

THE NUCLEUS

Review Questions

- How many protons are there in the nucleus $^{197}_{79}\text{Au}$? How many neutrons? How many electrons are there in the neutral atom?
- What are isotopes?
- What holds the nucleons in a nucleus together?

Conceptual Questions

- Is it possible to accurately predict an atom's mass from its atomic number? Explain.
- What would happen if the binding energy of a nucleus was zero?
- Why do heavier elements require more neutrons to maintain stability?

Practice Problems

For problems 7–9, see Sample Problem A and refer to Appendix H.

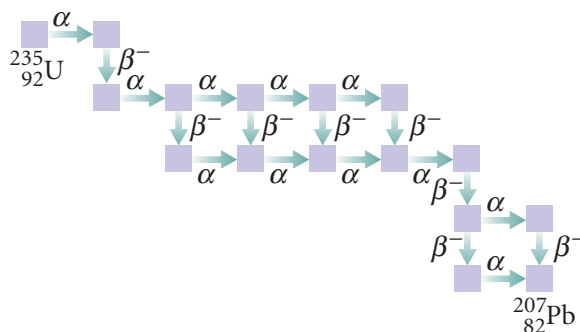
- Calculate the total binding energy of $^{12}_6\text{C}$.
- Calculate the total binding energy of tritium (^3_1H) and helium-3 (^3_2He).
- Calculate the average binding energy per nucleon of $^{24}_{12}\text{Mg}$ and $^{85}_{37}\text{Rb}$.

NUCLEAR DECAY AND REACTIONS

Review Questions

- Explain the main differences between alpha, beta, and gamma emissions.

- The figure below shows the steps by which $^{235}_{92}\text{U}$ decays to $^{207}_{82}\text{Pb}$. Draw this diagram, and enter the correct isotope symbol in each square.



- What factors make fusion difficult to achieve?

Conceptual Questions

- If a film is kept in a box, alpha particles from a radioactive source outside the box cannot expose the film, but beta particles can. Explain.
- An alpha particle has twice the charge of a beta particle. Why does the beta particle deflect more when both pass between electrically charged plates, assuming they both have the same speed?
- Suppose you have a single atom of a radioactive material whose half-life is one year. Can you be certain that the nucleus will have decayed after two years? Explain.
- Why is carbon dating unable to provide accurate estimates of very old materials?
- A free neutron undergoes beta decay with a half-life of about 15 min. Can a free proton undergo a similar decay? (Hint: Compare the masses of the proton and the neutron.)
- Is it possible for a $^{12}_6\text{C}$ (12.000 000 u) nucleus to spontaneously decay into three alpha particles? Explain.