OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



MARK SCHEME

C4.1 PREDICTING CHEMICAL REACTIONS

SCORE	PERCENTAGE
/121	%

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Question			Answer/Indicative content	Marks	Guidance
1			B	1	
			Total	**1**	
2			D	1	
			Total	**1**	
3		i	Molecular formula: At_2 (1) Atomic radius: 148 – 168 (1)	2	**DO NOT ALLOW** AT_2 / At2 **ALLOW** any range of numbers provided it is completely within the range given for the answer
		ii	Makes iodine and sodium bromide (1)	1	
		iii	Bromine is more reactive than iodine (1)	1	**ALLOW** ORA
			Total	**4**	
4			Enter text here. D	1	
			Total	**1**	
5			D	1	
			Total	**1**	
6		i	Same number of electrons in outer shell / all have 7 electrons in outer shell (1)	1	**ALLOW** outer electrons or valence electrons rather than electrons in the outer shell **ALLOW** valence shell rather than outer shell **DO NOT ALLOW** the wrong number of electrons in the outer shell
		ii	$2Na + Br_2 \rightarrow 2NaBr$ Correct formulae of reactants and products (1) Balancing – depend on correct formulae (1)	2	**ALLOW** any correct multiple of the equation including fractions **ALLOW** = or ⇌ instead of → **DO NOT ALLOW** and or & instead of + **ALLOW** one mark for correct balanced equation with minor errors of case and subscript e.g. 2NA + Br2 → 2NaBr
		iii	KAt (1)	1	
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
7	a	i	Molecular formula: At_2 (1) Atomic radius: 148 – 168 (1)	2	DO NOT ALLOW AT_2 / At2 ALLOW any range of numbers provided it is completely within the range given for the answer
		ii	Makes iodine and sodium bromide (1)	1	
		iii	Bromine is more reactive than iodine (1)	1	ALLOW ORA
	b	i	Same number of electrons in outer shell / all have 7 electrons in outer shell (1)	1	ALLOW outer electrons or valence electrons rather than electrons in the outer shell ALLOW valence shell rather than outer shell DO NOT ALLOW the wrong number of electrons in the outer shell
		ii	$2Na + Br_2 \rightarrow 2NaBr$ Correct formulae of reactants and products (1) Balancing – depend on correct formulae (1)	2	ALLOW any correct multiple of the equation including fractions **ALLOW** = or ⇌ instead of → DO NOT ALLOW and or & instead of + ALLOW one mark for correct balanced equation with minor errors of case and subscript, e.g. 2NA + Br2 → 2NaBr
		iii	KAt (1)	1	
			Total	**8**	

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Question			Answer/Indicative content	Marks	Guidance
8			magnesium, iron, copper, silver (1) AND any two from: magnesium will displace iron or magnesium reacts with iron(II) sulfate so magnesium is more reactive than iron (1) iron will displace copper so iron reacts with copper(II) sulfate so iron is more reactive than copper (1) magnesium will displace copper or magnesium reacts with copper(II) sulfate so magnesium is more reactive than copper (1) copper will displace silver or copper reacts with silver nitrate so copper is more reactive than silver (1)	3	allow Mg, Fe, Cu, Ag (1) Examiner's Comments Most candidates were unable to interpret the data to predict the order of reactivity of the metals.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
9			A – chloride (ions) B – iodide (ions) and sulfate (ions) C – sulfate (ions) all correct (2) BUT one or two correct (1) then any two from: white ppt with lead nitrate indicates chloride (ions) (1) yellow ppt with lead nitrate indicates iodide (ions) (1) white ppt with barium chloride indicates sulfate (ions) (1)	4	**allow** chlorine and iodine (ions) **ignore** names of compounds **allow** lead ions rather than lead nitrate **allow** barium ions rather than barium chloride Examiner's Comments Very few candidates scored marks on this question with the tests for ions not being well known. Many candidates misinterpreted the question and, rather than using the results to identify the ions in water samples A, B and C, gave responses such as ‘there are negative ions in sample B’
			Total	4	

