

## Conceptual Physics Review (Chapters 38-40)

### Chapter 38

- Give two examples of models for light.
- Describe the Bohr model of the atom and describe the current model of the atom.
- Describe the photoelectric effect, and explain which model of light it supports.
- Give evidence for the wave nature of electrons.
- Describe the wave properties of all matter, using de Broglie's formula for wavelength.
- Explain why the radius of an atom is not directly proportional to the mass of the atom.
- Explain what the atomic spectrum of an element reflects about its atomic structure.
- Determine the energy emitted by an electron that produces visible light of a given wavelength or frequency.

### Chapter 39

- Describe atomic nuclei, including what forces hold them together and why certain nuclei are unstable and therefore undergo spontaneous radioactive decay.
- Distinguish among the three types of rays (alpha, beta, and gamma) given off by radioactive nuclei.
- Compare the penetrating powers of the three types of radiation.
- Interpret the symbols used to label isotopes of an element.
- Explain what is meant by the half-life of an element.
- Predict how much of a given sample of radioactive isotope will remain at the end of some multiple of the half-life.
- Given the symbol for a radioactive isotope and the particle it gives off, predict the product of the decay.
- Explain how carbon dating works.
- Explain why the center of the earth is warm.

### Chapter 40

- Describe the role of neutrons in causing and sustaining nuclear fission.
- Explain how nuclear fission can be controlled in a reactor.
- Describe the equivalence of mass and energy.
- Distinguish between nuclear fission and nuclear fusion, and explain which elements undergo which process.
- Explain how it is possible that a neutron in a nucleus can have less mass than the same neutron alone, not in a nucleus.
- Define binding energy, and know which element has the greatest binding energy per nucleon.
- Describe the drawbacks of nuclear fission as a source of energy.
- Describe the drawbacks and the advantages associated with nuclear fusion as a source of energy.

### Labs

Review the Atomic Spectra Lab and the Half-Life Lab

### Homework

Review all homework problems from the textbook and all worksheets from chapters 38, 39, & 40.

## Questions and Problems

- When looking at the atomic spectrum for Argon, I observed a bright line in the violet region that has a wavelength of 455 nm.
  - Calculate the frequency of the visible light with that wavelength.
  - Calculate the energy of a photon of visible light with that wavelength.
  - What does this energy have to do with the energy levels in the Argon atom, according to the Bohr model of the atom?
- According to de Broglie, all matter has wavelike properties, just as all waves have particle-like properties. If I am jogging at a speed of 5.0 meters per second and my mass is 75.0 kg, calculate my de Broglie wavelength.
- Calculate and compare the de Broglie wavelengths for a proton and an electron, each traveling at  $3.00 \times 10^7$  m/s. You may recall that the mass of an electron is  $9.11 \times 10^{-31}$  kg and the mass of a proton is  $1.67 \times 10^{-27}$  kg.

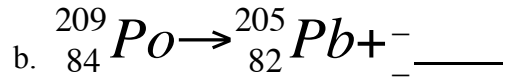
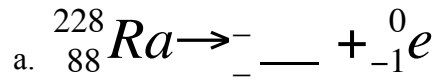
4. Explain the results of the photoelectric effect experiment. Use an analogy if you can, comparing red photons to feathers and blue photons to cannonballs or hockey pucks or something else. Be creative. Pretend you're explaining it to your grandparent, so it is very clear. Discuss the effects of increasing the intensity of the red light and the blue light.

5. Explain why a helium atom has a smaller radius than a hydrogen atom. Draw a picture of each atom to aid your explanation.

6. What evidence supports the theory that electrons in atoms exist at discrete energy levels? Which theory about the nature of electrons (particle or wave) is better supported by the discreteness of electron energy levels?

7. Describe what happens when an atom undergoes alpha decay.
  
8. Describe what happens when an atom undergoes beta decay.
  
9. Write an equation for a tritium nucleus undergoing beta decay.
  
10. Write an equation for a U-238 nucleus undergoing alpha decay.
  
11. Write an equation for a beryllium-8 nucleus undergoing alpha decay.
  
12. Radium-226 has a half-life of 1620 years.
  - a. What does this mean?
  
  - b. What fraction of an original sample of radium-226 will remain after 3240 years?
  
  - c. How many years does it take a sample of radium-226 to decay to 1/16 its original size?
  
13. Explain what two types of forces act within the nuclei of atoms. Describe the relative strengths of each type of force, including what happens to each force over a given distance.

14. Complete the following nuclear reactions, and identify the type of reaction.



15. Explain how carbon dating works. Be sure to specify what types of objects can be dated by this method.

16. Define binding energy. What element's nucleus has the greatest binding energy per nucleon? How does binding energy per nucleon relate to the mass per nucleon in the nucleus?

17. What has more mass, 6 protons and 6 neutrons all separated from each other or a carbon-12 nucleus? What accounts for the difference in mass?

18. Describe the fission of a U-235 nucleus, from start to finish. Include an explanation of the relative strength of different forces in the nucleus before and after a lone neutron is absorbed by the nucleus. Describe the products of the reaction.

19. Describe how a chain reaction can occur in a fission reactor and explain how the size of the piece of uranium can affect the chances of a chain reaction taking place.

20. In a breeder reactor, nonfissionable U-238 is converted into more fissionable Pu-239. Write three reactions to describe this three-step process. In the first step, U-238 combines with a neutron to form U-239. In the second step, U-239 undergoes beta decay. In the third step, the product of the second step undergoes beta decay. The final product of step three should be Pu-239.

21. Does iron undergo fission, fusion, both, or neither? Explain your answer.