

1. (a)

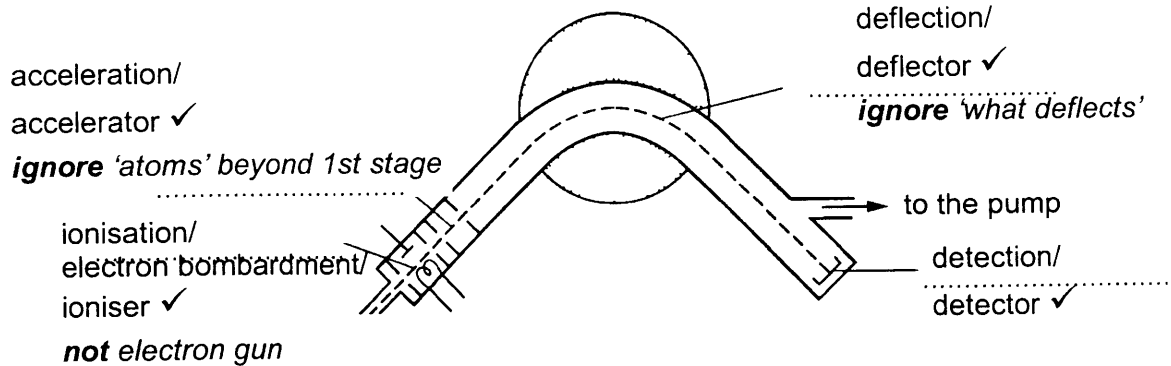
isotope	number of		
	protons	neutrons	electrons
$^{69}\text{Ga}$	31	38	31
$^{71}\text{Ga}$	31	40	31

✓

✓

[2]

(b)



[4]

(c) (i) average mass/weighted mean/average mass of an **atom / the isotopes** ✓  
 compared with carbon-12 ✓

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

**not 12 g**

**or...** mass of 1 mole of atoms ✓

compared with carbon-12 ✓

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

[3]

(ii)  $^{69}\text{Ga}$ : 61%;  $^{71}\text{Ga}$ : 39% ✓ (allow 62/38 → 69.76 below)

[1]

(iii)  $A_r = 69 \times 61/100 + 71 \times 39/100 = 69.78 \checkmark = 69.8 \checkmark$

ignore g / grammes

[2]

[Total: 12 marks]

- 2 (a)  $1s^2 2s^2 2p^6 3s^2$  ✓ [1]
- (b) (i) Mg: 0 ✓ [1]
- (ii) MgO: +2 / 2 / II ✓ [1]
- (c) (i)  $3\text{Mg(s)} + \text{N}_2\text{(g)} \longrightarrow \text{Mg}_3\text{N}_2\text{(s)}$  ✓✓  
 1 for correct formulae and balancing; 1 for correct state symbols [2]
- (ii)  $\text{N}_2$  is less reactive than  $\text{O}_2$  /  
 bond between N atoms is stronger than bond between O atoms /  
 nitrogen has a triple bond **and** oxygen has a double bond  
 activation energy of N > activation energy of O ✓  
*The emphasis here should be a comparison for the mark* [1]
- (d) MgO has a giant structure ✓  
 MgO is ionic / charged magnesium **and** oxide ions shown ✓  
 strong forces ✓ [3]
- (e) (i) MgO dissolves/disappears ✓ [1]
- (ii)  $m(\text{MgO}) = 24.3 + 16 = 40.3 \text{ (g mol}^{-1}\text{)}$  ✓ (accept 40)  
 mass MgO =  $0.0500 \times 40.3 = 2.015 \text{ g} / 2.02 \text{ g} / 2.01 \text{ g} / 2 \text{ g}$  ✓  
**g** is needed here [2]
- (iii) moles  $\text{HNO}_3 = 2 \times 0.0500 = 0.100 \text{ mol}$  ✓  
*right or wrong for 1st mark*  
 volume  $\text{HNO}_3 = 0.25 \text{ dm}^3 / 250 \text{ cm}^3$  ✓  
*i.e. moles  $\text{HNO}_3 / 0.400 \text{ dm}^3 / 1000 \times \text{moles  $\text{HNO}_3 / 0.400 \text{ cm}^3$$*   
 $0.05 / 0.400 \longrightarrow 0.125 \text{ dm}^3 / 125 \text{ cm}^3$  would score 1 mark as molar ratio not used [2]
- (f) (i) ions move / free ions ✓ [1]
- (ii)  $\text{Mg}^{2+} / \text{NO}_3^- / \text{H}^+ / \text{OH}^-$  ✓✓ 2 max [2]