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Question			Answer/Indicative content	Marks	Guidance
10	a		halogens (1)	1	**Examiner's Comments** Examiners saw a wide range of incorrect responses.
	b	i	**any two from:** idea of water sterilisation (1) (making) plastics (1) (making) pesticides (1) (making) bleach or disinfectant (1) (making) pharmaceuticals (1) (making) solvents (1)	2	**ignore** cleaning water **Examiner's Comments** It was usually because they described the use of chlorine 'in swimming pools' or 'to clean water', which was insufficient. Many candidates were only able to give one use of chlorine.
		ii	antiseptics or to sterilise wounds (1)	1	**Examiner's Comments** The use of iodine to sterilise wounds was not well known.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
11	a		lithium / rubidium / caesium / francium (1)	1	**allow** Li / Rb / Cs / Fr (1) **Examiner's Comments** Most candidates correctly gave the name of another Group 1 element.
	b		bubbles or gas or hydrogen given off (1) (sodium) reacts quickly (1) (sodium) melts (1) (sodium) skates across surface of water (1) (sodium) floats (1)	2	**allow** fizz (1) **allow** (yellow) flame observed (1) **allow** sodium gets smaller or disappears (1) **allow** forms a colourless solution (1) **Examiner's Comments** Good responses described several observations when sodium reacts with water. Most candidates scored at least one mark for stating that you see bubbles or fizzing. Centres are to be encouraged to advise candidates that a question worth two marks requires two points in their answer. Many candidates only wrote one observation.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
12			**any two from:** because it reacts with water (1) because it reacts with oxygen / because it reacts with air (1) because it is a reactive metal (1)	2	**allow** so that it does not react / prevent contact with oxygen / air and water (2) **allow** it reacts with moist air or damp air (2) **ignore** prevents corrosion / rusting **Examiner's Comments** Most candidates were able to score at least 1 mark for explaining that lithium reacts with water or air.
			Total	2	
13			C ✓	1(AO 1.2)	Examiner's Comments Most candidates realised that the gas was hydrogen, with carbon dioxide being the most common alternative.
			Total	1	
14			D ✓	1(AO 1.1)	Examiner's Comments Almost all candidates realised that carbon dioxide shows the largest percentage change. Some went for the largest percentage **increase** rather than percentage change, choosing option A.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
15			**Level 3 (5–6 marks)** Candidates recall word equation or an unbalanced symbol equation for the reaction between either caesium or lithium and water. Candidate applies knowledge of the reaction of alkali metals to predict observations and names of products formed in the reaction between caesium and water, including the idea that the reaction with caesium is faster. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Candidate applies knowledge of the reaction of alkali metals to predict an observation **and** gives the name or formulae of a product formed in the reaction between caesium and water. Quality of written communication partly impedes communication of the science at this level. **OR** Candidates recall word equation or an unbalanced symbol equation for the reaction between either caesium or lithium and water. **Level 1 (1–2 marks)** Candidate applies knowledge of the reaction of alkali metals to make a simple observation **OR** names a product formed in the reaction of caesium with water. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted at grades up to C Indicative Scientific points may include Word equations • caesium + water ? caesium hydroxide + hydrogen • Cs + H_2O ? CsOH + H_2 (need not be balanced) • lithium + water ? lithium hydroxide + hydrogen • Li + H_2O ? LiOH + H_2 (need not be balanced). Relevant points • hydrogen made • caesium hydroxide made • bubbles • floats and moves on the surface • gives a flame • gets smaller and forms a colourless solution • faster reaction than with lithium / extremely rapid reaction • caesium is more reactive than lithium • reaction is more explosive. Examiner's Comments Most candidates were able to reach level 1 with either a product or an observation. Better candidates were able to reach level 2, but only a very few were able to give a correct word equation to get level 3. A common error was to state that lithium was more reactive.
			Total	6	
16			D ✓	1(AO 1.1)	Examiner's Comments Most candidates realised that cobalt is a transition metal, with a sizeable minority opting for carbon
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
17			silver is deposited on the copper (strip) (1) because copper is more reactive than silver / silver is less reactive than copper / copper is higher in the reactivity series / silver is lower in reactivity series (1)	2	**allow** solution goes blue / copper turns black **allow** copper displaces silver / copper nitrate formed Examiner's Comments Candidates who scored two marks usually stated that silver was formed and copper nitrate produced.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
18			Level 3 (5–6 marks) Candidate applies knowledge of the reaction of alkali metals to predict some observations or comments of the reaction of caesium with water including a comparison of the rate of reaction with lithium AND Constructs the balanced symbol equation for the reaction between caesium or lithium and water. Quality of written communication does not impede communication of science at this level. Level 2 (3–4 marks) Candidate applies knowledge of the reaction of alkali metals to predict some observations or makes comments about the reaction between caesium and water AND gives the names or formulae of products formed in the reaction between caesium and water. Quality of written communication partly impedes communication of the science at this level. Level 1 (1–2 marks) Candidate applies knowledge of the reaction of alkali metals to predict some observations or makes comments about the reaction between caesium and water OR gives the names or formulae of products formed in the reaction between caesium and water. Quality of written communication impedes communication of the science at this level. Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted at grades up to A Indicative scientific points at level 3 must include: • $2Cs + 2H_2O$? $2CsOH + H_2$ OR $2Li + 2H_2O$? $2LiOH + H_2$. • faster reaction than with lithium / more reactive / more violent Indicative scientific points at levels 1, 2 and 3 may include: • caesium + water ? caesium hydroxide + hydrogen • lithium + water ? lithium hydroxide + hydrogen • hydrogen made • caesium hydroxide made • bubbles • fizzes • floats • moves on the surface • gives a flame • gets smaller • forms a colourless solution • alkaline solution formed • explodes • caesium loses electrons more easily Examiner's Comments This six mark question was often well answered by candidates. The best answers gave the balanced equation for the reaction of caesium and water and then explained in terms of electron loss why caesium was more reactive than lithium. Candidates who did not know the symbol equation could get partial credit by writing the word equation. The production of hydrogen was well known but candidates were less likely to name caesium hydroxide as the other

