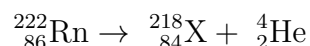


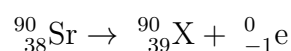
Solutions

2.1 $A : 222 - 4 = 218$; $Z : 86 - 2 = 84$.



(row balance B1, correct values B1)

2.2 A stays 90; $Z : 38 + 1 = 39$.

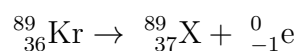


2.3 Halvings: $6400 \rightarrow 3200 \rightarrow 1600 \rightarrow 800$: three halvings.

$$t_{1/2} = 24/3 = \mathbf{8} \text{ hours}$$

(counting halvings C1, answer A1)

3.1 (a)



(mass unchanged C1, $Z + 1$ C1, balanced rows A1) (b) Mass number unchanged; atomic number increases by 1.

3.2 (a) Halvings: $1200 \rightarrow 600 \rightarrow 300 \rightarrow 150$: three halvings in 15 h (C1).

$$t_{1/2} = 15/3 = \mathbf{5} \text{ hours}$$

(C1, A1) (b) Two more halvings: $150 \rightarrow 75 \rightarrow \mathbf{37.5}$ Bq (each halving C1, answer A1).

3.3 (a) Time $9:00$ to $5:00 = 8$ hours $= 4$ half-lives (C1).

$$5120 \times \frac{1}{2^4} = 5120/16 = \mathbf{320} \text{ Bq}$$

(halving chain C1, answer A1) (b) Decay is a random process: it cannot be predicted for any individual nucleus – only the statistical behaviour of large numbers. (c) Background radiation has been subtracted / the sample is unchanged (no material lost).