

Exercise walk-through

4.1

The structure of an atom; mass number and isotopes (4.4.1.1–4.4.1.2)

Exercises 2.1·2.3

2.1 Carbon-13: state the number of protons, neutrons and electrons. [3]

2.2 What is an isotope? Use hydrogen-1 and hydrogen-2 in your answer. [2]

2.3 State two facts about the nucleus of an atom, one about its size and one about its mass. [2]

3 Exam-style questions

Exercises 2.1·2.3

2.1 Carbon-13: state the number of protons, neutrons and electrons. [3]

2.1 Protons 6; neutrons $13 - 6 = 7$; electrons 6.

2.2 What is an isotope? Use hydrogen-1 and hydrogen-2 in your answer. [2]

2.2 Isotopes are atoms of the same element with the same number of protons but different numbers of neutrons; hydrogen-1 has 0 neutrons and hydrogen-2 has 1 – same element, different masses.

2.3 State two facts about the nucleus of an atom, one about its size and one about its mass. [2]

3 Exam-style questions

2.3 The nucleus's radius is less than $1/10\,000$ of the atom's radius; most of the atom's mass is concentrated in the nucleus.

Exercise 3.1

3.1 The table shows three atoms.

Atom	A	Z
P	31	15
Q	32	16
R	31	16

- (a) Which two atoms are isotopes of the same element? Explain. [2]
- (b) State the number of neutrons in atom P. [1]
- (c) Atom P loses three electrons. State its new charge and the name for what it has become. [2]

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3.1 (a) Q and R: both have $Z = 16$ (same protons, same element) but different mass numbers 32 and 31 – different neutrons. (b) $31 - 15 = \mathbf{16}$ neutrons. (c) Charge $3+$; it has become a positive ion.

Exercise 3.2

3.2 An electron in an atom absorbs electromagnetic radiation and moves to a higher energy level.

(a) Describe what happens to its distance from the nucleus. [1]

(b) Later the electron emits radiation. Describe the change of level and where the emitted energy comes from. [2]

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3.2 (a) It moves further from the nucleus (to a higher energy level). (b) It drops back to a lower level, closer to the nucleus; the emitted radiation's energy comes from the electron losing energy in the transition.

Exercise 3.3

3.3 The radius of an atom is 2.0×10^{-10} m; the radius of its nucleus is 1.0×10^{-14} m.

(a) Calculate how many times larger the atom's radius is than the nucleus's. Give your answer in standard form. [2]

(b) The spec says the nucleus is “less than 1/10 000 of the radius of the atom”. Does this atom satisfy that? Show working. [2]

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3.3 (a)

$$\frac{2.0 \times 10^{-10}}{1.0 \times 10^{-14}} = \mathbf{2.0 \times 10^4} \text{ times}$$

(division in standard form C1, answer A1.) (b) The nucleus/atom ratio is $\frac{1.0 \times 10^{-14}}{2.0 \times 10^{-10}} = \frac{1}{2.0 \times 10^4}$, which is less than $\frac{1}{10\,000}$ (C1); so yes – this nucleus is smaller than the spec's limit ✓.