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Question			Answer/Indicative content	Marks	Guidance
					product. Answers were often well constructed and many candidates needed extra space to complete their answers
			Total	6	
19			correct order (1) (magnesium) zinc iron copper	1	**allow** correct symbols Zn Fe Cu **Examiner's Comments** Almost all candidates correctly placed the metals in order of reactivity.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
20	a		all have one electron in their outer shell (1)	1	**allow** orbit or energy level rather than shell **allow** have same number of electrons in outer shell (1) **allow** all lose one electron to make an ion / all lose one electron to get a stable outer shell / all lose 1 electron to get a stable outer octet / all lose 1 electron to get a complete outer shell (1) they all lose 1 electron is **not** sufficient on its own all have a single electron is **not** sufficient **ignore** to make stable atom **Examiner's Comments** Many candidates appreciated that all the elements in Group 1 had one electron in the outer shell. A small proportion of the candidates stated that the elements had the same number of electrons in the outer shell and this was also accepted in the mark scheme. Some candidates only referred to the elements losing one electron from the atom but this was not sufficient unless the answer referred to the formation of a stable outer shell. Other candidates made no reference to the outer shell electrons and just stated that the elements had similar properties.

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Question			Answer/Indicative content	Marks	Guidance
	b		$2Na + 2H_2O$? $2NaOH + H_2$ correct formulae (1) balancing – dependent on correct formulae (1)	2	**allow** any correct multiple including fractions e.g. $4Na + 4H_2O$? $4NaOH + 2H_2$ **allow** = or ? for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors of case, subscript or superscript e.g. $2NA + 2H_2O$? $2NaOH + H^2$ (1) **Examiner's Comments** Although many candidates could construct the balanced equation for the reaction between sodium and water there was a significant proportion of candidates that did not attempt to balance the equation. Only a small proportion of candidates tried to change the formulae of the reactants or products.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
21			Level 3 Candidate applies knowledge to predict the name of both products AND predicts a reaction time for rubidium AND writes a correctly balanced symbol equation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) Level 2 EITHER Candidate applies knowledge to predict the names of both products AND predicts a reaction time for rubidium OR predicts a reaction time for rubidium AND attempts a symbol equation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) Level 1 EITHER Candidate applies knowledge to predict the names of both products OR predicts a reaction time for rubidium and the name of one product OR candidate attempts a symbol equation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A*. Indicative scientific points may include: Names of Products • hydrogen must be stated but can be in a word equation • rubidium hydroxide must be stated but can be in a word equation Reaction Time • any time less than 7 seconds / reaction time less than potassium Equation • $2Rb + 2H_2O$? $2RbOH + H_2$ or correct multiple note Rb + H_2O ? product / formula is an attempt to write an equation Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question involved the chemistry of the alkali metals and also assessed quality of written communication. Most candidates could predict a reaction time for rubidium although some forgot to include the unit in their answer. Candidates found writing the symbol equation and naming the products much more demanding. Candidates often wrote the incorrect formulae and/or the incorrect products. The most common answers involved the formation of rubidium oxide and hydrogen. Level 3 was only available for candidates that could write the balanced symbol equation and gave the names of the correct products.

