AQA Style

GCSE
CHEMISTRY

H

Higher Tier   Chemistry Paper 1

Mark Scheme

Question 1

Question	Answers	Extra information	Mark
01.1	gas		1
01.2	reactivity decreases as you go down the group	Allow converse argument throughout.	1
	the outer electrons are farther from the nucleus	Allow more energy levels/ shells.	1
	less attraction between the outer electrons and the nucleus	Allow more shielding.	1
	(so) the electron is gained less easily		1
01.3	potassium chloride	Answers in either order.	1
	bromine		1
01.4	displacement (reaction)		1
01.5	no reaction		1
	because iodine is less reactive than bromine	Allow converse.	1
Total			**10**

Question 2

Question	Answers	Extra information	Mark
02.1	**Level 3:** There is a clear description of the difference between the two atomic models which is linked to an explanation of the evidence that caused the change in model.		**5-6**
	Level 2: There is a description of **both** atomic models **or** there is a description of one model **and** a description of the evidence from the alpha particle experiment.		**3-4**
	Level 1: There are simple statements that describe a model or the evidence from the alpha particle scattering experiment. Two marks can be given for two valid statements.		**1-2**
	No relevant content.		**0**
	Indicative content: **Plum Pudding Model** • a ball of positive charge • negative electrons embedded in it **Evidence** • alpha particle scattering experiment • mass of the atom is concentrated at the centre • the centre was charged **Nuclear Model** • positively charged nucleus • negatively charged electrons orbiting the outside		
02.2	6		**1**
02.3	similarity: (same) number of protons **or** (same) number of electrons difference: (different) numbers of neutrons	If numbers are quoted, they must be correct.	**1** **1**
02.4	$\dfrac{(20 \times 10) + (80 \times 11)}{100}$ 10.8		**1** **1**
Total			**11**

Question 3

Question	Answers	Extra information	Mark
03.1	A — zinc, B — copper, C — lithium (lines connecting A, B, C to copper, lithium, zinc)	Award **2** marks for three correct lines. Award **1** mark for one or two correct lines. If more than one line is drawn from one box, award no marks for that box.	2
03.2	$\dfrac{100}{1000} = 0.1$ (dm³) 0.1×300 30 (g)	Allow $\dfrac{300}{1000} = 0.3$ (g per cm³). Allow 100×0.3. If no other mark awarded, allow 30 000 for **1** mark.	1 1 1
03.3	(the concentration) increases or (the solution) becomes more concentrated	Allow concentration is higher than 300 grams per dm³.	1
03.4	chlorine		1
03.5	$2H^+ + 2e^- \longrightarrow H_2$		1
03.6	aluminium oxide must be molten so that the ions can move to the electrodes the melting point of aluminium oxide is high so melting requires a lot of energy it is mixed with cryolite which reduces the temperature/energy required for the process/electrolysis		1 1 1 1
Total			**12**

Question 4

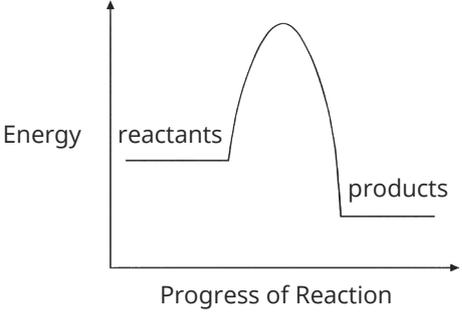| Question	Answers	Extra information	Mark
04.1	copper and magnesium	If more than one box is ticked award no marks.	1
04.2	it does not conduct electricity		1
	because the atoms are covalently bonded/it contains (simple) molecules	Accept molecules have no charge for the second and third mark.	1
	(so) it has no free/mobile electrons **or** ions		1
04.3	the reactants are used up	Allow electrolyte/electrode/ ions/metal/alkali for reactant.	1
04.4	the reaction (in rechargeable batteries) is reversible		1
04.5	Any **two** from: • hydrogen can be renewable (if made by electrolysis using renewable energy) • hydrogen fuel cells produce fewer pollutants • hydrogen fuel cells are cheaper than rechargeable batteries • rechargeable batteries may release toxic chemicals on disposal • there is a limit to how many times batteries can be recharged • rechargeable batteries can catch fire • you can travel more miles before a hydrogen fuel cell needs to be recharged	Allow hydrogen powered cars produce no/less carbon dioxide. Allow hydrogen powered cars only produce water.	2
Total			8

