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SUMMARY OF TERMS (KNOWLEDGE)

Nuclear fission The splitting of the nucleus of a heavy atom, such as uranium-235, into two smaller nuclei, accompanied by the release of much energy.

Chain reaction A self-sustaining reaction in which the products of one reaction event stimulate further reaction events.

Critical mass The minimum mass of fissionable material in a reactor or nuclear bomb that will sustain a chain reaction.

Breeder reactor A fission reactor that is designed to breed more fissionable fuel than is put into it by converting nonfissionable isotopes to fissionable isotopes.

Nuclear fusion The combination of light atomic nuclei to form heavier nuclei, often with the release of much energy.

Thermonuclear fusion Nuclear fusion produced by high temperature.

READING CHECK QUESTIONS (COMPREHENSION)

34.1 Nuclear Fission

1. Why doesn't a chain reaction normally occur in uranium mines?
2. Why is a chain reaction more likely to occur in a big piece of uranium than in a small piece?
3. What is meant by the idea of a critical mass?
4. Which will leak more neutrons: two separate pieces of uranium or the same pieces stuck together?
5. What were the two methods used to separate U-235 from U-238 in the Manhattan Project during World War II?

34.2 Nuclear Fission Reactors

6. What are the three possible fates of neutrons in uranium metal?
7. What are the four main components of a fission reactor?
8. What components are the safeguards to prevent a reactor from generating energy out of control?
9. What isotope is produced when U-238 absorbs a neutron?
10. What isotope is produced when U-239 emits a beta particle?
11. What isotope is produced when Np-239 emits a beta particle?
12. What do U-235 and Pu-239 have in common?

34.3 The Breeder Reactor

13. What is the effect of placing small amounts of fissionable isotopes with large amounts of U-238?
14. Name two isotopes that undergo nuclear fission.
15. What element reacts in a breeder reactor to breed nuclear fuel?

34.4 Fission Power

16. In what way is a nuclear reactor similar to a conventional fossil-fuel plant?
17. Cite three main advantages of fission power. Cite four main drawbacks.

34.5 Mass–Energy Equivalence

18. What celebrated equation shows the equivalence of mass and energy?
19. Is work required to pull a nucleon out of an atomic nucleus? Does the nucleon, once outside, have more energy than it did when it was inside the nucleus? In what form is this energy?
20. Which ions of like charge and equal speed are least deflected in a mass spectrometer?
21. What is the basic difference between the graphs in Figure 34.15 and Figure 34.16?
22. In which element is the mass per nucleon greatest? Least?
23. How does the mass per nucleon in uranium compare with the mass per nucleon in its fission fragments?
24. What becomes of the "lost" mass per nucleon in fission and fusion reactions?
25. If the graph in Figure 34.16 is seen as an energy valley, what can be said about the energy of nuclear transformations that progress toward iron?

34.6 Nuclear Fusion

26. When a pair of hydrogen nuclei are fused to create helium, how does the mass of the resulting helium nucleus compare with the sum of the nuclear masses before fusion?
27. For helium to release energy, should it be fissioned or fused?

34.7 Controlling Fusion

28. What isotopes of hydrogen fuse best at "moderate" temperatures?
29. Which isotope of hydrogen—deuterium or tritium—is abundant and which is scarce?
30. What kind of nuclear power is responsible for sunshine?