[Total: 17 marks]

3. (a) (i) purification/sterilisation/kills or removes germs/disinfects ✓  
 not 'to make bleach' not 'cleans the water'

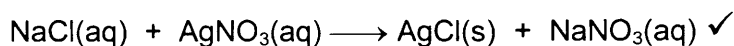
[1]

- (ii) turns red / yellow / orange ✓  
 then colourless / bleaches ✓  
*colourless then 'nothing' scores 1 mark*  
*colourless then 'red' does **not** score because overall bleaching is not implied.*

[2]

- (b) reagent silver nitrate/Ag<sup>+</sup> ions ✓  
 observation white (precipitate) / goes white ✓  
 equation  $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$  /

mark independently



(state symbols not required)

Fluorine for reagent + 'correct' displacement equation scores 1 mark)

[3]

- (c) (i) Cl : C = 85.6/35.5 : 14.4/12 ✓ = 2.4 : 1.2  
 = 2 : 1 ✓

Cl<sub>2</sub>C has mass of 83. 166 = 2 x 83

molecular formula = Cl<sub>4</sub>C<sub>2</sub> ✓

Cl : C = 85.6/17 : 14.4/12 → Cl<sub>4</sub>C scores 1 mark /

Cl : C = 85.6/17 : 14.4/6 → Cl<sub>2</sub>C scores 1 mark

Cl : C = 85.6/35.5 : 14.4/6 → ClC scores 1 mark

[3]

- (ii) perc is covalent / perc is **not** ionic / C-Cl bond in perc is covalent  
 / no Cl<sup>-</sup> ions / perc is molecular ✓

[1]

- (d)  $m(\text{NaClO}_3) = 106.5 \text{ g mol}^{-1}$  ✓  
 moles NaClO<sub>3</sub> = 4.26/106.5 = 0.04 mol ✓  
 moles O<sub>2</sub> = 0.06 mol ✓  
 volume O<sub>2</sub> = 0.06 x 24 = 1.44 (dm<sup>3</sup>) ✓

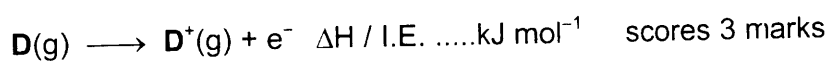
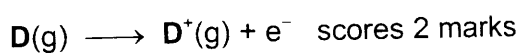
*If no molar ratio has been used, ans → 0.96 dm<sup>3</sup> : worth 3 marks*

[4]

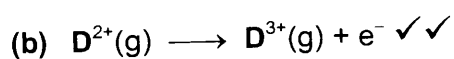
[Total: 14 marks]

4. (a) Energy change when **each atom in 1 mole** ✓  
of **gaseous atoms** ✓  
**loses an electron** ✓ (to form 1 mole of gaseous 1+ ions).

*1 mole of gaseous atoms loses 1 mole of electrons would score all 3 marks*



[3]



*(1st mark for equation; 2nd mark for state symbols*

*'-' not required in  $e^-$ ; ignore wrong **D'** except if H or He used; **X** is acceptable*

[2]

- (c) Group 4 ✓

Sharp rise in successive ionisation energy between 4th and 5th IE ✓

marking a change to a new shell/energy level / there are 4 electrons in the outer shell ✓

**mention of 'orbital' or 'sub-shell cancels the 'shell mark'**

*Each marking point in (c) is independent*

[3]

[Total: 8 marks]

## 5. Group 2

atomic radii increases down group ✓

down group, electrons added to a new shell / more shells ✓

down group, **more** shielding ✓ : *'more' is essential*

increased nuclear charge outweighed / despite increased nuclear charge ✓

**Period 3**

atomic radii decrease across period ✓

number of protons/nuclear charge increases ✓

across period, electrons added to same shell / same or similar shielding ✓

nuclear attraction increases / shell drawn in by increased nuclear charge ✓

*watch for distinction between nuclear **attraction** and nuclear **charge** in candidates' scripts.*

[8]

**Quality of Written Communication**

At least **two** complete sentences that are legible and where the spelling, punctuation and grammar allow the meaning to be clear. ✓

[1]

[Total: 9 marks]