OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



MARK SCHEME

M1 ARITHMETIC AND NUMERICAL COMPUTATION

SCORE	PERCENTAGE
/89	%

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Question			Answer/Indicative content	Marks	Guidance
1	a		0.67 (1)	1	
	b		mass is conserved in the reactions / mass of magnesium + mass of oxygen = mass of magnesium oxide (1) as mass of magnesium increases so does the mass of oxygen / mass of magnesium increases so does the mass of magnesium oxide / mass of oxygen increases so does the mass of magnesium oxide (1)	2	**allow** correct ideas about direct proportionality (2) for example • if you double (or any other multiple) the mass of magnesium you double (or the appropriate multiple) the mass of magnesium oxide made (1) • if you double (or any other multiple) the mass of magnesium you double (or the appropriate multiple) the mass of oxygen used (1)
	c		any answer between 59.7 and 60.6 (%) (2) **but if answer is incorrect then** $\frac{0.2 \times 100}{0.33}$ / $\frac{0.4 \times 100}{0.67}$ / $\frac{0.6 \times 100}{1.00}$ / $\frac{1.0 \times 100}{1.67}$ (1)	2	
			Total	5	
2			21 (%) (1)	1	
			Total	1	
3	a	i	40(°C) (1)	1	
		ii	solubility decreases as temperature increases / ora (1)	1	assume unqualified answer refers to temperature increasing
		iii	yes (no marks) idea that 1 kg can dissolve 2.5 g (1) so 3 kg can dissolve 3 × 2.5 (g) (1)	2	if no = 0 marks for the question **no** marks for 7.5 kg on its own – marks are for the working out
	b		quoting a solubility for carbon dioxide from any temperature (1) and show it is less than the solubility of sulfur dioxide at the same temperature (1)	2	**allow** much larger y-axis scale (1) **allow** the (solubility) values for sulfur dioxide are greater than the values for carbon dioxide at all temperatures (2)

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Question			Answer/Indicative content	Marks	Guidance
	c	i	as pH (of ocean) goes down the percentage of carbon dioxide (in air) goes up (1)	1	**ignore** just quoting data
		ii	**any two from:** as pH (of ocean) goes down the mass of carbon dioxide dissolved (per kg of sea water) goes up (1) as percentage of carbon dioxide (in air) goes up the mass of carbon dioxide dissolved (per kg of sea water) goes up (1) as years increase the pH (of ocean) goes down (1) as years increase the as percentage of carbon dioxide (in air) goes up (1) as years increase the mass of carbon dioxide dissolved (per kg of sea water) goes up (1)	2	**allow** ora
		iii	the mass of carbon dioxide dissolved (per kg of sea water) changes with temperature / solubility of carbon dioxide (in sea water) changes with temperature (1)	1	**allow** to have a fair test / to control all the variables **allow** a more general statement about the solubility of gases e.g. solubility of gases change with temperature **allow** change in temperature changes pH temperature is an important factor is **not** sufficient **not** temperature depends on the mass of carbon dioxide
			Total	**10**	
4			28.6 (%) (2) **but if answer incorrect then** $\frac{12 \times 100}{42}$ (1)	**2**	**allow** 28.5 (1)

Question			Answer/Indicative content	Marks	Guidance
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
5	a	i	25 – 27 (°C) (1)	1	
		ii	yes (no marks) idea that 1 kg can dissolve 2.5 g (1) so 3 kg can dissolve 3 × 2.5 (g) (1)	2	if no = 0 marks for the question no marks for 7.5 kg on its own – marks are for the working out
	b	i	quoting a solubility for carbon dioxide at a particular temperature and the solubility of sulfur dioxide at the same temperature (1) divide solubility of sulfur dioxide by solubility of carbon dioxide to get a number bigger than 50 / AW	2	the solubilities quoted must be within ±5 for sulfur dioxide and ±0.5 for carbon dioxide **allow** showing that 50 x CO_2 solubility is less than that of SO_2 **allow** at 0 °C (solubility of) SO_2 is 69 times that of CO_2 = 2 marks **allow** at 10 °C (solubility of) SO_2 is 68 times that of CO_2 = 2 marks **allow** at 40 °C (solubility of) SO_2 is 60 times that of CO_2 = 2 marks
		ii	20 – 40 (g) (1)	1	
		iii	more gas dissolves (in Arctic Ocean) (1)	1	**allow** more gas dissolves (in cold water) **allow** solubility of gas is more (in Arctic) **allow** ora

