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Period 11

2. This question is about the radioactive decay of potassium-40.

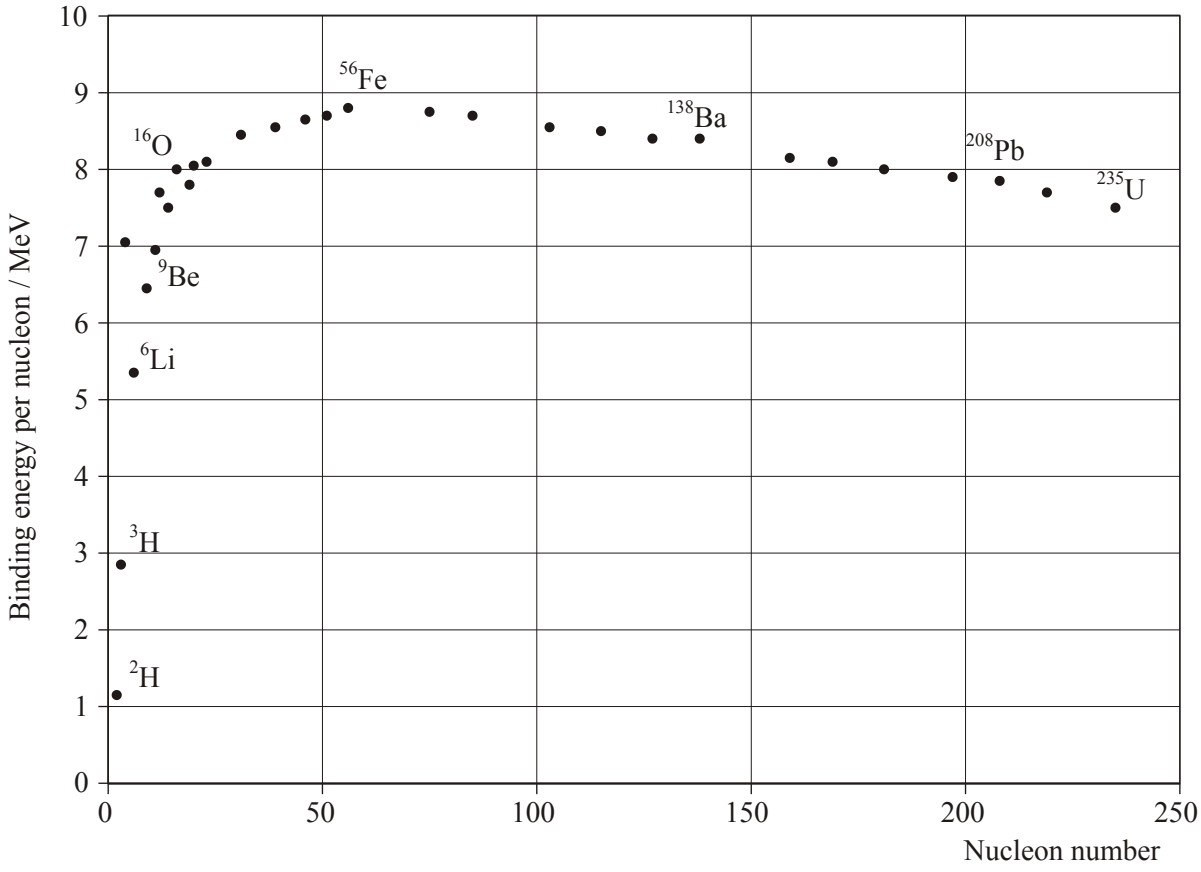
A nucleus of the nuclide $^{40}_{19}\text{K}$ (potassium-40) decays to a stable nucleus of the nuclide $^{40}_{18}\text{Ar}$ (argon-40).

(a) State the names of the **two** particles emitted in this decay.

$$^{40}_{19}\text{K} \longrightarrow {}^{40}_{18}\text{Ar} + {}^{0}_{+1}\text{e} + {}^{0}_{0}\nu_e$$

(2)

The graph below shows the variation with nucleon (mass) number of the binding energy per nucleon.



(c) Use the graph to explain why energy can be released in both the fission and the fusion processes.

Energy is released when a nucleon reaches a determined binding energy. From the graph, it can be seen how nucleons (in the process of forming elements) tend to fuse until reaching the highest binding energy per nucleon possible (iron's), and tend to undergo fission once they pass this binding energy amount to go back to it.

(3)

(e) Uranium-238, $^{238}_{92}\mathrm{U}$, undergoes α-decay to form an isotope of thorium. Write down the nuclear equation for this decay.

$$^{238}_{92}\mathrm{U} \longrightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\alpha$$

(2)

5. This question is about a proton.

The proton is made out of three quarks.

(a) Explain why the three quarks in the proton do not violate the Pauli exclusion principle.

It is because the two up quarks a proton has have an <u>opposite</u> spin direction; they do not exist in the exact same state.

(2)