Collins

AQA

GCSE

Chemistry

SET A – Higher Tier

Author: Sunetra Berry

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Answers

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Commissioning Editor: Rachael Harrison
Project Leader and Management: Natasha Paul and Chantal Addy
Author: Sunetra Berry
Cover Design: Paul Oates
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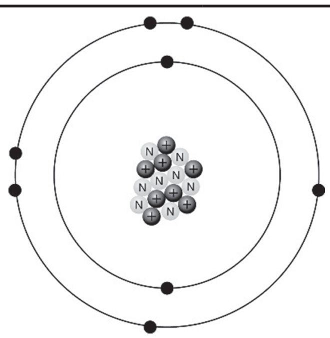
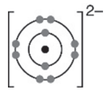
Paper 1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.1	Sodium chloride, Scandium		1	**AO2** 4.2.2.4 4.2.2.7
01.2	Carbon dioxide, Methane, Oxygen		1	**AO2** 4.2.2.4
01.3	 Diagram for calcium atom: 2 electrons transferred to form Ca^{2+} Diagram for fluorine atom: 1 electron gained to form F^- Therefore, need two Fs for each Ca (or one calcium reacts with two fluorine atoms). Two electrons from calcium atom are transferred, one to each of two F atoms. Calcium fluoride is an ionic compound.		1 1 1 1	**AO2** 4.2.1.3
01.4	Dot and cross diagrams only show how electrons are rearranged. Three-dimensional diagrams only show the arrangement of ions in space. (or other sensible reason)		1 1	**AO3** 4.2.1.3
02.1	polystyrene, or any suitable insulator		1	**AO1** 4.5.1.1
02.2	*x*-axis labelled 'volume', with units *y*-axis labelled 'temperature', with units suitable even scale for each axes points correctly plotted		1 1 1 1	**AO2** 4.4.2.2 4.4.2.4
02.3	lines of best fit correctly drawn		2	**AO2** 4.4.2.2 4.4.2.4
02.4	20 cm^3 allow ±0.1		1	**AO3** 4.4.2.2
02.5	$H^+ + OH^- \rightarrow H_2O$		1	**AO1** 4.4.2.2 4.4.2.4
02.6	10 cm^3 = pH 2–4 15 cm^3 = pH 2–4 25 cm^3 = pH 10–12 40 cm^3 = pH 10–12		1 1 1 1	**AO2** 4.4.2.2 4.4.2.4
03.1			1	**AO1** 4.1.1.7
03.2		1 mark for correct number of electrons; 1 mark for brackets and 2–	1 1	**AO2** 4.1.1.7
03.3	The radius of an atom is about 0.1 nm		1	**AO1** 4.1.1.5
03.4	Isotopes contain the same number of protons. Isotopes contain the same number of electrons.		1 1	**AO1** 4.1.1.5
03.5	Similarities: All isotopes have 8 protons/ 8 electrons / or they all have the same number of protons **and** the same number of electrons. Differences: They all have different number of neutrons.		1 1	**AO1** 4.1.1.5
03.6	(70 × 16) + (25 × 17) + (5 × 18) ÷ 100 = 16.35		1 1 1	**AO2** 4.1.1.6
04.1	The beam produced is deflected by an electric field. Flashes of light were observed when particles hit the screen.		1 1	**AO1** 4.1.1.3
04.2	Evidence: Most alpha particles passed straight through the gold foil. A small proportion of alpha particles rebounded. Explanation: As most passed through, the atom must be made mostly of empty space. Rebounding suggests the alpha particles hit a central **positive** nucleus.		2 2	**AO3** 4.1.1.3
05.1	Same volume of nitric acid and same mass of metal. React each metal in turn with acid. Start time and record time for bubbles to stop fizzing. One which stops fizzing first is the most reactive.		1 1 1 1	**AO3** 4.4.1.2
05.2	$2Al + 6HNO_3 \rightarrow 2Al(NO_3)_3 + 3H_2$	1 mark for correct equation; 1 mark for balancing	2	**AO2** 4.1.1.1

