Solutions

Each answer shows the steps, then the **result**.

2.1

- the electron can only have certain allowed energy values, not any value in between

2.2

- it emits a photon carrying the energy difference

2.3

- the photon carries the difference between the two levels:

$$E = E_i - E_f = (-1.5\text{ eV}) - (-3.4\text{ eV})$$

- $E = \mathbf{1.9}$ eV

2.4

- protons = 26 (the lower number)
- neutrons = $56 - 26 = 30$
- electrons = $26 - 3 = 23$ (a 3+ ion has lost three)

2.5

- same: 6 protons; different: carbon-12 has 6 neutrons and carbon-14 has 8
- the mass of an atom is almost all in its protons and neutrons (each about 1840 times the electron's mass), so the mass goes with the nucleon number, 14 to 12

3.1 B

- quantized.

3.2 C

- moves to a lower level.

3.3

(a)

- the photon carries the difference between the two levels:

$$E = E_i - E_f = (-0.85\text{ eV}) - (-3.4\text{ eV})$$

- $E = \mathbf{2.55}$ eV

(b)

- emitted (the electron drops to a lower level)

3.4

(a)

- the wave must join up with itself, so $2\pi r = n\lambda$; only these radii are allowed, each with its own energy, so energies are quantized

(b)

- $3\lambda = 2\pi r$, so $\lambda = 2\pi \times 0.476\text{ nm}/3 = \mathbf{0.997}$ nm

(c)

- $p = h/\lambda = 6.65 \times 10^{-25}$ kg m/s, so $v = p/m_e = \mathbf{7.30 \times 10^{5}}$ m/s

3.5 B

- losing a negative electron leaves more protons than electrons; adding one (A) makes a negative ion, and C and D leave the charges balanced