EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed
78 Minutes

Score /65

Percentage %

CHEMISTRY

OCR AS & A LEVEL

Mark Scheme

Module 2: Foundatons in chemistry

Question			er	Marks	Guidance
1	(a)	(	The H^+ **OR** hydrogen **ions OR** protons in (sulfuric) acid have been replaced by ammonium ions **OR** NH_4^+ ✓	1	**ALLOW** 'a positive ion' for 'ammonium ions' **BUT IGNORE** 'a positive metal ion' **OR** 'metal ions' for 'ammonium ions' **IGNORE** references to being produced by the reaction of an acid and a base **DO NOT ALLOW** hydrogen atoms **OR** ammonia ions **DO NOT ALLOW** 'H for H^+ OR NH_4 for NH_4^+
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE IF answer = 0.104 (mol) award 3 marks Amount of H_2SO_4 = 0.100 × 32.5/1000 = 3.25 × 10^{-3} **OR** 0.00325 mol ✓ Amount of NH_3 = (mol of H_2SO_4) × 2 = 6.50 × 10^{-3} **OR** 0.0065 mol ✓ No. of mol of NH_3 = (mol of NH_3) × 400 / 25.0 = 0.104 (mol) ✓	3	If there is an alternative answer, check to see if there is any ECF credit possible using working below **ALLOW ECF** for amount of H_2SO_4 × 2 **ALLOW ECF** for amount of NH_3 × 400 / 25.0 **ALLOW** concentration approach for marking point 3 Conc ammonia = 6.50 × 10^{-3} x 1000 / 25.0 = 0.260 mol dm^{-3} mol of NH_3 = (conc of NH_3) × 400 / 1000 = 0.104 (mol) **ALLOW** calculator value or rounding to 2 sig figs or more **BUT IGNORE** 'trailing' zeroes, eg 0.200 allowed as 0.2
	(b)		Predicted bond angle 107º ✓ *Explanation* There are 3 bonded pairs **and** 1 lone pair ✓ Electron pairs repel ✓ Lone pairs repel more than bonded pairs ✓	4	**ALLOW** range 106–108º **ALLOW** a response which is equivalent to 3 bp and 1 lp, eg 'There are four pairs of electrons. One is a lone pair' **ALLOW** 'bonds' for 'bonded pairs' **ALLOW** diagram showing N atom with 3 dot-and-cross bonds and 1 lone pair clearly drawn onto it for second mark **IGNORE** stick versions of bonding **DO NOT ALLOW** 'atoms repel' for 'electron pairs repel' **IGNORE** 'electrons repel' **ALLOW** 'bonds repel'

Question			er	Marks	Guidance
1	(c)	(	OH^- ✓	1	Correct charge must be seen **ALLOW** OH^- if seen as the ONLY negative product of an equation
		(ii)	$N_2H_5^+$ **OR** $N_2H_6^{2+}$ ✓	1	**ALLOW** $H_2N–NH_3^+$ **OR** $H_3N–NH_3^{2+}$
	(d)	(	C*l* goes from (+)1 to –1 ✓ N goes from –3 to –2 ✓ C*l* is reduced **AND** N is oxidised ✓	3	**ALLOW** 1(+), 1–. Only look for oxidation numbers seen above or below equation if not seen in text **IGNORE** Cl^- Cl^+ **DO NOT ALLOW** If a second species is seen going down in oxidation number with the exception of N going from –3 to –4 **ALLOW** 3 –, 2 –. Only look for oxidation numbers seen above or below equation if not seen in text **IGNORE** N^{3-} N^{2-} **DO NOT ALLOW** If a second species is seen going up in oxidation number **ALLOW** ECF for oxidation of any species showing an increase in oxidation number **AND** for reduction of any species showing a decrease in oxidation number **IGNORE** references to electron loss **OR** gain **ALLOW** 3 marks for labelled equation such as below $2NH_3 + NaClO \rightarrow N_2H_4 + NaCl + H_2O$ – + – oxidation reduction
		(ii)	sodium chlorate(I) ✓	1	**ALLOW** sodium chlorate I (ie no brackets) **ALLOW** sodium hypochlorite **IGNORE** bleach **DO NOT ALLOW** sodium chlorate (with no Roman numeral)
		(iii)	$N_2H_4 + 2NH_2Cl \rightarrow 2NH_4Cl + N_2$ ✓✓	2	One mark for N_2 One mark for NH_4Cl **AND** balancing
			Total	**16**	