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Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
05.3	72 ÷ 1000 = 0.072 dm^3 hydrogen gas 24 dm^3 of any gas contains 1 mole of molecules (atoms if it's a noble gas, e.g. argon) 0.072 ÷ 24 = 0.003 moles		1 1	**AO2** 4.3.5
06.1	6 × 6.02 × 10^{23} = 3.612 × 10^{24} (must be in Standard Form)		1 1	**AO2** 4.3.2.1
06.2	number of moles present in 1 cm^3 = 2 ÷ 1000 = 0.002 number of moles present in 25 cm^3 = 0.002 × 25 = 0.05 moles		1 1	**AO2** 4.3.2.5
06.3	mass = number of moles × M_r mass = 0.05 × 63 = 3.15 g (ecf)	1 mark for calculation; 1 mark for unit	2	**AO2** 4.3.2.5
06.4	M_r $Fe(NO_3)_3$ = 242 atom economy = (2 × 242) ÷ (160 + (6 × 63)) × 100 = 89.96% = 90% to 2 significant figures		1 1 1	**AO1** 4.3.3.2
06.5	$2Fe + 6HNO_3 \rightarrow 2Fe(NO_3)_3 + 3H_2$	1 mark for correct equation; 1 mark for balancing	2	**AO2** 4.1.1.1 4.3.3.2
06.6	moles of $Fe(NO_3)_3$ in 200 kg = 200 000 ÷ 242 = 826.45 moles 1 mole Fe_2O_3 produces 2 moles $Fe(NO_3)_3$ (from equation) moles of Fe_2O_3 = 826.45 ÷ 2 = 413.22 moles mass of Fe_2O_3 = moles × M_r = 413.22 × 160 = 66 115.70 g = 66 115.70 ÷ 1 000 000 = 0.0661 tonnes to 3 s.f.		1 1 1 1	**AO2** 4.3.2.2
06.7	6:1 mole ratio, so moles of HNO_3 = 6 × 826.45 = 4958.7 moles volume of HNO_3 used = 4958.7 ÷ 2 = 2479.35 dm^3 2480 dm^3 to 3 s.f.		1 1 1	**AO2** 4.3.2.2 4.3.4
07.1	Swirl or dropwise add titrant from the burette towards end point or until the indicator changes colour / correct colour change of indicator given (pink to colourless for phenolphthalein; yellow to red for methyl orange; blue to red for litmus)		2	**AO1** **AO3** 4.3.4
07.2	equation: $NaOH + HCl \rightarrow NaCl + H_2O$ So, 1 mole NaOH reacts with 1 mole HCl moles of NaOH in 25 cm^3 = 25 ÷ 1000 × 1 = 0.025 if *x* cm^3 HCl is needed for complete reaction (end point of the titration) *x* cm^3 HCl contains 0.025 mole HCl 1 dm^3 HCl contains 0.025 ÷ x × 1000 mole HCl, which is the concentration of the acid in mol/dm^3		1 1 1	
07.3	Repeat the titration with further aliquots of NaOH until concordant titres are obtained.		1	
08.1	hydrogen ion or H^+		1	**AO1** 4.4.2.4
08.2	any one from: Acid A is a strong acid OR Acid B is a weak acid. Acid A dissociates fully OR Acid B does not dissociate fully. The concentration of H^+ is the same as the concentration of Acid A / less than the concentration of Acid B. Plus one from: Rate of reaction depends on number of collisions between H^+ and $CaCO_3$. If Acid A and Acid B have the same concentration, the concentration of H^+ is higher for Acid A and so CO_2 is produced in a shorter time.		1 1	**AO2** 4.4.2.6
08.3	24 dm^3 (24 000 cm^3)		1	**AO2** 4.3.5
08.4	conversion of volumes from cm^3 to dm^3; division by 1000 Moles of CO_2 produced in 2 mins with Acid A = 11 × 10^{-3} ÷ 24 4.58 × 10^{-4} moles (3 s.f. and in Standard Form)		1 1	**AO2** 4.3.5
08.5	pH 1		1	**AO2** 4.4.2.4
08.6	no… …because it is a weak acid and will not dissociate to form the same concentration of H^+ ions. The pH will not change as much.		1 1	**AO2** 4.4.2.4
09.1	A brown solid / coating appears over magnesium. The blue solution of copper sulfate solution becomes paler / colourless.		1 1	**AO1** 4.4.1.2

