Chapter 10 – The Atom

Section Review 10.1

1. Name the three subatomic particles. Describe the location and charge of each particle.

a.

b.

c.

2. What force holds (a) an electron in an atom, and (b) the nucleus together? List the scientists who contributed to the discovery of these forces.

a.

b.

List the scientists:

3. One atom has 12 protons and 12 neutrons. Another has 13 protons and 12 neutrons. Are they the same or different elements? Explain.

Section Review 10.2

1. Describe how the colors in a spectrum from an atom are different from those in a rainbow.

2. Why does light from atoms show spectral lines?

3. How many electrons can fit in the same quantum state in the same atom?

4. What is probability?

Section Review 10.3

1. Sketch a graph showing the energy of the nucleus (y-axis), versus the atomic number (x-axis). Use the graph to explain what kinds of nuclear reactions release energy.

2. Write the nuclear reaction that represents the alpha decay of uranium-238.

3. If americium-241 has a half life of 458 years, how long do you need to wait until only ¼ of the sample of americium-241 is left?

4. List one advantage and one disadvantage of nuclear power.

Chapter 10 Review

Understanding Vocabulary

Select the correct term on page 268 to complete the sentences.

1. Carbon-12, carbon-13, and carbon-14 are _____ of the element carbon.

2. Of the four fundamental forces, the force which is strongest is the _____.

3. The _____ is 1,837 times more massive than the electron, while the _____ is 1, 839 times more massive.

4. When an atom's electron falls from an excited state to a lower energy level, light is given off that may be observed as _____.

5. The location of an electron must be described using a(n) _____ because it's exact location cannot be specified according to the _____.

6. Fission and fusion reactions are examples of _____, both releasing huge amounts of energy.

7. Of the three most common types of radioactive decay, the process releasing the most massive particle is _____.

Reviewing Concepts

Section 10.1

1. Contrast John Dalton's atomic theory with today's electron cloud or quantum theory of the atom.

2. What did Ernest Rutherford discover about the atom with his gold foil experiment?

3. What particles make up the nucleus of the atom?

4. What takes up the most volume or space in an atom, the nucleus or the electron cloud?

5. If the positive charge on protons in the nucleus causes protons to repel each other, why doesn't the nucleus break apart?

6. Compare electrons, protons, and neutrons in terms of size, mass, and charge.

7. Name the scientist(s) credited with the discovery of the electron, the proton, the nucleus, and the neutron.

8. Name the four fundamental forces in the atom in order from strongest to weakest and the scientist responsible for identifying or measuring each.

a.

b.

c.

d.

9. Describe the significance of the atomic number and mass number of an element.

10. What is an isotope? Provide an example of isotopes for a given element.

11. What is the derivation of the atomic mass unit? What is the value in kilograms and the abbreviation for one atomic mass unit?

Section 10.2

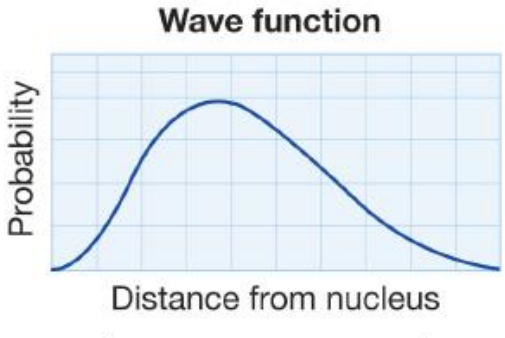
12. What is the evidence that an electron's energy is restricted to a specific value?

13. What is a photon?

14. How did Neils Bohr explain the spectral lines for small elements such as hydrogen or helium?

15. Why is probability used to predict the behavior of particles instead of exact calculations?

16. The graph at right might be used to represent the _____ for a specific quantum state of an electron.



Section 10.3

17. Compare and contrast chemical and nuclear reactions, with respect to the subatomic particles involved, the energy released, and how the atoms may or may not change.

18. Compare and contrast fusion and fission reactions.

19. In a chemical reaction, balanced equations are written assuming the law of conservation of mass is strictly obeyed. Can this assumption similarly be made with nuclear reactions? Explain.

20. Why is the energy released from a nuclear reaction so much greater than the energy from a chemical reaction?

21. Summarize the three kinds of radioactive decay in the chart below.

Decay	Proton # change	Neutron # change	Ejected particle
Alpha			
Beta			
Gamma			

22. What is the periodic table and how is it organized?

23. What is the half-life of an element?

24. Briefly describe three uses of radioactive isotopes.

a.

b.

c.

25. "All life on Earth depends upon the energy produced by fusion reactions." Briefly explain this statement.

Solving Problems

Section 10.1

1. An atom has seven protons and eight neutrons. What is this atom's atomic number? What is its mass number? What element is this atom?

2. How many neutrons are in a silicon atom with an atomic number of 14 and a mass number of 30?

3. Carbon-12 and carbon-14 have an atomic number of 6. How many protons and neutrons do carbon-12 and carbon-14 have?

4. Find the number of protons in an oxygen atom.

5. An atom has 20 protons and 24 neutrons.

    a. What is this atom's mass number?

    b. What is this atom's atomic number?

    c. What element is this atom?

6. A common isotope of carbon has a mass number of 13. What is the total number of particles in its nucleus?

7. Draw a model of an atom that has five protons, five neutrons, and five electrons. Label the charge of each particle. What element is this?

