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 $^{10}_{5}B$ and $^{11}_{5}B$.
What is the percentage of $^{11}_{5}B$ 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?

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]

(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 = $^{1}_{1}H$ D = $^{2}_{1}H$ He = $^{4}_{2}He$ O = $^{16}_{8}O$)

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: ^3He, 0.992%; ^4He, 99.008%.

(a) State what is meant by isotopes. [1]

atoms of the same element that have same number of protons but different number of neutrons

(b) State the difference in the atomic structures of ^3He and ^4He. [1]

the ^4He nucleus is bigger and heavier as there are more neutrons also.

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

C_6^{12}

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

$\frac{(3 \times 0.992) + (4 \times 99.008)}{100} = 3.99008$

(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 mol of electrons from one mol of gaseous atom to form 1 mol of gaseous ions.

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

$He_{(g)} \longrightarrow He^+_{(g)} + e^-$

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

(Total for Question 7= 12 marks)

Because the $1s^2$ in He is fully filled which means it is more stable than Because the 1s in He is fully filled while in H it is half fully filled so it is more stable than He has more protons than H so greater force of attraction as electrons are closer to the nucleus

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]

in group 3 as the first major jump lies between the 3rd and 4th Ionization energies,

(b) Which of the following represents the **second** ionisation energy of boron? [1]

- $B(g) \rightarrow B^{2+}(g) + 2e^- \quad \Delta H = +2427 \text{ kJ mol}^{-1}$
- $B^+(g) \rightarrow B^{2+}(g) + e^- \quad \Delta H = +2427 \text{ kJ mol}^{-1}$ B
- $B(g) \rightarrow B^{2+}(g) + 2e^- \quad \Delta H = -2427 \text{ kJ mol}^{-1}$
- $B^+(g) \rightarrow B^{2+}(g) + e^- \quad \Delta H = -2427 \text{ kJ mol}^{-1}$

$_5B\ 1s^2 2s^2 2p^1$

$B^+\ 1s^2 2s^2$

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

In B^+ ion there are less electrons with the same protons so greater attraction so more energy is needed to remove another mol of electrons.

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

$_5B: 1s^2 2s^2 2p^1$

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

It is a p-element as the valence electrons are in the p sub shell.

(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)

$_5B: 1s^2 2s^2 2p^1$

$_4Be: 1s^2 2s^2$

The electrons in 2p in Boron is further from the nucleus than the $2s^2$ in Be so less force of attraction and so less energy is needed.

9

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	10 541
aluminium	578	1817	2745	11 578

Explain why:

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

11Na: $1s^2 2s^2 2p^6 3s^1$ 12Mg: $1s^2 2s^2 2p^6 3s^2$ both has same shells of shielding, but the proton number in Mg is less so less attraction between the nucleus and negative sea of electrons less so energy is needed to overcome.

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

The 3s in Mg is closer to the nucleus than 3p in Al so more force of attraction between the nucleus and negative sea of electrons so greater energy is needed

2,10
3 11

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

12Mg$^+$: $1s^2 2s^2 2p^6$ 13Al$^+$: $1s^2 2s^2 2p^6 3s^2$ Mg has Lower proton number so less Force of attraction between the nucleus and negative sea of electrons so less energy is needed

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

(Total for Question 13 = 8 marks)

Because Aluminium has 3 electrons in the 3rd main shell after it forms Al^{3+}, the 4th electron must be remove from the 2nd main shell so more energy is needed