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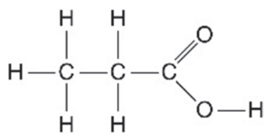
Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
09.2	Magnesium. It has lost electrons to form Mg^{2+} ions. $Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$		1 1	**AO2** 4.4.1.4
09.3	$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$	1 mark for balanced equation; 1 mark for state symbols	2	**AO2** 4.4.1.4 4.1.1.1 4.2.2.2
09.4	A – silver metal B – silver in a solution of silver nitrate C – magnesium metal D – magnesium in a solution of magnesium nitrate		1 1 1 1	**AO3** 4.5.2.1
09.5	Mg is the most reactive metal (and the most likely to be oxidised). Ag is the least reactive metal (and the most likely to be reduced). Using most and least reactive metals should produce highest voltage.		1 1 1	**AO1** 4.5.2.1
09.6	$Mg(s) + 2Ag^+(aq) \rightarrow Mg^{2+}(aq) + 2Ag(s)$	1 mark for balanced equation; 1 mark for state symbols	2	**AO2** 4.4.1.4 4.1.1.1 4.2.2.2
10.1	**Level 3**: A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.		5–6	**AO3** 4.4.3.3 4.4.3.4
	Level 2: A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise. For example, the idea that there are mixed ions with aqueous magnesium chloride; but the correct ionic equations may not be given.		3–4	
	Level 1: Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised. For example, the idea that the positive ions are attracted to the negative electrode and negative ions are attracted to the positive electrode.		1–2	
	No relevant content		0	
	Indicative content **Molten magnesium chloride** High temperature required to melt magnesium chloride. Mg^{2+} ions attracted to the negative cathode. Cl^- ions attracted to the positive anode. Cathode $Mg^{2+}(l) + 2e^- \rightarrow Mg(s)$ Anode $2Cl^-(l) \rightarrow Cl_2(g) + 2e^-$ **Aqueous magnesium chloride** Carried out at low / room temperature Mixture of ions present / Mg^{2+} / H^+ / Cl^- / OH^- ions Mg^{2+} **and** H^+ ions attracted to the negative cathode. Cl^- **and** OH^- ions attracted to the positive anode. cathode: $2H^+(l) + 2e^- \rightarrow H_2(g)$ anode: $2Cl^-(l) \rightarrow Cl_2(g) + 2e^-$ **Explanation** Hydrogen is less reactive than Mg and is more easily reduced. This will be formed at the cathode in the electrolysis of aqueous magnesium chloride.			

Paper 2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.1	Heavy fuel oil		1	**AO1** 4.7.1.2
01.2	Any three from: crude oil is heated it boils and gaseous products pass into the fractionating column the fractionating column is cooler at the top compounds / molecules condense at a region of the column that is the same as their boiling point		3	**AO1/ AO2** 4.7.1.2
01.3	any one from: fuels, solvents, lubricants, polymers, detergents		1	**AO1** 4.7.1.2
01.4			1	**AO2** 4.7.1.2 4.7.2.4

