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1 The relative atomic mass of boron is 10.8.

A sample of boron contains the isotopes $^{10}_5\text{B}$ and $^{11}_5\text{B}$.
What is the percentage of $^{11}_5\text{B}$ atoms in the isotopic mixture of this sample?

- A 0.8% B 8.0% C 20% D 80% [1]

(Total for Question 1 = 1 mark)

2 Which of the following elements has no paired p electrons in a single uncombined atom of the element?

- A carbon B oxygen C fluorine D neon [1]

(Total for Question 2 = 1 mark)

3. Which of the following electronic configurations is that of an atom of an element which forms a simple ion with a charge of -3 ? N^{3-} & P^{3-}

- A $1s^2 2s^2 2p^6 3s^2 3p^1$ B $1s^2 2s^2 2p^6 3s^2 3p^3$
C $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$ D $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$ [1]

(Total for Question 3 = 1 mark)

4 A sample of chlorine contains isotopes of mass numbers 35 and 37.

The sample is analysed in a mass spectrometer. How many peaks corresponding to Cl_2^+ are recorded?

- A 1 B 2 C 3 D 4 [1]

(Total for Question 4 = 1 mark)

5 What is the atomic number of an element that contains atoms which have four unpaired electrons in their ground state?

- A 6 B 16 C 22 D 26 [1]

$1s^2 2s^2 2p^2$ $1s^2 2s^2 2p^6 3s^2 3p^4$ (Total for Question 5 = 1 mark)

6 Which of the following ions has more electrons than protons, and also has more protons than neutrons?

- ($\text{H} = {}^1_1\text{H}$ $\text{D} = {}^2_1\text{H}$ $\text{He} = {}^4_2\text{He}$ $\text{O} = {}^{16}_8\text{O}$)
 A OD^- B D_3O^+ C He^+ D OH^- [1]

(Total for Question 6 = 1 mark)

7 A sample of helium from a rock was found to contain two isotopes with the following composition by mass: ${}^3\text{He}$, 0.992%; ${}^4\text{He}$, 99.008%.

(a) State what is meant by isotopes. [1]
 Elements with same proton number but different neutron number.

(b) State the difference in the atomic structures of ${}^3\text{He}$ and ${}^4\text{He}$. [1]
 ${}^3\text{He}$ has one ~~more~~ ^{less} neutron than ${}^4\text{He}$ so it is an isotope.

(c) (i) Which isotope is used as the basis for relative atomic mass measurements? [1]



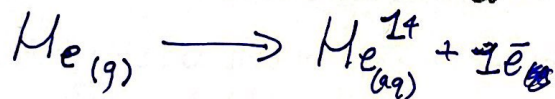
(ii) Calculate the relative atomic mass of helium in the rock sample. [2]

$$\frac{99.008 \times 4 + 0.992 \times 3}{100} = 3.99$$

(d) Helium has the largest first ionisation energy of all the elements.

(i) State what is meant by first ionisation energy. [2]
 1 mol of an element ~~is~~ needed to react ~~to~~ form 1e^-

(ii) Write an equation, including state symbols, to represent the first ionisation energy of helium. [2]



(iii) Explain why the first ionisation energy of helium is larger than that of hydrogen. [2]

(Total for Question 7 = 12 marks)

more shells & shielding e^- 's
 so ~~is~~ bigger force of attraction = between nucleus & cloud of e^- 's

8 The five ionisation energies of boron are:

801 → 2427 → 3660 → 25 026 → 32 828

(a) State and justify the group in the Periodic Table in which boron is placed. [2]

group 3 since 3 major leaps

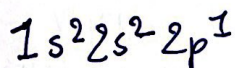
(b) Which of the following represents the second ionisation energy of boron?

- A $B(g) \rightarrow B^{2+}(g) + 2e^- \Delta H = + 2427 \text{ kJ mol}^{-1}$
B $B^+(g) \rightarrow B^{2+}(g) + e^- \Delta H = + 2427 \text{ kJ mol}^{-1}$
C $B(g) \rightarrow B^{2+}(g) + 2e^- \Delta H = - 2427 \text{ kJ mol}^{-1}$
D $B^+(g) \rightarrow B^{2+}(g) + e^- \Delta H = - 2427 \text{ kJ mol}^{-1}$ [1]

(c) Explain why the second ionisation energy of boron is larger than the first. [2]

more electrons and higher charge
so greater force of attraction between nucleus & cloud of e⁻'s

(d) Give the electronic configuration of a boron atom. [1]



(e) Is boron classified as an s-, a p- or a d-block element? Justify your answer. [2]

p, since its last shell ends with p and it is a group 3 element

(f) Explain why the first ionisation energy of boron is less than that of beryllium, even though a boron atom has a greater nuclear charge. [2]

(Total for Question 8 = 10 marks)
less force of attraction but greater size. → between nucleus & cloud of e⁻'s

The table gives the first four ionisation energies of the elements sodium, magnesium and aluminium.

Ionisation energy / kJ mol^{-1}				
Element	1st	2nd	3rd	4th
sodium	496	4563	6913	9544
magnesium	738	1451	7733	10541
aluminium	578	1817	2745	11578

Explain why:

- (a) the first ionisation energy of sodium is lower than that of the first ionisation energy of magnesium. [2]

Smaller size ~~so~~ and so less force of attraction between nucleus and cloud of e^- 's

- (b) the first ionisation energy of magnesium is higher than the first ionisation energy of aluminium. [2]

greater force of attraction between nucleus & cloud of e^- 's and more e^- 's

- (c) the second ionisation energy of magnesium is lower than the second ionisation energy of aluminium. [2]

less force of attraction between nucleus & cloud of e^- 's and smaller size

- (d) the fourth ionisation energy of aluminium is higher than its third ionisation energy. [2]

(Total for Question 13 = 8 marks)

~~more~~ greater force of attraction between nucleus & cloud of e^- 's and greater size.