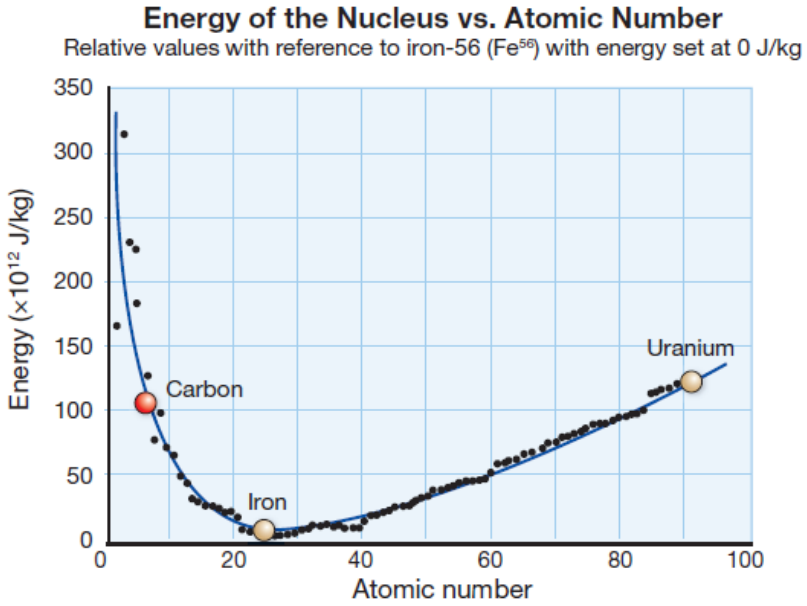
Section 10.2

8. Atom A gains enough energy to promote an electron from the first energy level to the fourth energy level. Atom B gains enough energy to promote an electron from the third energy level to the fourth energy level. When both electrons fall back to their original energy levels (ground state level), one atom emits a red photon and the other a green photon. Which atom emits the green photon? Why?

9. If you roll a six-sided die once, what is the probability that you will roll a four? If you roll this same die 100 times, how many times would you expect to roll a four?

Section 10.3

10. Use the graph at right and the Periodic Table of the Elements on page 261 to number the electrons in a-f in order of increasing energy of their nuclei.



a. carbon (C)

b. iron (Fe)

c. magnesium (Mg)

d. lithium (Li)

e. lead (Pb)

f. krypton (Kr)

11. Use the graph above and your knowledge of nuclear reactions to indicate which pairs of atomic nuclei would be most likely to release energy by fission and which would release energy by fusion.

a. helium-4 and carbon-12

b. uranium-235 and strontium-135

c. carbon-12 and carbon-12

12. Radon has a half-life of 3.8 days. How long does it take for 16 g of radon to be reduced to 2 g of radon?

Test Practice

Section 10.1

1. Which subatomic particle has the highest mass?

a. gamma ray b. electron c. proton d. neutron

2. Which is the weakest of the four fundamental forces?

a. gravity b. weak force c. electromagnetic d. strong nuclear force

3. Who was the first scientist to measure the gravitational force between two objects?

a. Hideki Yukawa b. John Mitchell
c. Henry Cavendish d. Charles-Augustin Coulomb

Section 10.2

4. Photons of frequencies corresponding to the colors blue, green, red, and violet are emitted by an atom as electrons fall from the 3rd, 4th, 5th, and 6th, energy levels to the 2nd level. The transition responsible for the emission of a photon with a frequency producing red light is

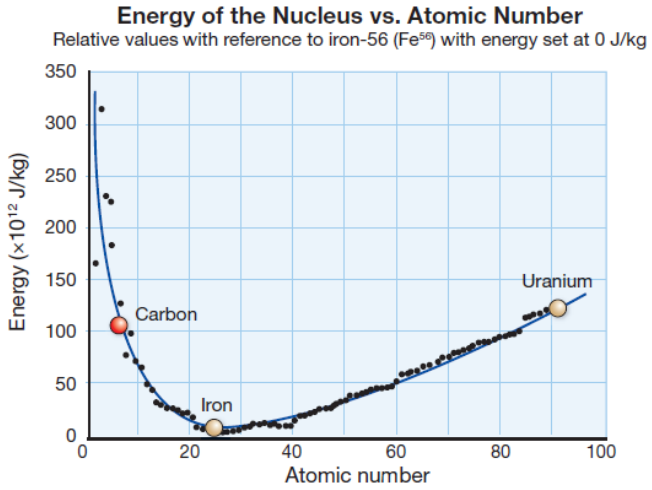
a. level 3 to 2. b. level 4 to 2. c. level 5 to 2. d. level 6 to 2.

Section 10.3

5. A high energy photon is always emitted in the process of

a. alpha decay.
b. beta decay.
c. gamma decay.
d. all radioactive decay.

6. According to the graph at right, the largest amount of energy would be given off from a nuclear change of



a. carbon nuclei to uranium nuclei.
b. carbon nuclei to iron nuclei.
c. uranium nuclei to carbon nuclei.
d. iron nuclei to carbon nuclei.

7. Carbon-15 has a half-life of 2.4 s. Starting with 200 g, after 12 s the number of grams of carbon-15 remaining would be

a. 50. b. 25. c. 5. d. 12.5.

8. The nucleus of an atom becomes unstable when an atom contains

a. too many neutrons compared to protons.

b. too many electrons compared to protons.

c. too many electrons compare to neutrons.

d. any of the above combinations

Refer to the isotope notation below right to answer questions 9 and 10.

$^{60}_{28}Ni$

9. This isotope can be properly identified as

a. nickel-28. b. nickel-32. c. nickel-60. d. nickel-88.

10. The number of protons in this isotope is

a. 28. b. 32. c. 60. d. 88.