Question			Answer	Mark	Guidance
2	(a)		Rb-87 has (two) more neutrons ✓	1	**ALLOW** Different numbers of neutrons **ALLOW** 2 neutrons **ALLOW** Rb-85 has 48 neutrons **AND** Rb-87 has 50 neutrons **IGNORE** correct references to protons and electrons **DO NOT ALLOW** incorrect references to protons and electrons
	(b)		The (weighted) mean **mass** of an **atom** (of an element) **OR** The (weighted) average **mass** of an **atom** (of an element) ✓ compared with 1/12th (the mass) ✓ of (one atom of) carbon-12 ✓	3	**ALLOW** average atomic mass **DO NOT ALLOW** mean mass of an element **ALLOW** mean mass of isotope**s** **OR** average mass of isotope**s** **DO NOT ALLOW** the singular; 'isotope' For second **AND** third marking points **ALLOW** compared with (the mass of) carbon-12 which is 12 **ALLOW** mass of **one mole** of **atoms** ✓ compared to 1/12th ✓ (mass of) **one mole OR** 12 **g** of carbon-12 ✓ **ALLOW** mass of **one mole** of atoms 1/12th mass of **one mole** OR 12**g** of carbon-12
	(c)		$\frac{(85.00 \times 72.15) + (87.00 \times 27.85)}{100}$ = **OR** *61.3275 + 24.2295* **OR** *85.557* ✓ A_r = 85.56 (to 2 decimal places) ✓	2	**ALLOW** two marks for correct answer A_r = 85.56 (with no working) **ALLOW** one mark for **ECF** from **seen** incorrect sum provided final answer is between 85 and 87 and is to 2 decimal places, e.g. 85.567 gives **ECF** of 85.57 for one mark

Question			er	Mark	Guidance
2	(d)		Spherical **OR** sphere ✓	1	**DO NOT ALLOW** 'circular' **IGNORE** unlabelled 2-D diagrams
	(e)	(i)	$Sr^{+}(g) \rightarrow Sr^{2+}(g) + e^{-}$ ✓	1	**ALLOW** e for electrons **ALLOW** $Sr^{+}(g) - e^{-} \rightarrow Sr^{2+}(g)$ **DO NOT ALLOW** $Sr^{+}(g) + e^{-} \rightarrow Sr^{2+}(g) + 2e^{-}$ **IGNORE** state symbols for electrons
	(e)	(ii)		3	**Use annotations with ticks, crosses ECF etc. for this part** Comparison should be used for each mark
			Sr has one **more** proton **OR** great**er** nuclear charge ✓		**ALLOW** Sr has more protons **ALLOW** 'across the period' for 'Sr' **IGNORE** 'atomic number increases', but **ALLOW** 'proton number' increases **IGNORE** 'nucleus gets bigger' 'Charge increases' is insufficient **ALLOW** 'effective nuclear charge increases' **OR** 'shielded nuclear charge increases' ***Quality of Written Communication –*** *Nuclear* ***OR*** *proton(s)* ***OR*** *nucleus spelled correctly* ***ONCE*** *for the* ***first*** *marking point*
			(Outermost) electrons are in the same shell **OR** (outermost) electrons experience same shielding **OR** Atomic radius of Sr is small**er** ✓		**ALLOW** shielding is similar **ALLOW** screening for shielding **IGNORE** sub-shells **DO NOT ALLOW** 'distance is similar'
			Sr has great**er** nuclear attraction (on outer electrons / outer shell/s) **OR** the (outer) electrons are attracted more strongly (to the nucleus) ✓		**ALLOW** 'greater nuclear pull' for 'greater nuclear attraction' **DO NOT ALLOW** 'nuclear charge' for nuclear attraction **ORA** throughout

