron ions because lead is less reactive than iron • explains that all metals react with copper ions because they are all more reactive than copper • explains that copper is less reactive than iron so reactions with copper give greater temperature changes Answers placing metals in order alone may be awarded Level 1 but have no line of reasoning Note omitting 'ions' e.g. 'iron' rather than 'iron ions' limits logical structure at level 3 only.

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	**Any two from:** need for heating (in industrial process) ✓ energy used for transport (bottles or finished articles) ✓ energy used by machinery for sorting and washing ✓	2	1.1	**ALLOW** need (lots of) energy to give high temperature **IGNORE** energy used for collection, sorting and washing alone.
		(ii)	energy comes from non-renewable fuels / fossil fuels / finite fuels ✓ harmful emissions from burning fuels / named emission e.g. CO, C particulates, NOx, SOx ✓	2	1.1	**IGNORE** references to comparison of energy demand for different processes **IGNORE** named fuel e.g. coal/gas/oil **IGNORE** 'emits carbon dioxide' alone **IGNORE** 'causes climate change/global warming' alone **ALLOW** emits carbon dioxide which is a greenhouse gas/causes climate change/global warming **IGNORE** 'pollution' or 'harm to the environment.
	(b)		**Any two from:** less landfill/do not need to be incinerated/not biodegradable ✓ raw materials do not need to be extracted ✓ raw materials for polymer production are finite/non-renewable ✓	2	3.2a	**IGNORE** litter arguments **IGNORE** energy arguments **ALLOW** (as additional point) prevents plastic waste in the oceans / harms marine or sea life / prevents microplastic waste ✓ **ALLOW** for MP3 crude oil does not need to be extracted

	(c)		**Any two from:** ideas about lifetime of use / time before disposal / insulation will be used for a longer time than a jacket ✓ energy or water use in manufacturing jackets and insulation will be different / manufacture involves different processes ✓ padded jackets have other materials added ✓ idea that house insulation reduces energy use in houses ✓	**2**	**3.2a**	**IGNORE** points about amounts / likelihood of recycling **IGNORE** they use different amounts of energy alone **IGNORE** different steps alone (too vague)

Question			Answer	Marks	AO element	Guidance
10	(a)		**Any two from:** (Defines proportional) number of moles of the element is (directly) proportional to number of moles of oxygen ✓ (Multiples) number of moles of element doubles as number of moles of oxygen doubles / number of moles of oxygen is (always) half number of moles of element ORA ✓ (Line) straight line goes through origin AW ✓	2	3.1a 1.1	**IGNORE** positive correlation **DO NOT ALLOW** inversely proportional (max 1) **IGNORE** oxygen increases by 0.5 and element increases by 1.0 each time / both increase by the same interval each time **ALLOW** one doubles when the other doubles **For MP3 ALLOW** both increase by the same increment each time from (0,0)
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 24(g) award 3 marks** 0.75 quoted in working ✓ RFM oxygen = 32 ✓ Answer = 24 (g) ✓	3	2.2	**ALLOW ECF** for incorrect number of moles of oxygen up to a value of 3.0 e.g. 3 x 32 = 96 g (2 marks) **ALLOW ECF** for RFM = 16 for oxygen (to give answer 12 g) (2 marks)
	(c)	(i)	$2X + O_2 \rightarrow 2XO$ ✓	1	3.2b	
		(ii)	Explanation: from the graph, 2 moles of element X reacts with 1 mole of oxygen ✓	1	3.1b	**ALLOW** 'amount' = moles

Question			Answer	Marks	AO element	Guidance
11	(a)		Filtration ✓ (filtration because) calcium carbonate (and excess calcium sulfate) is a solid / to remove solids ✓	2	3.3a 2.2	
	(b)		$2NH_3(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$ correct formulae only ✓ balanced and state symbols ✓	2	2.1	
	(c)		T F T ✓✓	2	1.1	All correct = 2marks 2 correct =1 mark

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