



RECOGNISING ACHIEVEMENT

AS
FOUNDATION CHEMISTRY
Mark Scheme 2811
January 2004

Question	Expected Answers	Marks
1 (a) (i)	^{79}Br has two ✓ less neutrons than ^{81}Br ✓	[2]
	(ii) ^{79}Br and ^{81}Br have same number of protons ✓ and same number of electrons ✓	[2]
(b) (i)	$1s^2 2s^2 2p^6 3s^2 3p^6 \dots \dots \dots 3d^{10} 4s^2 4p^5$ ✓✓ Award 1 mark for p^5 .	[2]
	(ii) Highest energy sub-shell/sub-shell/ being filled is the p sub-shell/outer electrons are in a p (sub-shell/orbital/shell) ✓	[1]
(c) (i)	Number AND type of atoms (making up a molecule)/number of atoms of each element ✓ <i>Not ratio</i>	[1]
	(ii) $\text{P}_4 + 6 \text{Br}_2 \longrightarrow 4 \text{PBr}_3$ ✓	[1]
	(iii) ratio P : Br = 16.2/31 : 83.8/79.9 /= 0.52 : 1.05 /= 1 : 2 ✓ Empirical formula = PBr_2 ✓ Correct compound = P_2Br_4 /phosphorus(II) bromide but not PBr_2 ✓	[3]
		Total: 12

Question	Expected Answers	Marks
2 (a)	shared pair ✓ of electrons ✓ i.e. 'shared electrons' is worth 1 mark. pair of electrons for second marks	[2]
(b)	H ₂ O: all correct including lone pairs around O ✓ CO ₂ : correct covalent bonds around carbon ✓ lone pairs added around oxygen atoms ✓ (must be 'dot AND cross' or electron source clearly shown (different coloured for source is OK)	[3]
(c) (i)	molecule shown as non-linear ✓ angle: 104 - 105° ✓ molecule shown as linear ✓	[4]
(ii)	angle: 180° ✓ shape of H ₂ O shape of CO ₂ Electron pairs repel / groups (or regions) of electrons repel/ electron pairs get as far apart as possible ✓ Oxygen in water surrounded by 4 areas of electron density/2 bonds and 2 lone pairs AND Carbon in CO ₂ surrounded by 2 regions of electron density/2 double bonds ✓	[2]
(d) (i)	Attraction of electrons ✓ in a bond ✓ towards an atom	[2]
(ii)	CO ₂ is symmetrical/H ₂ O is not symmetrical ✓ In CO ₂ , dipoles cancel/in H ₂ O, the dipoles don't cancel ✓	[2]
		Total: 15

Question	Expected Answers	Marks
3 (a)	Energy change when each atom in 1 mole ✓ of gaseous atoms ✓ loses an electron ✓ (to form 1 mole of gaseous 1+ ions).	[3]
(b)	increasing nuclear charge/number of protons ✓ electrons experience greater attraction or pull / atomic radius decreases / electrons added to same shell / same or similar shielding ✓	[2]
(c)	N has an single electron in each p orbital/ O has a paired p orbital ✓ in O, this pairing leads to repulsion/higher energy level ✓	[2]
(d)	(From 2 → 10 → 18 / down group) 1st ionisation energies decrease/easier to remove electrons ✓ electron is further from nucleus/ atomic radius increases/ electron in a different shell/ atoms increase in size ✓ (not sub-shell or orbital) electron experiences more shielding ✓ (more is essential here) distance and shielding outweigh the increased nuclear charge ✓ NOT: attraction/pull; effective nuclear charge	[4]
		Total: 11

Question	Expected Answers	Marks
4 (a)	Strontium reacts with oxygen/strontium oxide forms/SrO forms ✓ $2\text{Sr} + \text{O}_2 \longrightarrow 2\text{SrO}$ / $\text{Sr} + \frac{1}{2}\text{O}_2 \longrightarrow \text{SrO}$ ✓	[2]
(b) (i)	In Sr, oxidation number = 0 ✓ In Sr(OH) ₂ , oxidation number = (+)2 ✓ OR Oxidation number increases from Sr → Sr(OH) ₂ ✓ by 2 ✓	[2]
(ii)	$0.438/87.6 = 5.00 \times 10^{-3} / 0.00500 \text{ mol}$ ✓	[1]
(iii)	$0.00500 \times 24.0 = 0.120 \text{ dm}^3$ ✓ (accept 120 cm ³)	[1]
(iv)	$0.00500 \times 1000/200 = 0.0250 \text{ mol dm}^{-3}$ ✓	[1]
(c) (i)	heat ✓	[1]
(ii)	$3\text{SrO(s)} + 2\text{Al(s)} \longrightarrow 3\text{Sr(s)} + \text{Al}_2\text{O}_3\text{(s)}$ ✓	[1]
(iii)	Molar mass of SrCO ₃ = 87.6 + 12 + 16×3 = 147.6 g mol ⁻¹ ✓ Mass SrCO ₃ required = 100 × 147.6/87.6 = 168 tonnes ✓ Mass of ore needed = mass SrCO ₃ × 100/2 = 168 × 100/2 = 8400 tonnes / 8425 tonnes (from 168.484931507) ✓ (answer depends on rounding) 5000 tonnes is 50 × 100 tonnes: worth 1 mark	[3]
(iv)	98% waste produced which must be disposing of /made into something worthwhile / CO ₂ being removed by something sensible/ any sensible comment ✓	[1]
		Total: 14

Question	Expected Answers	Marks
5	<p>Physical states of halogens chlorine gas; bromine liquid; iodine solid/ boiling point increases from $\text{Cl}_2 \longrightarrow \text{Br}_2 \longrightarrow \text{I}_2$ ✓ number of electrons/number of shells increases down group ✓ van der Waals' forces/ induced dipole-dipole interactions/ AW ✓ stronger forces to be broken (between the molecules) ✓</p> <p>Displacement with chloride, nothing happens ✓ with iodide, \longrightarrow darker orange/brown/darker yellow /\longrightarrow purple with organic solvent ✓ $\text{Br}_2 + 2\text{I}^- \longrightarrow \text{I}_2 + 2\text{Br}^-$ ✓ (or a full equation, e.g. with NaI) The strength of oxidising power is $\text{Cl}_2 > \text{Br}_2 > \text{I}_2$ / Reactivity order is $\text{Cl}_2 > \text{Br}_2 > \text{I}_2$ ✓</p> <p>Quality of written communication</p> <ul style="list-style-type: none"> organise relevant information clearly and coherently, using specialist vocabulary when appropriate; <p>Evidence should link together two of the marking points: e.g. size of the intermolecular forces linked to temperature at which a substance changes state / number of electrons linked to magnitude of intermolecular forces /amount of energy needed to overcome forces order of reactivity linked to observation ✓</p> <p>The key is a 'because' or 'therefore': i.e bromine doesn't displace chlorine because it is less reactive. Greater intermolecular forces: therefore more energy needed to break them.</p>	<p>[4]</p> <p>[4]</p> <p>[1]</p>
		Total: 9