Question 5

Question	Answers	Extra information	Mark
05.1	a shared pair of electrons in the overlap **or** on the intersection between each of the hydrogen atoms and the carbon atom	Electrons can be dots, crosses or e- in any combination. Ignore any inner shell electrons on the carbon atom. Do **not** allow inner shell electrons on the hydrogen atoms. Do **not** accept if electrons are added to outer shells outside the overlap.	1
05.2	$M_r = 16$ $\dfrac{4}{16}$ (× 100) 25%	 An answer of 25(%) with no working shown scores **3** marks. Allow 6.25% for **2** marks.	1 1 1
05.3	small molecule with weak intermolecular forces that require little energy to overcome	Allow simple/small molecular structure. Allow weak forces between molecules. Allow **1** mark for low boiling point if no other marks awarded.	1 1 1
05.4	in graphite one electron from each carbon atom is delocalised electrons can move through the structure (and carry the current/charge/electricity) diamond has no delocalised electrons so it cannot conduct electricity	Allow graphite has delocalised/free electrons. Allow each carbon atom forms (covalent) bonds with four other carbon atoms.	1 1 1 1
Total			11

Question 6

Question	Answers	Extra information	Mark
06.1	ionic (bonding)		**1**
06.2	number of moles of $Fe = \dfrac{112}{56} = 2$		**1**
	number of moles of $HCl = \dfrac{182.5}{36.5} = 5$		**1**
	6 moles of hydrochloric acid would be needed to react with 2 moles of iron	Allow correct reasoning showing insufficient HCl is available. Allow error carried forward from incorrect calculation of number of moles.	**1**
	(so) hydrochloric acid is the limiting reactant	Allow HCl.	**1**
06.3	iron has been oxidised because the iron atoms have lost electrons	If more than one box is ticked award no marks.	**1**
Total			**6**

Question	Answers	Extra information	Mark
07.1	number of moles of $MgCO_3$ $= \dfrac{210}{84} = 2.5$	An answer of 182.5 (g) with no working shown scores **4** marks.	**1**
	number of moles of HCl = $2.5 \times 2 = 5$		**1**
	mass of HCl = 5×36.5		**1**
	= 182.5 (g)		**1**
07.2	the gas/carbon dioxide is lost		**1**
	so the measurement/mass does not include all of the products/atoms		**1**
Total			**6**

Question 8

Question	Answers	Extra information	Mark
08.1	(polystyrene is a) good thermal insulator	Allow polystyrene is a poor conductor of heat.	1
	(so) it reduces heat loss to the surroundings		1
08.2	Any **one** from: • add a lid • use more than one polystyrene cup/nested polystyrene cups • add insulation inside the beaker/between the cup and the beaker • use a temperature probe and data logger to measure the temperature		1
08.3	there is a curved line starting at the reactants line which goes up and then down	Allow curve to start/finish anywhere along reactant/ product lines.	1
	the line for the products is lower than the line for the reactants	The products energy level does not need to be labelled, but if it is then the label must be correct.	1
08.4	Na_2SO_4		1
	correct balancing 2NaOH and $2H_2O$		1

Energy | reactants | products | Progress of Reaction

08.5	(bonds broken)		**1**
	$(3 \times 522) + (2 \times 460) = 2486$		
	(bonds made)		**1**
	$(2 \times 522) + (2 \times 265) + (2 \times 460)$ $= 2494$		
	(energy change = bonds broken – bonds made) $2486 – 2494 = (-) 8$ (kJ/mol)	Allow calculation of difference between their calculations of energy for bonds broken and bonds made. Ignore energy change sign. An answer of 8 or -8 (kJ/mol) with no working shown scores **3** marks. An incorrect answer for one step does not prevent allocation of marks for subsequent steps.	**1**
08.6	strong acids ionise completely in (aqueous) solution	Allow all H^+ ions are released into the solution.	**1**
	weak acids only partially ionise in (aqueous) solution	Allow there are fewer H^+ ions in the solution.	**1**
08.7	dilution by a factor of 100	Allow pH changes by 1 when solution is diluted by a factor of 10.	**1**
	(pH =) 3	Allow pH changes by 2. An answer of 3 scores **2** marks.	**1**
Total			**14**