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Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.5	alkane general formula of alkanes = C_nH_{2n+2} accept it is a saturated hydrocarbon	explanation required for the mark	1	**AO1** 4.7.1.1
01.6	compared with petrol, diesel… is more viscous is less flammable has higher boiling point	allow converse arguments	 1 1 1	**AO2** 4.7.1.3
01.7	$C_{14}H_{30} \rightarrow 3C_2H_4 + C_8H_{18}$	all symbols and balancing must be correct	1	**AO2** 4.1.1.1 4.7.1.4
01.8	**steam cracking**, any two from: higher temperature very quick reaction lots of alkenes made **catalytic cracking**, any two from: zeolite catalyst used more small chain alkanes made longer chains broken		2 2	**AO2** 4.7.1.4
02.1	(both are safe to drink but) potable water contains dissolved substances / pure water does not contain any dissolved substances		1	**AO1** 4.10.1.2
02.2	River B three reasons (referring to choice and safety recommendations): less chloride than A **and** within safe limits less sodium that A **and** within safe limits pH higher than A **and** within safe limits		1 1 1 1	**AO3** 4.10.1.2
02.3	filtration sterilisation		1 1	**AO1** 4.10.1.2
02.4	to kill pathogens / to sterilise		1	**AO1** 4.10.1.2
02.5	**Level 3**: A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links. The answer includes an explanation of the limitations/benefits of the source location. A link is made between the difficulty of removing contaminants, energy required in the treatment processes and types of processes needed.		5–6	**AO3** 4.10.1.2
	Level 2: A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise. For example processes may be given, but not linked to particular contaminants. More than one idea is present such as energy requirements linked to removal of pollutants.		3–4	
	Level 1: Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised. For example more processes are required for treatment of sea water compared to groundwater, without qualification. Answer is limited to the idea of pollutants only.		1–2	
	No relevant content		0	
	Indicative content Both sources – sterilisation with one of ozone, chlorine or ultraviolet radiation **Seawater only** Desalination by distillation or reverse osmosis Large amounts of energy required Can only occur near a sea/ocean Plentiful supply **Groundwater only** Needs to be pumped up from groundwater source Already naturally filtered through rock so extra filtration not needed May be contaminated with pesticides or fertilisers which need to be removed Limited supply – if overused may run out Overuse can lead to subsidence			
03.1	reaction is reversible		1	**AO1** 4.6.2.1
03.2	it is endothermic		1	**AO1** 4.6.2.2
03.3	450 °C iron catalyst 200 atmospheres		1 1 1	**AO1** 4.10.4.1
03.4	ammonium hydroxide phosphoric acid		1 1	**AO2** 4.10.4.2
03.5	N = nitrogen P = phosphorus K = potassium	1 mark for two correct; 2 marks for all three correct	2	**AO1** 4.10.4.2

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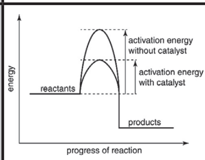
Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
03.6	calcium phosphate + nitric acid → calcium nitrate + phosphoric acid phosphoric acid + ammonium hydroxide → ammonium phosphate + water	in each equation: 1 mark for products and 1 mark for reactants	2 2	**AO2** 4.10.4.2
04.1	Stationary phase = paper Mobile phase = methanol		1 1	**AO1** 4.8.1.3
04.2	Horse 2		1	**AO2** 4.8.1.3
04.3	caffeine = 7.5 ÷ 10 = 0.75 paracetamol = 3 ÷ 10 = 0.30		1 1	**AO2** 4.8.1.3
04.4	distance of spot = 0.75 × 12 = 9.0 cm		1	**AO2** 4.8.1.3
04.5	sketch should show paper in solvent, with start line above solvent three spots on the start line (caffeine, paracetamol, horse 4)		1 1	**AO2** 4.8.1.3
05.1	compare the spectra of the combined metals and match them to the individual metals in the spectra given		1	**AO2** 4.8.3.7
05.2	Place the sample in a flame **and** pass the light given out through a spectroscope		1	**AO2** 4.8.3.7
05.3	The spectrum for Na^+ closely matches part of the spectrum for Ca^{2+} so it is difficult to tell them apart		1	**AO2** 4.8.3.7
05.4	sulfate: add barium chloride and dilute hydrochloric acid halide: add silver nitrate and dilute nitric acid cation test: add NaOH(aq)		1 1 1	**AO1/ AO3** 4.8.3.1 4.8.3.2 4.8.3.4 4.8.3.5
05.5	Salt A = lithium bromide Salt B = iron(III) sulfate Salt C = calcium iodide		1 1 1	**AO1/ AO2** 4.8.3.1 4.8.3.2 4.8.3.4 4.8.3.5
05.6	any two from: flame emission spectroscopy… is more accurate is more sensitive can measure concentrations		2	**AO2** 4.8.3.7 4.8.3.6