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Question			Answer/Indicative content	Marks	Guidance
					Many candidates also included lots of extra material, for example explaining why rubidium reacted faster in terms of electron loss. Candidates must take care that they address the question that is set and not waste time including irrelevant material.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
22	a		idea of electron gained (1) **but** (Group 7 elements) going up the group easier to gain electrons / fluorine gains electrons more readily / ora for astatine (2)	2	assume unspecified comments refer to fluorine electrons lost = 0 for the question **allow** fluorine has a smaller atom / astatine has a larger atom / fluorine has less (electron) shielding / astatine has more (electron) shielding / stronger attraction between outer electrons and nucleus in fluorine / ora where appropriate (1) **Examiner's Comments** This question was about trends in Group 7. Candidates found quite challenging and often referred to electron loss rather than electron gain. Other candidates used the wrong information from the table relating reactivity with melting and boiling point. The best answers referred to fluorine being the most able to gain electrons. Sometimes candidates gave higher level answers such as increased shielding down the group.
	b		appearance of iodine – **grey solid / black solid** (1) melting point of astatine – anywhere in the range **200 to 310** (1) boiling point of fluorine – anywhere in the range **-80 to -150** (1)	3	**both** colour **and** state required **Examiner's Comments** This question was about trends in Group 7. Candidates often got one of the numerical answers correct but many candidates could not give the appearance of iodine as a grey / black solid. Common incorrect answers included a brown liquid, orange liquid and a purple solid. Some candidates did not answer the question and it was not clear if they could not answer the question or that they had missed the question.
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
23			Level 3 Identifies (by name or by the ions present) both compounds A and B, with one explanation for each compound AND writes the balanced symbol equation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) Level 2 Identifies one ion or one compound (in either A or B) AND writes the balanced symbol equation. OR Identifies one compound (either A or B) with one explanation OR Identifies two ions present (either/or in A and B) with one explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) Level 1 Identifies one ion or one compound in (either A or B) OR writes the balanced symbol equation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A. Indicative scientific points may include: Symbol equation $FeC?_3 + 3AgNO_3$? $3AgC? + Fe(NO_3)_3$ **allow** any correct multiple e.g. $2FeC?_3 + 6AgNO_3$? $6AgC? + 2Fe(NO_3)_3$ **allow** = or ? for arrow **not** 'and' or & for + **allow** correctly balanced equation with minor errors of case, subscript or superscript at level 1 e.g. $FEC?_3 + 3AgNO^3$? $3AgC? + Fe(NO_3)_3$ Compound A • compound **A** contains copper (ions) / Cu^{2+} • compound **A** contains chloride (ions) / $C?^?$ • compound **A** is copper chloride / $CuC?_2$ Reasons • because copper (ions) give a blue ppt with sodium hydroxide or hydroxide (ions) • because chloride (ions) give a white ppt with silver nitrate or silver ions Compound B • compound **B** contains iron(II) (ions) • compound **B** contains bromide (ions) • compound **B** is iron(II) bromide Reasons • iron(II) (ions) give a green ppt with sodium hydroxide or hydroxide (ions) • bromide (ions) give a cream ppt with silver nitrate or silver ions **allow** ppt or solid **allow** reference to chlorine and bromine

