03 Atomic Structure

Set B **Answer key**

A Multiple choice

6 MARKS

1 **C** They have the same number of electrons. [1]

Mg^{2+}, Ne, O^{2-} and Al^{3+} each have 10 electrons, arranged as 2.8.

A They have different proton numbers, so they are different elements and not isotopes.

B Each has 2 electron shells.

D The numbers of neutrons differ (for example 12 in magnesium-24 and 14 in aluminium-27).

2 **D** 26 [1]

X^{2+} has 2 fewer electrons than protons, so protons = 10 + 2 = 12. Nucleon number = 12 + 14 = 26.

3 **C** $^{37}_{17}Z^-$ [1]

The nucleon number is 17 + 20 = 37 and the proton number is 17. Only a negative ion fits the options with these numbers.

A. The nucleon number is 18, but it should be 37.

B

D The proton number is 18, but it should be 17.

4 **D** $^{40}K^+$ [1]

Chlorine-37 has 17 protons, 20 neutrons and 17 electrons. R has 19 protons (potassium), 21 neutrons and 18 electrons. The nucleon number is 19 + 21 = 40 and the charge is 19 – 18 = +1.

5 **D** S^{2-} [1]

A Al^{3+} has 10 electrons: 2.8, so 2 shells.

B Be^{2+} has 2 electrons: 2, so 1 shell.

C N^{3-} has 10 electrons: 2.8, so 2 shells.

D S^{2-} has 18 electrons: 2.8.8, so 3 shells.

6 **D** proton number 20 and nucleon number 39 [1]

X^{2+} has 18 electrons, so the atom has 18 + 2 = 20 electrons and 20 protons. Nucleon number = 20 + 19 = 39.

B Structured questions

22 MARKS

7 **(a)** **A** and **E** [1]

Both have more electrons than protons.

(b) **B** and **C** [1]

Both have 17 protons but different numbers of neutrons (20 and 18).

(c) 17 + 20 = **37** [1]

(d) **Sulfur** (proton number 16) [1]

(e) **2−** *or* **−2** [1]

It has 16 protons and 18 electrons.

8 **(a)** Nucleon number **40** and electronic configuration **2.8.8** [1]

(b) R has a stable electronic configuration, with eight electrons in its valence shell (an octet), so it is unreactive. [1]

(c)(i) Atoms of the same element with the same number of protons but different numbers of neutrons. [1]

(ii) Isotopes of the same element have the same number of valence electrons. [1]

9 They have the same number of protons but different numbers of neutrons. [1]

Both have 92 protons. [1]

Uranium-235 has 143 neutrons (235 – 92) while uranium-238 has 146 neutrons (238 – 92).

or Same proton number but different nucleon numbers. [1]

10 **(a)(i)** Deuterium $^{2}_{1}H$ and tritium $^{3}_{1}H$ (D and T are accepted as symbols) [1]

(ii) Hydrogen, deuterium and tritium atoms each contain one proton. [1]

A deuterium atom has one more neutron than a hydrogen atom, while a tritium atom has two more neutrons than a hydrogen atom (use of data). [1]

(iii) They all have one positively charged proton and one negatively charged electron, so they have equal numbers of positive and negative charges. [1]

(iv)

Heavy water has similar chemical properties to ordinary water, so it will not disrupt biological processes and can be used in the same way in the body. **[1]**

Deuterium atoms are twice as heavy as hydrogen atoms, so they can be detected using techniques such as mass spectrometry. **[1]**

(b)

name of ion	chemical symbol	number of electrons
hydrogen ion	H^+	0
hydride ion	H^-	2

Both correct **[1]**

11

Argon has the electronic configuration 2.8.8. **[1]**

It is unreactive because it has a fully filled valence shell. **[1]**

12

Calcium **[1]**

The proton numbers add up: 94 + 20 = 114.