Question			er	Mark	Guidance
2	(e)	(iii)	2nd IE of Rb involves removing electron from shell closer to nucleus ✓ Strong**er** nuclear attraction on (outermost electron) of Rb **OR** (outermost electron) of Rb experiences **less** shielding ✓	2	**IGNORE** new shell **ALLOW** There is one shell fewer in Rb^{+} (than Sr^{+}) **ALLOW** Rb^{+} has a smaller radius (than Sr^{+}) **ALLOW** Rb^{+} loses an electron from the 4th shell **AND** Sr^{+} loses an electron from the 5th shell. **ALLOW** responses which do not specifically say 'nuclear' attraction (e.g. Rb has greater attraction) as long as nucleus is seen in first point A comparison of Rb to Sr must be used, e.g. 'Because of shielding' is not enough **ORA**
			Total	**13**	

Question			Answer	Mark	Guidance
3	(a)	(i)	mol of H_xA = $\frac{25.00 \times 0.0500}{1000}$ = 1.25×10^{-3} **OR** 0.00125 mol ✓	1	**ALLOW** 0.0013 **OR** 1.3×10^{-3} **ALLOW** correct answer only without working
		(ii)	mol of NaOH = $\frac{12.50 \times 0.200}{1000}$ = 2.5(0) × 10^{-3} **OR** 0.0025(0) mol ✓	1	**ALLOW** correct answer without working
		(iii)	Answer **2a(ii)** rounded to nearest whole number ✓ Answer **2a(i)** If **2a(i)** and **2a(ii)** are correct this will be $x = \frac{2.50 \times 10^{-3} \text{ mol}}{1.25 \times 10^{-3} \text{ mol}} = 2$ **OR** H_2A	1	**ALLOW** answer without working if answers to **2a(i) AND 2a(ii)** are seen **DO NOT ALLOW** responses without seeing answers in **2a(i) AND 2a(ii)**
	(b)	(i)	HNO_3 ✓ $CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$ ✓	2	**IGNORE** state symbols **ALLOW** correct multiples
		(ii)	(Electrostatic) **attraction** between **oppositely** charged **ions** ✓	1	**Attraction** is essential **IGNORE** references to metal and non-metal
		(iii)	**Ions** are mobile **OR** ions can move ✓	1	**IGNORE** 'free ions' **IGNORE** 'delocalised ions' **IGNORE** ions can move when molten **IGNORE** charge carriers **DO NOT ALLOW** Any mention of electrons moving **ALLOW** ions move when **in** a liquid **IGNORE** responses which give liquid ions
		(iv)	(+) 5 ✓	1	**ALLOW** V

Question			Answer	Mark	Guidance
3	(c)		$Cu(NO_3)_2•6H_2O$ ✓	1	**ALLOW** $Cu(NO_3)_26H_2O$ **ALLOW** $Cu(NO_3)_2(H_2O)_6$ **ALLOW** $Cu(NO_3)_2.6H_2O$ **DO NOT ALLOW** $CuN_2O_6•6H_2O$
			Total	**9**	