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Question			Answer/Indicative content	Marks	Guidance
					(ions) Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question involved the analysis of experimental observations concerned with qualitative analysis. Candidates were expected to make a conclusion and justify the conclusion based upon the experimental evidence. Candidates could either identify the name of the compound present or the ions contained in the solution. In terms of the justification the test, the ion present and the result all had to be included for example compound A contained copper ions because it gave a blue ppt. with sodium hydroxide. In addition candidates had to construct one balanced equation having been given the formulae for each reactant and product. Candidates had little difficulty constructing the balanced equation and some candidates only did this part of the question and as a result matched level 1. Candidates found the identification of the compound or ions much more difficult and often only identified one compound or one ion with no justification for this conclusion. This type of answer matched level 2 providing the balanced equation was given. The most able candidates were able to give a comprehensive and logical answer that explained the ions present and then deduced the name of the compound.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
24			A – chloride (ions) B – iodide (ions) and sulfate (ions) C – sulfate (ions) **all correct (2)** **BUT** **one or two correct (1)** **then one** correct explanation from (1) white ppt with lead nitrate indicates chloride (ions) yellow ppt with lead nitrate indicates iodide (ions) white ppt with barium chloride indicates sulfate (ions)	3	**allow** correct formulae of ions **allow** chlorine and iodine (ions) **ignore** names of compounds **allow** lead ions rather than lead nitrate **allow** barium ions rather than barium chloride **Examiner's Comments** Candidates found this question very challenging and many candidates did not understand the term negative ion and as a result identified barium chloride ions, lead nitrate ions or sodium ions as negative ions. The test for halide ions was recognised by more candidates than that for sulfate ions and some candidates identified the sulfate ion as S^{2-}. Only the most able candidates were able to give all the correct ions present in the three solutions and provide at least one correct explanation.
			Total	**3**	
25			potassium hydroxide (1) hydrogen (1)	2	order unimportant **allow** correct formulae i.e. H2 (1) and KOH (1) **not** H **Examiner's Comments** Examiners saw a range of incorrect responses.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
26	a		**Any two from:** (Potassium) reacts violently / sparks / ignites / explodes ✓ floats / moves around on surface of water ✓ moves quickly (on water) ✓ lilac flame ✓ melts (into a ball) ✓ dissolves ✓ (hydrogen gas ignites with) a squeaky pop ✓	2(AO 2.2)	**ALLOW** (potassium) disappears / gets smaller **Examiner's Comments** Most candidates were able to give two correct observations. When candidates did not gain credit, it was usually because they stated the type of observations you would make (eg **if** the potassium caught fire, **if** the potassium floated etc) rather than the actual observations made.
	b		**Any two from:** (Down Group 1) outer electron or outer shell gets further from the nucleus / more shielding / atomic radius increases / more electron shells / ORA ✓ Idea of less attraction between nucleus and outer shell electron ✓ Outer shell electron is lost more easily ✓	2(AO 1.1)	**ALLOW** outer electron in potassium is further from the nucleus than in lithium / ORA **IGNORE** potassium has more electrons (than lithium) **DO NOT** allow idea that outer electron is lost more quickly / AW **Examiner's Comments** Good responses to this question described the idea that down Group 1 there are more electron shells, so there is less attraction between the nucleus and the **outer** shell electron, which is lost more easily. When candidates did not gain both marks it was usually because they did not state that it was the **outermost** or **outer** shell electron that is lost.