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Question			Answer/Indicative content	Marks	Guidance
	c	i	the mass of carbon dioxide dissolved (per kg of sea water) changes with temperature / solubility of carbon dioxide (in sea water) changes with temperature(1)	1	**allow** to have a fair test / to control all the variables **allow** a more general statement about the solubility of gases e.g. solubility of gases change with temperature **allow** change in temperature changes pH temperature is an important factor is **not** sufficient **not** temperature depends on the mass of carbon dioxide
		ii	**any two from:** sulfur dioxide is also involved in making oceans acid / other factors involved in making oceans acid (1) idea that remote island not representative of whole ocean / could have tested more locations / AW (1) should have tested more years / reduce the gap between testing (1) should test at same time of year (1) did not repeat results (1) there is one anomalous result / identification of pH 7.96 as being an outlier (1)	2	**allow** one mark for not enough evidence collected if no other mark awarded she is only looking at one aspect of the ocean is **not** sufficient
			Total	10	
6			B	1 (AO2.1)	
			Total	1	
7			B	1 (AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
8			C	1 (AO2.1)	
			Total	**1**	
9			D	1 (AO2.1)	
			Total	**1**	
10			$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$ Formulae ✓ Balancing ✓	2 (AO2.2 ×2)	**ALLOW** any correct multiple, including fractions **ALLOW** = / ⇌ instead of → **NOT** 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 e.g. $CH_{4\,(g)} + 2O_{2\,(g)} \rightarrow 2H_2O_{\,(g)} + Co_{2\,(g)}$
			Total	**2**	
11		i	Hydrogen ion / H^+	1 (AO1.1)	
		ii	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ Reactant ✓ Product ✓	2 (AO2.2 ×2)	
			Total	**3**	
12			Mass of **M**$_3$ = 164 – (31 + 16 × 4) = 69 ✓ Mass of **M** = 69/3 = 23 ✓ **M** = sodium **OR** Na ✓	3 (AO2.2)	**ALLOW** metal closest to calculated **M** by **ECF**
			Total	**3**	
13			C ✓	1 (AO 2.2)	
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
14			B ✓	1 (AO2.1)	
			Total	**1**	
15			D ✓	1 (AO2.2)	
			Total	**1**	
16			B ✓	1 (AO2.2)	
			Total	**1**	
17			B ✓	1 (AO2.1)	
			Total	**1**	
18			**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 373 (tonnes) award 4 marks** M_r $CaCO_3$ = 100.1 **and** M_r CaO = 56.1 ✓ 209 g of calcium oxide = $\frac{100.1}{56.1} \times 209$ = 372.9215686 (g) ✓ = 373 (g) (**3 significant figures**) ✓	4 (AO3 × 2.2) (AO1.2)	Need both relative formula masses for 1 mark **DO NOT ALLOW** 100 or 56 **ALLOW** ECF from incorrect RFMs **ALLOW** ECF **ALLOW** ECF for sig fig mark
			Total	**4**	
19			**D** ✓	1 (AO2.2)	
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
20	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 $CL_2 + 2NAI \rightarrow 2NaCl + I2$
			Total	**6**	

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Question			Answer/Indicative content	Marks	Guidance
21			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)** Describes how incomplete combustion of hydrocarbons such as propane happens. **AND** Describe the problems of incomplete combustion for campers, including a correct balanced symbol equation. *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)** Describes how incomplete combustion of hydrocarbons such as propane happens. **AND** Attempts to describe the problems of incomplete combustion for campers. **OR** Includes a correct balanced symbol equation. *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)** Describes how incomplete combustion of hydrocarbons such as propane happens. **OR** Attempts to describe the problems of incomplete combustion for campers. **OR** Attempts a correct balanced symbol equation. *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 (AO2 × 1.1) (AO4 × 2.1)	**AO1.1 Knowledge and understanding of why incomplete combustion happens** • Insufficient oxygen / air • This can happen if there is not enough ventilation, such as in a caravan • Not enough oxygen / air for complete combustion **AO2.1 Application of knowledge and understanding of sources of CO and the associated problems** • Carbon monoxide gas is produced, which is toxic • Carbon monoxide combines with haemoglobin / red blood cells • So less oxygen can be carried / there is a lack of oxygen to cells • Can cause unconsciousness / death • Carbon particles / soot produced • Cause blackening of the inside of the caravan • Less energy produced so wastes camping gas / fuel • • Takes longer to heat the caravan / to cook food **AO2.1 Application of knowledge and understanding to produce a balanced symbol equation** Eg $C_3H_8 + 3½O_2 \rightarrow 3CO + 4H_2O$ OR $C_3H_8 + 3O_2 \rightarrow 2CO + C + 4H_2O$ Other balanced equations are possible
			Total	**6**	