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
06.1	**Level 3**: A detailed and safe method is given which would produce valid results. The maximum volume and resolution of the equipment needed to measure any gas is given.		5–6	**AO1/ AO3** 4.6.1.2
	Level 2: A safe method is described which would produce valid results but some of the detail is missing. The maximum volume and resolution of some the equipment needed is given.		3–4	
	Level 1: A simple method is given which demonstrates some of the required practical procedures needed to produce valid results but will not produce valid results in its entirety. It shows some understanding of resolution		1–2	
	No relevant content		0	
	Indicative content wear safety glasses **Control variables** use a weighing balance to measure of the same mass of each compound e.g. 1.0 g use the same powdered surface area of each catalyst same volume of H_2O_2 e.g. 50 cm^3 use a 50 cm^3 pipette or volumetric flask to measure it out **Method** put the H_2O_2 in a 250 cm^3 conical flask with a bung in the top with a delivery tube to a gas syringe or upturned measuring cylinder in a trough filled with water add the catalyst to the H_2O_2 and start the stop clock measure volume every 15 seconds until the end of reaction record volume of gas produced every 15 seconds ask another group to repeat procedure plot a graph of all catalysts to compare results			
06.2		1 mark for curve labelled 'without catalyst'; 1 mark for lower curve labelled 'with catalyst'	2	**AO1** 4.6.1.4

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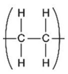
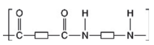
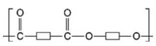
Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
06.3	a catalyst provides an alternative reaction pathway with a lower activation energy so more reactants will have energy greater than the activation energy		2	**AO1** 4.6.1.4
06.4	labelled axes are needed: vertical axis label is 'Mass (g)', horizontal axis label is 'Time (min)' correct plots correct line of best fit	correct plots (2 marks for all six correct; 1 mark for 4 or 5 correct)	 1 2 1	**AO2** 4.6.1.1
06.5	gradient line drawn at 3 minutes; draw a suitable gradient line correct calculation of the gradient from their tangent (gradient range between 6×10^{-3} to 9×10^{-3} acceptable) units g/min		1 1 1 1	**AO2** 4.6.1.1
06.6	curve should be below first curve (line of best fit drawn for 06.4 they should both reach the same final mass loss		1 1	**AO3** 4.6.1.2
07.1	**repeating units** (top to bottom):  addition  condensation  condensation	1 mark for each polymer correctly drawn **along with** the type of polymerisation	3	**AO1/ AO2** 4.7.3.1 4.7.3.2
07.2	paper (no mark without giving reasons) any two reasons from: less energy needed to make it higher rate of biodegradability made from renewable source		1 2	**AO3** 4.10.2.1
07.3	mention of: paper causes more pollution compared to plastic harder to decide/no obvious choice not sure if benefits outweigh disadvantages/more info needed		 1 1 1	**AO3** 4.10.2.1
07.4	life-cycle assessments can be misinterpreted need all relevant information to make an informed choice		2	**AO3** 4.10.2.1
08.1	Reaction 2 (must have reason for mark) two reasons from: there are more moles (4) on the left-hand side but only 2 moles on the right-hand side; reaction 3 has a lower difference in the moles on the left-hand side compared to the right-hand side reaction 1 is not in gaseous state, so not affected by pressure		1 2	**AO3** 4.6.2.7
08.2	all three reactions are exothermic; therefore the increase in temperature will cause the equilibrium to shift to the left favouring the endothermic reaction so as to reduce the temperature		1 1	**AO2** 4.6.2.6
08.3	Reaction 4 is endothermic whereas reaction 3 is exothermic The yield of products in reaction 4 will increase with a temperature increase, whereas the yield of products in reactions 3 will decrease The increase in temperature will cause the equilibrium position in reaction 4 to shift to the right, whereas the equilibrium position in reaction 3 will shift to the left		1 1 1	**AO3** 4.6.2.6

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