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>c</td><td></td><td>
<table>
<tr><th>Element</th><th>Formula</th><th>Colour</th><th>State at room tem perature</th></tr>
<tr><td>Fluorine</td><td>F_2</td><td>pale yellow</td><td>Gas</td></tr>
<tr><td>Chlorine</td><td>Cl_2</td><td>green✓</td><td>gas ✓</td></tr>
<tr><td>Bromine</td><td>Br_2</td><td>brown</td><td>liquid</td></tr>
<tr><td>Iodine</td><td>I_2</td><td>grey</td><td>solid ✓</td></tr>
</table>
</td><td>3(AO 1.1)</td><td>Examiner's Comments
 Misconception
The colour of chlorine as yellow and iodine being a liquid at room temperature were common misconceptions.</td></tr>
<tr><td></td><td>d</td><td></td><td>(Fluorine has) weak intermolecular forces / weak forces between molecules ✓

which only require a small amount of energy to break / which are easy to break ✓</td><td>2(AO 1.1)</td><td>ALLOW weak intermolecular bonds

DO NOT ALLOW references to covalent bonds between molecules
OR weak forces between atoms – scores 0

Examiner's Comments

Higher ability candidates described that fluorine has weak intermolecular forces, which are easily broken.
 Misconception

A common misconception is still that simple covalent molecules have low melting & boiling points due to weak covalent bonds between molecules or weak forces between atoms.</td></tr>
<tr><td></td><td>e</td><td></td><td>(Group 0 elements) have a full / complete outer shell ✓

Idea that they have no tendency to lose or gain electrons ✓</td><td>2(AO 1.1)</td><td>ALLOW 8 electrons in outer shell

IGNORE idea that they have no tendency to react unless linked to gaining a full outer shell (of electrons)

Examiner's Comments

Good responses to this question described that the elements in Group 0 have a full outer shell, so have no tendency to lose or gain electrons.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>11</td><td></td></tr>
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Question			Answer/Indicative content	Marks	Guidance
27			B ✓	1 (AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
28	a		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ Formulae ✓ Balancing ✓	2(AO 2.2)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** 'and/&' instead of '+' balancing mark is dependent on the correct formulae but **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae eg $Mg + 2HCL \rightarrow Mgcl_2 + H_2$ <u>Examiner's Comments</u> The task of writing an equation has two main components: writing the correct formulae, most of which were given, and then doing the balancing. In this case, higher ability candidates showed mastery of the formulae and went on to gain both marks. Most other candidates were uncertain of the formulae of hydrogen gas and used 'H' or '2H'. Some did not see the formula of the hydrochloric acid in the stem and wrote HCl_2.

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Question			Answer/Indicative content	Marks	Guidance
	b		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)** Analyses the results (in relation to <u>both</u> volume of acid & mass of magnesium) to show that they do not support the prediction. **AND** explains the results using the reacting particle model. *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)** Analyses the results (in relation to <u>both</u> volume of acid & mass of magnesium) to show that they do not support the prediction OR sees that (both) predictions are incorrect and uses the data to show that only concentration affects reaction time **AND** explains the results using the reacting particle mode Uses the reacting particle model in terms of more collisions rather than frequency of collisions. *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)** Analyses the results to show one of the predictions to be incorrect **OR** Uses the reacting particle model in terms of more collisions rather than frequency of collisions. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks**	6(AO 3×2.2 3×2.2b)	**AO3.2b Analyse information and ideas to draw conclusions.** • results show as volume decreases reaction time does not change so reaction time does not change • results show that as mass of magnesium increases reaction time does not change • reaction in experiment 3 is faster / has a shorter reaction time, than experiment 2 **AO2.2 Apply knowledge and understanding of scientific enquiry, techniques and procedures.** • concentration is higher in experiment 3 • acid particles are more crowded in experiment 3 / acid particles are closer together / more acid particles per unit volume / more acid particles per cm^3 / more acid particles in the same space • more (successful) collisions per second / collisions more often / increased collision frequency / more chance of a collision **IGNORE** references to 'faster' collisions <u>Examiner's Comments</u> While candidates often had trouble in describing what the table showed, many of them showed a clear intuitive understanding and pointed out that it was only changes in concentration that produced an effect. The higher ability candidates responded to both the command prompts and interpreted the table and also included ideas about the reacting particle model. A very large number of candidates did not respond to this second prompt, which limited the number of marks available to them.

