RECOGNISING ACHIEVEMENT

Subject: Foundation Chemistry Code: 2811

Session: January Year: 2004

Mark Scheme

FINAL VERSION

MAXIMUM MARK	60

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit ____ = (underlining) key words which **must** be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument				
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)**	$1s^2 2s^2 2p^6 3s^2 3p^6 \ldots\ldots 3d^{10} 4s^2 4p^5$ ✓✓ 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 ✓ ***Not*** *ratio*		**[1]**
		(ii)	$P_4 + 6\ Br_2 \longrightarrow 4\ PBr_3$ ✓		**[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

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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_2O: 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_2O 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_2O is not symmetrical ✓ In CO_2, dipoles cancel/in H_2O, the dipoles don't cancel ✓	**[2]**
		Total: 15

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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

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Question		**Expected Answers**	**Marks**
4	**(a)**	Strontium reacts with oxygen/strontium oxide forms/SrO forms ✓ $2Sr + O_2 \longrightarrow 2SrO$ / $Sr + {}^1/_2 O_2 \longrightarrow SrO$ ✓	**[2]**
	(b) **(i)**	In Sr, oxidation number = 0 ✓ In $Sr(OH)_2$, oxidation number = (+)2 ✓ OR Oxidation number increases from $Sr \longrightarrow Sr(OH)_2$ ✓ by 2 ✓	**[2]**
	(ii)	0.438/87.6 = 5.00 x 10^{-3} / 0.00500 mol ✓	**[1]**
	(iii)	0.00500 x 24.0 = 0.120 dm^3 ✓ (accept 120 cm^3)	**[1]**
	(iv)	0.00500 x 1000/200 = 0.0250 mol dm^{-3} ✓	**[1]**
	(c) **(i)**	heat ✓	**[1]**
	(ii)	...3..SrO(s) + ...2..Al(s) $\longrightarrow$ ...3..Sr(s) + ...Al_2O_3(s) ✓	**[1]**
	(iii)	Molar mass of $SrCO_3$ = 87.6 + 12 + 16x3 = 147.6 g mol^{-1} ✓ Mass $SrCO_3$ required = 100 x 147.6/87.6 = 168 tonnes ✓ Mass of ore needed = mass $SrCO_3$ x 100/2 = 168 x 100/2 = 8400 tonnes / 8425 tonnes *(from 168.484931507)* ✓ *(answer depends on rounding)* *5000 tonnes is 50 x 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

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Question	**Expected Answers**	**Marks**
5	***Physical states of halogens*** chlorine gas; bromine liquid; iodine solid/ boiling point increases from $Cl_2 \longrightarrow Br_2 \longrightarrow I_2$ ✓ 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) ✓ ***Displacement*** with chloride, nothing happens ✓ with iodide, $\longrightarrow$ darker orange/brown/darker yellow /$\longrightarrow$ purple with organic solvent ✓ $Br_2 + 2I^- \longrightarrow I_2 + 2Br^-$ ✓ (or a full equation, e.g. with NaI) The strength of oxidising power is $Cl_2 > Br_2 > I_2$ / Reactivity order is $Cl_2 > Br_2 > I_2$ ✓ ***Quality of written communication*** • organise relevant information clearly and coherently, using specialist vocabulary when appropriate; **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 ✓ 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.	**[4]** **[4]** **[1]**
		Total: 9