Question	Answers	Extra information	Mark
09.1	Any **two** from: • copper has a higher melting/boiling point • copper is denser • copper is harder • copper is stronger • copper is less reactive • copper has ions with different charges • copper forms coloured compounds • copper can be used as a catalyst	Ignore references to atomic structure. Allow a description of a specific reaction showing a difference in reactivity. Allow can form more than one ion.	**2**
09.2	total M_r of reactants = 143 + 12 = 155 $\dfrac{127}{155} \times 100$ 81.93548387 (%) 81.9%	Allow ecf for subsequent steps. Allow $\dfrac{127}{\text{their } M_r} \times 100$ Allow any correct rounding to 2 or more significant figures. Allow an answer from an incorrect calculation given to 3 significant figures. An answer of 81.9(%) scores **4** marks.	**1** **1** **1** **1**

09.3	carbon is more reactive (than copper)	Allow converse argument.	**1**
	(so) carbon will displace copper (from copper oxide) **or** (so) carbon will remove oxygen (from copper oxide)	Allow copper ions gain electrons. Allow carbon transfers electrons to copper (ions).	**1**
09.4	the atom economy is higher (for the extraction of copper from copper oxide) so the reaction is more sustainable/ there is less waste	Allow converse. Allow any sensible economic reason, e.g. raw materials are expensive for a small return, waste disposal is expensive, etc. Do **not** allow 'cheaper' unqualified.	**1**
09.5	(atom economy) will increase		**1**
Total			**10**

Question 10

Question	Answers	Extra information	Mark
10.1	**Level 3:** There is a clear description of a method that would lead to a valid outcome. All steps are identified and logically sequenced. For six marks, at least one additional point is made.		5-6
	Level 2: There is a description of most steps of the method, which may not be in a fully logical sequence. The method may not lead to a valid outcome. For four marks, at least one additional point is made.		3-4
	Level 1: There are simple statements that describe some relevant steps. Two marks can be given for two valid statements.		1-2
	No relevant content.		0
	Indicative content: **Key steps:** • measure 300cm^3 of (hydrochloric) acid into a conical flask • add a few drops of indicator to the acid (allow named indicator) • fill burette with aluminium hydroxide (to the 0cm^3 mark) • add aluminium hydroxide to the conical flask until a colour change is observed (if a colour change is specified, this must be correct for the indicator named) • add dropwise/drop by drop near the endpoint • record the volume of aluminium hydroxide added **Additional information:** • measure acid using a pipette • conical flask avoids splashing • place on white tile to see the colour change • swirl the conical flask • read volume from the bottom of the meniscus • read with eye level to the surface of the liquid • repeat until concordant results are obtained		

10.2	chooses titrations 2, 4 and 5		1
	33.12 (cm³)	Allow mean = 33.116(6…) (cm³)	1
		Allow a correctly calculated mean from an incorrect choice of titrations.	
10.3		An incorrect answer for one step does not prevent the allocation of marks for subsequent steps.	
	number of moles of Al(OH)$_3$ $$= \frac{33.12}{1000} \times 0.2 = 0.006624$$	Allow ecf from **10.2.**	1
	number of moles of HCl = 3 × 0.006624 = 0.019872		1
	concentration $$= \frac{0.019872}{0.3} = 0.06624$$	Allow $\dfrac{0.019872}{300} \times 1000$	1
	0.066 (mol/dm³)	An answer of 0.066 (mol/dm³) with no working shown scores **4** marks.	1

| 10.3 | **or**

number of moles of $Al(OH)_3$

$= \dfrac{35.54}{1000} \times 0.2$

number of moles of HCl =
$3 \times 0.007108 = 0.0231324$

concentration =
$\dfrac{0.021324}{0.3} = 0.07108$

0.071 (mol/dm³) | Allow $\dfrac{0.021324}{300} \times 1000$

Allow **4** marks for an answer of 0.071 (mol/dm³) with no working shown. | |
| **Total** | | | **12** |