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Question			Answer/Indicative content	Marks	Guidance
			No response or no response worthy of credit.		
	c		**Any two from:** **Cooling the acid:** • idea that acid particles move slower / particles have less energy ✓ • idea of decreased collision frequency ✓ • idea of less successful collisions / collisions are less energetic ✓ **AND** **Predicted reaction time** – Any time more than 30s ✓	3(AO 3 × 2.2)	**ALLOW** particles don't move as much **ALLOW** 'less (unspecified) kinetic energy' **IGNORE** 'less energy' unless linked to particles <u>Examiner's Comments</u> Higher ability candidates realised that the particles would move slower or have less energy and suggested a suitable reaction time. Occasionally they even went on to discuss collision frequency or the idea of successful collisions and so scored all three marks. Others showed much confusion over 'rate of reaction' and 'time for reaction'. Many said that when the rate is less the time is less, to the point where examiners could not give credit for statements such as 'the reaction is slower' because there was so much evidence of misunderstanding in that area. A significant number of candidates were able to explain what happens when temperature increases but had some difficulty in reversing their argument to explain what happens if temperature falls. Answers such as 'Less chance of more frequent successful collisions' and 'Fewer frequent successful collisions' were common. These candidates were still able to gain full marks, but centres should be aware of this as a potential problem.
			Total	**11**	

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Question			Answer/Indicative content	Marks	Guidance
29	a		Fluorine – **gas** ✓ Astatine – Radius in the range **0.148 - 0.210** ✓	2 (AO1.1) (AO3.2a)	
	b	i	Iodine + sodium bromide ✓	1 (AO2.1)	**Both required for the mark** **ALLOW** answers in either order
		ii	Bromine is more reactive than iodine / ORA ✓	1 (AO1.1)	**ALLOW** iodine cannot displace bromine
		iii	$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$ Formulae ✓ Balancing ✓	2 (AO1.1) (AO2.1)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+' balancing mark is dependent on the correct formulae but **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae eg $CL_2 + 2NAI \rightarrow 2NaCl + I2$
	c	i	Idea of preventing potassium reacting with air or oxygen / idea of preventing potassium reacting with water ✓	1 (AO1.1)	**ALLOW** potassium reacts with air or oxygen / potassium reacts with water
		ii	(Sodium and potassium) both have 1 electron in their outer shell / both have the same number of electrons in their outer shell ✓	1 (AO1.1)	**ALLOW** both form 1+ ions
			Total	**8**	
30		i	Green ✓	1 (AO3.2b)	
		ii	Magnesium most reactive Zinc Iron Copper least reactive correct order – 2 marks magnesium as most reactive and copper as least – 1 mark	2 (AO3.2b)	
		iii	$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$ ✓	1 (AO2.2)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+' **ALLOW** a minor error in subscripts / formulae
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
31	a		$2Na + 2H_2O \rightarrow 2NaOH + H_2$ Formulae ✓ Balancing ✓	2 (AO1.1) (AO2.1)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+' balancing mark is dependent on the correct formulae but **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae eg $2Na + 2H_2O \rightarrow 2NaoH + H2$
	b		(Sodium atom) loses an electron / Oxidation is loss of electrons ✓	1 (AO1.1)	
	c		**Any two from:** Outer electron in rubidium is further from the nucleus / ORA ✓ Idea that attraction of rubidium's nucleus for outer electron is less / ORA ✓ Outer electron in rubidium is lost more easily / ORA ✓	2 (AO1.1)	**Assume unqualified answer refers to rubidium** **ALLOW** outer electron in higher energy level / shell **ALLOW** more shielding in rubidium **IGNORE** idea that outer electron is lost more quickly **Reference to outer electron needed at least once**
			Total	**5**	
32			C most reactive A D B least reactive correct order – 2 marks C as most reactive and B as least – 1 mark	2 (AO3.2b)	
			Total	**2**	

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