Question			Answer	Mark	Guidance
4	(a)		Used to neutralise **acidic** soils ✓ Excess will result in soils becoming **too** alkaline (to sustain crop growth) ✓	2	**ALLOW** raises the pH of the soil **IGNORE** references to fertilisers **ALLOW** pH becomes **too** high **IGNORE** 'harmful' **IGNORE** 'corrosive'
	(b)	(i)	0.00131 × 40.1 = 0.0525 g **OR** 5.25×10^{-2} ✓	1	**ALLOW** 0.053 **OR** 0.05253 **OR** 0.052531 g **IGNORE** 0.05 **if correct answer seen in working** **DO NOT ALLOW** 0.052 **OR** 0.0524
		(ii)	0 00131 × 24.0 = 0.0314 dm^3 **OR** 3.14×10^{-2} ✓	1	**ALLOW** 0.031 **OR** 0.03144 dm^3 **IGNORE** 0.03 **if correct answer seen in working** **DO NOT ALLOW** 31.4
		(iii)	Mol of OH^- ions = 0.00131 × 2 = 0.00262 **OR** 2.62×10^{-3} ✓ Mol of OH^- ions in 1 dm^3 = $0.00262 \times \frac{1000}{250}$ = 0.0105 mol dm^{-3} ✓	2	**ALLOW** 0.0026 **ALLOW** 0.01048 **OR** 0.01(0) **ALLOW ECF** from incorrect mol of OH^- **DO NOT ALLOW** 2nd mark as **ECF** if 0.0525 is used as no of mol of OH^- ions **DO NOT ALLOW** 2nd mark as **ECF** if 0.0314 is used as no of mol of OH^- ions 0.00524 mol dm^{-3} is a likely **ECF** as a result of not multiplying 0.00131 by 2, but 0.00131 must be seen in working
	(c)	(i)	**Fewer** moles of Ba (in 0.0525 g) **OR Fewer** atoms of Ba (in 0.0525) ✓	1	**ORA** Assume candidate is referring to Ba if not stated **IGNORE** A_r Ba > A_r Ca
		(ii)	Idea of Ba having a quick**er** rate **OR more** vigorous reaction ✓	1	**ALLOW more** exothermic **OR** gets hot**ter OR** fizzes more Assume candidate is referring to Ba if not stated Comparison is essential **IGNORE** 'Ba more reactive' **ORA**
			Total	**8**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		**Mass** of the **isotope** compared to 1/12th **OR** **mass** of the **atom** compared to 1/12th ✓ (the mass of a) carbon-12 **OR** ^{12}C (atom) ✓	**2**	**IGNORE** Reference to average **OR** weighted mean (i.e. correct definition of relative atomic mass will score both marks) **ALLOW** mass of a **mole** of the isotope/atom with 1/12th the mass of a **mole OR** 12 **g** of carbon-12 for two marks. **ALLOW 2 marks for:** '**Mass** of the isotope **OR mass** of the atom compared to ^{12}C atom given a mass of 12.0' i.e. 'given a mass of 12' **OR** C12 is 12 communicates the same idea as 1/12th.' **ALLOW** 12C **OR** C12 **ALLOW 2 marks for:** $\frac{\text{mass of the isotope}}{\text{mass of 1/12th mass of carbon-12}}$ i.e. fraction is equivalent to 'compared to' **ALLOW 1 mark for** a mix of mass of atom and mass of mole of atoms**,** i.e. 'mass of the isotope/mass of an atom compared with 1/12th the mass of a **mole OR** 12 g of carbon-12.' **DO NOT ALLOW** mass of 'ions' OR mass of element
	(b)		$\frac{(151 \times 47.77) + (153 \times 52.23)}{100}$ **OR** 72.1327 + 79.9119 **OR** 152.0446 (calculator value) ✓ A_r = 152.04 ✓	**2**	**ALLOW** Correct answer for two marks **ALLOW** One mark for ECF from transcription error in first sum provided final answer is to 2 decimal points and is to between 151 and 153 and is a correct calculation of the transcription

Question			Expected Answers	Marks	Additional Guidance
	(c)	(i)	^{153}Eu has (2) more neutrons **OR** ^{153}Eu has 90 neutrons **AND** ^{151}Eu has 88 neutrons ✓	1	**ALLOW** There are a different number of neutrons **IGNORE** Correct references to protons / electrons **DO NOT ALLOW** Incorrect references to protons / electrons
		(ii)	(It has the) same number of protons **AND** electrons **OR** Both have 63 protons and 63 electrons ✓	1	**ALLOW** Same number of protons **AND** same electron configuration **DO NOT ALLOW** 'Same number of protons' without reference to electrons (and vice versa)

