

15 marks · one mark for each correct letter

The reason given for each answer is for learning: it is not needed in the exam.

Q	Answer	Why
1	A	Correct. Most alpha particles met nothing that could deflect them: the atom is mostly empty space.
2	C	Correct. Turning an alpha particle back needs a huge repulsive force, which needs the positive charge packed into a tiny region.
3	B	Correct. $N = A - Z = 59 - 27 = 32$. The neutral atom has 27 electrons; Co^{2+} has lost two: 25.
4	D	Correct. Each line is a photon of one energy, equal to a difference between energy levels: only certain differences exist.
5	A	Correct. W has the smallest energy gap (1.0 eV), so the smallest photon energy and the longest wavelength ($\lambda = hc/\Delta E$).
6	C	Correct. X: $\Delta E = 2.5$ eV; Y: $\Delta E = 5.0$ eV. Twice the energy, so half the wavelength ($\lambda \propto 1/\Delta E$).
7	D	Correct. $E = 3.0 \times 1.60 \times 10^{-19} = 4.8 \times 10^{-19}$ J; $\lambda = hc/E = 4.1 \times 10^{-7}$ m.
8	B	Correct. The excited atoms emit photons of the same wavelengths, but in all directions, so few continue along the beam.
9	A	Correct. 10.2 eV matches the gap $n = 1 \rightarrow 2$. 14.0 eV is more than the ionisation energy, so it ionises the atom. 11.0 eV matches no gap.
10	C	Correct. $n = 3$ needs 12.09 eV (less than 12.5 eV); $n = 4$ needs 12.75 eV (more). The electron can give part of its energy.
11	D	Correct. $E_k = kq_1q_2/d$, so $d \propto 1/E_k$.
12	B	Correct. $R = R_0 A^{1/3}$: $(216/27)^{1/3} = 8^{1/3} = 2$.
13	C	Correct. Rutherford assumed only the electric force. Close to the nuclear surface, the strong nuclear force also acts.
14	D	Correct. $r = n^2 r_1$: $3^2 = 9$.
15	B	Correct. $3K/4 = 30$ eV, so $K = 40$ eV. $\Delta E = 40(1/4 - 1/9) = 5.6$ eV.