



FOUNDATION CHEMISTRY

Mark Scheme 2811

June 2002

1. (a) (Atoms of) the same element / with same protons.... with different masses/different numbers of neutrons ✓ [1]

(b)

isotope	percentage composition	number of	
		protons	neutrons
^{191}Ir	38%	77	114
^{193}Ir	62%	77	116

Accept 37-39% for ^{191}Ir , 61-63% for ^{193}Ir but **must** add up to 100. ✓ ✓ ✓

[3]

- (c)(i) average atomic mass/weighted mean/average mass ✓

compared with carbon-12 ✓

1/12th of mass of carbon-12/on a scale where carbon-12 is 12 ✓

mass of 1 mole of element/mass of 1 mole of carbon-12 is equivalent to first two marks

"mass of the element that contains the same number of atoms as are in 1 mole of carbon-12" → 2 marks (mark lost because of mass units) ✓

[3]

- (ii) $38 \times 191/100 + 62 \times 193/100$ ✓ = 192.2 ✓

Answers from other percentages above:

$$37 \times 191/100 + 63 \times 193/100$$
 ✓ = 192.3 ✓

$$39 \times 191/100 + 61 \times 193/100$$
 ✓ = 192.2 ✓

[2]

- (d)(i) Simplest (whole number) ratio of atoms/moles/elements ✓

- (ii) ratio Ir : F = $62.75/192$: $37.25/19$ or 0.327 : 1.96 ✓
= 1 : 6 or formula = IrF_6 ✓

(or using answer for Ir from (c)(ii))

[2]

- (iii) $\text{Ir} + 3\text{F}_2 \rightarrow \text{IrF}_6$ ✓ (consequential on response to (ii))

[1]

[Total: 13]

2. (a) trend in reactivity: more reactive down group ✓
explanation: electrons lost more easily / ionisation energies decrease

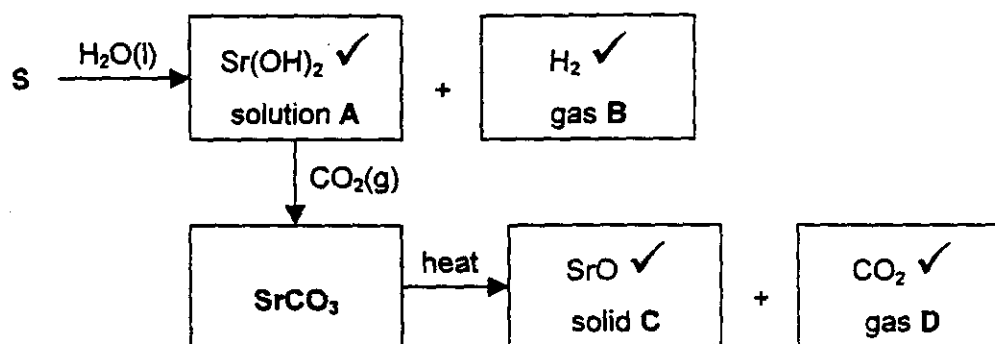
/ less attraction or pull ✓

some attempt to relate this increase in size of atom / more shells / energy levels ✓

and increase in shielding ✓

[4]

(b)



[4]

[Total: 8]

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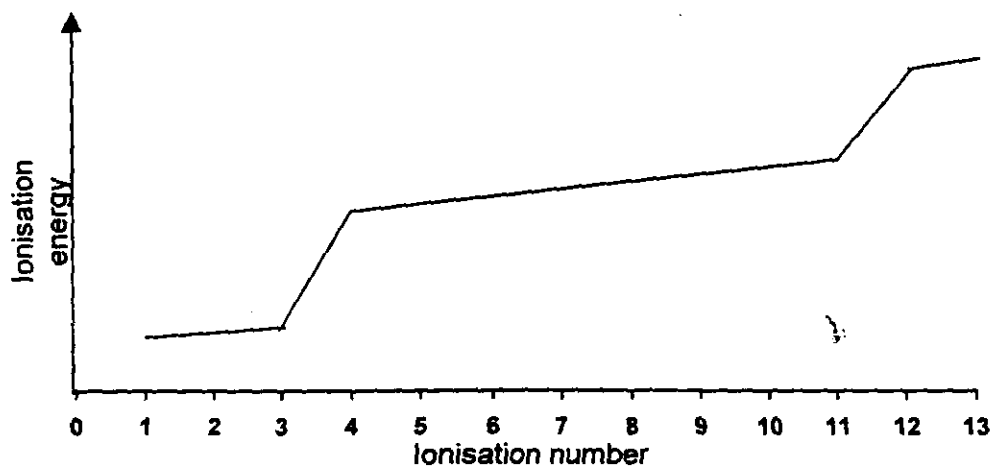
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3. (a)(i) $O^+(g) \longrightarrow O^{2+}(g) + e^-$ equation ✓ ;
state symbols but an electron must be in the equation somewhere ✓ [2]