Question			Expected Answers	Marks	Additional Guidance
	(d)		Xe has a bigger atomic radius **OR** Xe has more shells ✓	3	**ALLOW** Xe has more energy levels **ALLOW** Xe has electrons in higher energy level **ALLOW** Xe has electrons further from nucleus **IGNORE** Xe has more orbitals **OR** more sub-shells **DO NOT ALLOW** 'different shell' or 'new shell'
			Xe has **more** shielding ✓		**ALLOW More** screening There must be a clear comparison ie **more** shielding **OR** **increased** shielding. i.e. **DO NOT ALLOW** Xe 'has shielding' **ALLOW** Xe has **more** electron repulsion from inner shells
			The nuclear attraction decreases **OR** Outermost electrons of Xe experience less attraction (to nucleus) **OR** Increased shielding / distance outweighs the increased nuclear charge ✓ ORA throughout		**ALLOW** Xe has less nuclear pull **IGNORE** Xe has less effective nuclear charge **DO NOT ALLOW** nuclear charge for nuclear attraction
			Total	**9**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)	(i)	The H^+ ion in an (nitric) acid has been replaced by a metal ion **OR** by a Ca^{2+} ion ✓	1	**DO NOT ALLOW** it has been produced by the reaction of an acid and a base as this is stated in the question. **IGNORE** references to replacement by NH_4^+ ions or positive ions. **ALLOW** H **OR** Hydrogen for H^+; **DO NOT ALLOW** Hydrogen atoms **ALLOW** Ca **OR** Calcium for Ca^{2+}. **DO NOT ALLOW** Calcium atoms **ALLOW** 'metal' for 'metal ion
		(ii)	$2HNO_3(aq) + Ca(OH)_2(aq) \rightarrow Ca(NO_3)_2(aq) + 2H_2O(l)$ Formulae ✓ Balance **AND** states ✓	2	**ALLOW** multiples **ALLOW** (aq) **OR** (s) for $Ca(OH)_2$
		(iii)	Accepts a **proton OR** accepts $\mathbf{H^+}$ ✓	1	**ALLOW** $\mathbf{H^+} + OH^- \rightarrow H_2O$ **ALLOW** OH^- reacts with $\mathbf{H^+}$ **OR** OH^- takes $\mathbf{H^+}$ **ALLOW** OH^- 'attracts' $\mathbf{H^+}$ if 'to form water' is seen **DO NOT ALLOW** OH^- neutralises H^+ ('neutralises' is in the question)
	(b)	(i)	Calculates correctly $\frac{0.0880 \times 25.0}{1000} = 2.20 \times 10^{-3}$ mol **OR** 0.00220 mol ✓	1	**ALLOW** 0.0022 **OR** 2.2×10^{-3} mol
		(ii)	Calculates correctly $\frac{0.00220}{2} = 1.10 \times 10^{-3}$ mol **OR** 0.00110 mol ✓	1	**ALLOW** 0.0011 **OR** 1.1×10^{-3} mol **ALLOW** ECF for answer **(i)**/2 as calculator value or correct rounding to 2 significant figures or more but ignore trailing zeroes
		(iii)	$\frac{0.00110 \times 1000}{17.60} = 0.0625$ mol dm^{-3} **OR** 6.25×10^{-2} mol dm^{-3} ✓	1	**ALLOW** 0.063 **OR** 6.3×10^{-2} mol dm^{-3} **ALLOW** ECF for answer **(ii)** × 1000/17.60 **OR** ECF from **(i)** for answer **(i)**/2 × 1000/17.60 as calculator value or correct rounding to 2 significant figures or more but ignore trailing zeroes

	(c)	**(i)**	(The number of) Water(s) of crystallisation ✓	**1**	**IGNORE** hydrated **OR** hydrous
		(ii)	142.1 ✓ $x = \frac{322.1 - 142.1}{18.0} = 10$ ✓	**2**	**ALLOW** 142 **ALLOW** M_r expressed as a sum **ALLOW** ECF from incorrect M_r and x is **calculated correctly** **ALLOW** ECF values of x from nearest whole number to calculator value **ALLOW** 2 marks if final answer is 10 **without any working**
			Total	**10**	