

NATIONAL ORTHODOX SCHOOL  
CHEMISTRY QUIZ

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DATE: 2-11-2022

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]

C:  $1s^2 2s^2 2p^2$  ✗      O:  $1s^2 2s^2 2p^4$       F:  $1s^2 2s^2 2p^5$       (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?

- 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  $\text{Cl}_2^+$  are recorded?

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

(Total for Question 4 = 1 mark)

$35 + 35 = 35$   
 $35 + 37 = 36$   
 $37 + 37 = 37$   
 $35 + 37 = 36$

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]

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

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

- (H =  $^1_1\text{H}$       D =  $^2_1\text{H}$       He =  $^4_2\text{He}$       O =  $^{16}_8\text{O}$ )  
A  $\text{OD}^-$       B  $\text{D}_3\text{O}^+$       C  $\text{He}^+$       D  $\text{OH}^-$       [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]

Atoms that have the same number of protons and electrons but different number of neutrons

(b) State the difference in the atomic structures of  ${}^3_2\text{He}$  and  ${}^4_2\text{He}$ . [1]

${}^3_2\text{He}$  has 1 neutron while  ${}^4_2\text{He}$  has 2

(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]

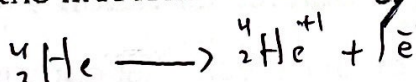
~~math~~  $\frac{4 \times 0.992 + 3 \times 99.008}{100} = 3.5$

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

(i) State what is meant by first ionisation energy. [2]

The amount of energy needed to remove 1 mole of electrons from 1 mole of gaseous atoms to form 1 mole of (+1) ion in a gaseous state.

(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)

because ~~Helium~~ helium has ~~more shells~~ same shells and shielding electrons but Helium has greater proton number ~~and~~ so more energy needed to remove an electron.  $\rightarrow$  greater forces of attraction so between positive nucleus and negative cloud of electrons



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]

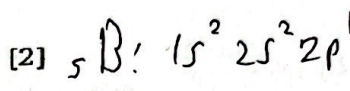
group 3 since there was ~~two~~ two jumps between the first and second and third and fourth.

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

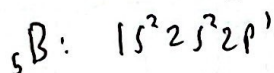
- A  $B(g) \rightarrow B^{2+}(g) + 2e^- \Delta H = + 2427 \text{ kJ mol}^{-1}$   
 B  $B^+(g) \rightarrow B^{2+}(g) + e^- \Delta H = + 2427 \text{ kJ mol}^{-1}$   
 C  $B(g) \rightarrow B^{2+}(g) + 2e^- \Delta H = - 2427 \text{ kJ mol}^{-1}$   
 D  $B^+(g) \rightarrow B^{2+}(g) + e^- \Delta H = - 2427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

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

Because ~~more~~ more energy is needed to remove 1 electron from fully filled s orbital than to remove an electron from p orbital.



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



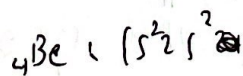
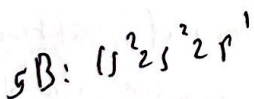
(e) Is boron classified as an s-, a p- or a d-block element? [2]

Justify your answer.

p, it is found in group 3.

(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)



Boron has one lone electron in the p orbital so it is easier to remove ~~the~~ an e<sup>-</sup> than to remove from fully filled s orbital in Beryllium. So less forces of attraction so less energy needed.

↓  
 between ~~the~~ positive nucleus and negative cloud of electrons

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

Ionisation energy / kJ mol <sup>-1</sup>				
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]

~~Some shells and shielding electrons~~  
 Sodium has less proton number than Magnesium so less forces of attraction between positive nucleus and negative cloud of electrons so less ionization energy.

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

Magnesium has a fully filled s orbital but Aluminium has 1 electron in the p orbital so Magnesium has greater forces of attraction between positive nucleus and negative cloud of electrons so higher ionization energy.

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

Magnesium has lower proton number so less forces of attraction between positive nucleus and negative cloud of electrons so more energy needed.

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

(Total for Question 13 = 8 marks)

~~Aluminium has more shells and shielding than Magnesium so greater forces of attraction between the positive nucleus and the negative cloud of electrons so greater ionization energy.~~

The fourth ionisation energy of Aluminium has more shells and shielding so greater forces of attraction between the positive nucleus and the negative cloud of electrons so greater ionization energy.