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Question			Answer/Indicative content	Marks	Guidance
22		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 120 (tonnes) award 3 marks M_r of NH_3 = 17 **AND** M_r of NH_4NO_3 = 80 ✓ Mass of ammonium nitrate = $\frac{80}{17}$ x 25.5 / 1.5 x 80 ✓ = 120 (tonnes) ✓	3 (AO2.1)	**ALLOW** ECF from incorrect RMMs
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 10(g) award 2 marks Actual mass = $\frac{80 \times 12.5}{100}$ ✓ = 10 (g) ✓	2 (AO1.2) (AO2.2)	**ALLOW** % yield = (am ÷ pm) x 100 **OR** 80 = (am ÷ 12.5) x 100 for 1 mark if no other mark awarded
			Total	5	
23			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 124.49(%) award 3 marks 11,000,000 – 4,900,000 = 6.1×10^6 ✓ 6,100,000 ÷ 4,900,000 = 1.244897959 ✓ 1.244897959 × 100 = 124.49(%) ✓	3 (AO2×2.2) (AO1.2)	**ALLOW** ECF from calculation
			Total	3	
24			D ✓	1 (AO2.2)	
			Total	1	
25			B ✓	1 (AO2.2)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
26		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 120 (tonnes) award 3 marks M_r of NH_3 = 17 **AND** M_r of NH_4NO_3 = 80 ✓ Mass of ammonium nitrate = $\frac{80}{17}$ × 25.5 / 1.5 × 80 ✓ = 120 (tonnes) ✓	3 (AO2.1)	**ALLOW** ECF from incorrect RMMs
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 10(g) award 2 marks Actual mass $= \frac{80 \times 12.5}{100}$ ✓ = 10 (g) ✓	2 (AO1.2) (AO2.2)	**ALLOW** % yield = (am ÷ pm) × 100 **OR** 80 = (am ÷ 12.5) × 100 for 1 mark if no other mark awarded
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
27			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)** Describes tests, the results, and identifies each of the three samples **AND** Includes correct balanced symbol equations for the reactions which occur. *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)** Describes tests, the results, and identifies each of the three samples **OR** Describes a test and the result, to identify one of the three samples and attempts to identify the other two **AND** Includes a balanced symbol equation for the reaction which occurs. *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)** Describes a test and the result, to identify one of the three samples. *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 (AO3 × 1.2) (AO3 × 2.2)	**AO1 Knowledge and understanding of alkanes, alkenes and acids** • Alkanes do not react with bromine water • Alkenes react with bromine water / bromine water is decolourised • Acids react with carbonates to give off carbon dioxide / fizzing observed **AO2 Application and knowledge of tests and results** • Add sodium carbonate (or any suitable carbonate) • Ethanoic acid effervesces • Pentane and pentene do not effervesce • ALLOW other suitable reactions, eg addition of a metal; ethanoic acid effervesces • ALLOW use of universal indicator to identify ethanoic acid • Add bromine water to separate samples of pentane and pentene and shake • With pentene bromine water changes from orange to colourless / bromine water is decolourised • With pentane and ethanoic acid bromine water stays orange **AO2.1 Application of knowledge and understanding to produce balanced symbol equations** $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + CO_2 + H_2O$ $C_5H_{10} + Br_2 \rightarrow C_5H_{10}Br_2$
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
28	a	i	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 0.00125 / 1.25×10^{-3} award 2 marks** Moles = $\frac{\text{volume}}{24}$ / $\frac{0.030}{24}$ / $\frac{30}{24{,}000}$ ✓ = 0.00125 / 1.25×10^{-3} ✓	2 (AO2.2)	**ALLOW** 1 mark only for 30 ÷ 24 or 0.030 ÷ 24,000, correctly calculated
		ii	0.0025 / 2.5×10^{-3} (g) ✓	1 (AO2.2)	**unit not needed** **ALLOW** ECF from **(i)** ie 2 x answer from **(i)**
	b		Moles of chromium = $\frac{10.40}{52.0}$ = 0.2 ✓ Moles of nickel = $\frac{17.61}{58.7}$ = 0.3 ✓ Idea that ratio is 2:3 / ratio isn't 1:1 so <u>equation 2</u> ✓	3 (AO2.2)	**ALLOW** other methods of calculation eg 10.40g of chromium forms $\frac{10.40}{52.0} \times 58.7$ = 11.74g nickel $\frac{11.74}{3} \times 2 = 17.61\text{g}$ of nickel So, equation 2 **ALLOW** answers that show equation 1 is not correct **Third marking point is dependent on correct mathematical reasoning**
			Total	**6**	

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