

Solutions

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

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 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.

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.

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.

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 ✓.