1) Q (LHS) $\rightarrow$ Q (RHS)

a) $+2 \rightarrow +2$: match ✓

b) $+2 \rightarrow +2$: match ✓

c) $+2 \rightarrow +3$: no charge conservat° $\Rightarrow$ IMPOSSIBLE

2) $+2 \rightarrow +2$ ✓

$+2 \rightarrow +3$ $\Rightarrow$ Violates baryon n° conservat°

$+2 \rightarrow +2$ ✓

3) Λ^0 mass : $1115.6 \ \frac{MeV}{c^2}$

$p + \pi^- + \pi^0$ mass : $938.3 + 139.6 + 135 = 1212.9 \ \frac{MeV}{c^2}$

$m_{\Lambda^0} < m_{p+\pi^-+\pi^0}$ $\Rightarrow$ Total E not conserved $\Rightarrow$ IMPOSSIBLE

4) a) $d\bar{u} + uud \rightarrow d\bar{s} + uds$: quark flavour conservat° obeyed
dud $\qquad$ dud

$\Downarrow$

STRONG FORCE

b) $u\bar{d} + uud \rightarrow u\bar{s} + uus$: quark flavour conserved
uuu $\qquad$ uuu

can happen though

5) net $p = 0 \rightarrow$ net $p = 0$: needed

$p_{\gamma_1} = \vec{p}$

$p_{\gamma_2} = -\vec{p}$

$E = \frac{hc}{}$

$$E_\gamma = \frac{\quad}{\lambda}$$

$\Downarrow$

$$\lambda = \frac{hc}{E_\gamma} = \frac{6.62 \times 10^{-34} \times 3 \times 10^{8}}{0.51 \frac{MeV}{c^2} \times 1.6 \times 10^{-13} J/MeV} = 2.42 \times 10^{-12} m$$

6) $M_{nuc} \approx Au$ $\quad$ $R_{nu} = 1.1$ always

$$V = \frac{4}{3}\pi R_{nuc}^3 = \frac{4}{3}(1.1\ fm)^3 A$$

$$\rho_{nuc} = \frac{M_{nuc}}{V} = \frac{1u}{\frac{4}{3}(1.1 fm)^3} = 3 \times 10^{13}\ kg\ m^{-3}$$

7) $V = 10^{-6} m^3$

$M = \rho_{nuc} V = 3 \times 10^{11} kg$

8) a) nuclear mass ≠ atomic mass

not including e

$$m_{nuc} = m_{atom} - 28 m_e = 59.91543\ u$$

b) $\frac{B}{A}$: binding energy per nucleon $= \frac{(28 m_p + 32 m_n - m_{nuc}) \times 931.5}{60}$ MeV

$$= \frac{526.8}{60} = 8.78\ MeV$$

9) lower atomic mass = more stable

(mass goes down in decay)

$^{41}_{20}Ca \rightarrow {}^{41}_{19}K + e^+ + \nu_e$ } β^+ decay moving through isobar => β decay

$${}^{41}_{20}Ca + e^- \rightarrow {}^{41}_{19}K + \nu_e$$ { K-capture — two possibilities

difference conditions when they can happen

$m_{atom}({}^{41}_{20}Ca) - m_{atom}({}^{41}_{19}K) < 2m_e \Rightarrow$ only K-capture possible

$$Q = [m_{atom}({}^{41}_{20}Ca) - m_{atom}({}^{41}_{20}K)]c^2$$
$$= 0.42\ \text{MeV} > 0$$

exothermic

if it had been > 2 MeV => can do both decay types

10) $Q = [M(LHS) - \Sigma M(RHS)]c^2$

$= B(RHS) - B(LHS)$

only true if same building blocks left 2 right

$${}^{8}_{4}Be \rightarrow {}^{4}_{2}He + {}^{4}_{2}He$$

$Q = 2 \times 28.3 - 56.50 = 0.1\ \text{MeV} > 0$ EXOTHERMIC DELAY CAN HAPPEN

$Q = 3 \times 28.3 - 92.16 = -7.26\ \text{MeV} < 0$

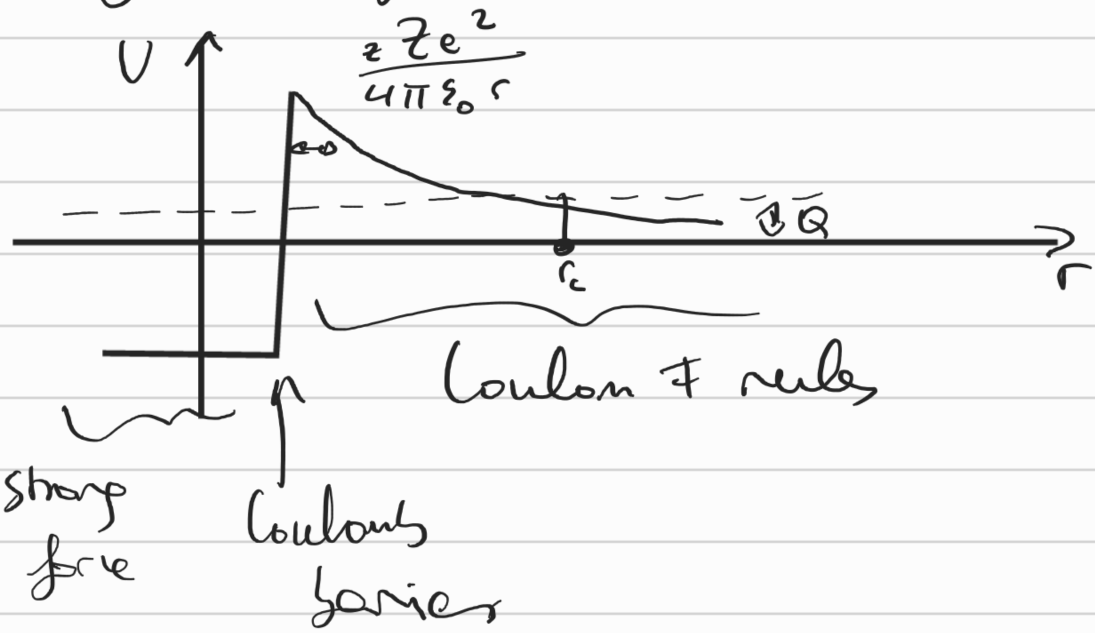
Decay not possible

$$Q = B({}^{6}_{3}Li) - B({}^{2}_{1}H) - B({}^{4}_{2}He)$$

$$= 1.47 \text{ MeV} \quad \text{Exothermic}$$

ii) potential & α-decay

beyond strong F $\Rightarrow$ Coulomb force rules



$Q \uparrow \quad t_{1/2} \downarrow$

$$r_c = \frac{Ze^2}{4\pi\varepsilon_0 Q} = 2 \times 88 \frac{e^2}{4\pi\varepsilon_0} \frac{1}{Q}$$

Z daughter nucleus

Q diff each activity

$\Downarrow$

diff both unstable particles