(ii) Large difference between 6th and 7th ionisation energies ✓
marks a different shell (closer to nucleus) ✓ [2]

(b)(i) $1s^2 2s^2 2p^6 3s^2 3p^1$ ✓ [1]

(ii)



sharp rise between ionisation 3 and ionisation 4 ✓

sharp rise between ionisation 11 and ionisation 12 ✓

i.e. the two steepest rises

(for 2,8,3 pattern the wrong way around, award 1 mark)

(c)(i) $4Al(s) + 3O_2(g) \longrightarrow 2Al_2O_3(s)$ equation ✓ ; state symbols ✓ [2]

(ii) Al^{3+} ions / highly charged aluminium ions ✓ are small ✓ ;
 O^{2-} ions / anions / negative ions are large ✓ ;
 O^{2-} ions / anions / negative ions are polarised / distorted ✓

4 → [3 max]

(d) $M(Al_2O_3) = 102 \text{ g mol}^{-1}$ ✓

amount of $Al_2O_3 = 25/102 = 0.2451 / 0.245 / 0.25$ ✓ [2]

[Total: 14]

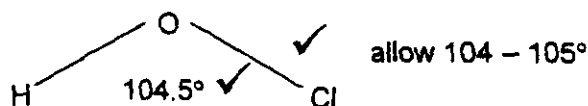
4. (a) HOCl: +1 ✓ HCl: -1 ✓ [2]

(b) covalent bonds shown correctly ✓
all molecule correct (i.e. chlorine's and oxygen's lone pairs) ✓ [2]

(c)(i) electron pairs repel ✓
as far apart as possible ✓
the number of electron pairs (surrounding central atom) decides the shape ✓
lone pairs repel more (than bonded pairs) ✓

4 → [3 max]

(ii)



[2]

(d)(i) loss of electrons / ox number increases / gains oxygen / loses hydrogen ✓

[1]

(ii) brown / orange / yellow colour ✓

[1]

(iii) $\text{Cl}_2 + 2\text{I}^- \longrightarrow 2\text{Cl}^- + \text{I}_2$ ✓

[1]

(e)(i) Molar mass of NaCl = 58.5 g mol⁻¹ ✓
mass of NaCl dissolved = 58.5 x 4 g = 234 g ✓

[2]

(ii) 2 mol NaCl → 1 mol Cl₂

∴ amount of Cl₂ produced = 2 mol ✓ (i.e. half 1st answer to (e)(i))

volume of Cl₂ produced = 24 x 2 = 48 dm³ ✓

[2]

(iii) 1 dm³ brine → 48 dm³ Cl₂(g)

2.5 x 10⁸ / 48 dm³ brine → 2.5 x 10⁸ dm³ Cl₂(g)

∴ 5.2 x 10⁷ (dm³) ✓ (but wrong unit is wrong!)

[1]

[Total: 17]

5. (a) diagram of H bonding between water molecules (O of 1 molecule to H of another) ✓
 dipoles shown ✓ with lone pair involved in bond ✓
 (could be in words; could describe another molecule such as NH_3) [3]

Two properties from:

- | | |
|--------------------|---|
| <i>property</i> | higher melting/boiling point than expected ✓ |
| <i>explanation</i> | strength of H bonds/H-bonds need to be broken ✓
must imply that intermolecular bonds are broken |
| <i>property</i> | ice is lighter than water/ max density at 4°C ✓ |
| <i>explanation</i> | H bonds hold H_2O molecules apart
/ open lattice in ice
/ H-bonds are longer ✓ |
| <i>property</i> | high surface tension/viscosity ✓ |
| <i>explanation</i> | strength of H bonds/H-bonds need to be broken ✓ |

4 max → [4]

Q – legible text with accurate spelling, punctuation and grammar ✓

[1]

[Total: 8]