Chapter 11 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

1. What's the energy of a photon whose wavelength is 2.07 nm ?

   (A) 60 eV
   (B) 600 eV
   (C) 960 eV
   (D) 6000 eV

2. A metal whose work function is 6.0 eV is struck with light of frequency 7.2×10^{15} Hz. What is the maximum kinetic energy of photoelectrons ejected from the metal's surface?

   (A) 7 eV
   (B) 13 eV
   (C) 19 eV
   (D) 24 eV

3. An atom with one electron has an ionization energy of 25 eV. How much energy will be released when the electron makes the transition from an excited energy level, where $E = -16$ eV, to the ground state?

   (A) 9 eV
   (B) 11 eV
   (C) 16 eV
   (D) 25 eV

4. The single electron in an atom has an energy of –40 eV when it's in the ground state, and the first excited state for the electron is at –10 eV. What will happen to this electron if the atom is struck by a stream of photons, each of energy 15 eV ?

   (A) The electron will absorb the energy of one photon and become excited halfway to the first excited state, then quickly return to the ground state, emitting a 15 eV photon in the process.
   (B) The electron will absorb the energy of one photon and become excited halfway to the first excited state, then quickly absorb the energy of another photon to reach the first excited state.
   (C) The electron will absorb two photons and be excited to the first excited state.
   (D) Nothing will happen.

5. What is the de Broglie wavelength of a proton whose linear momentum has a magnitude of 3.3×10^{-23} kg·m/s ?

   (A) 0.0002 nm
   (B) 0.002 nm
   (C) 0.02 nm
   (D) 0.2 nm

6. A partial energy-level diagram for an atom is shown below. What photon energies could this atom emit if it begins in the $n = 3$ state?

   –3 eV _____ $n = 4$

   –5 eV _____ $n = 3$

   –8 eV _____ $n = 2$

   –12 eV _____ $n = 1$ ground state

   (A) 5 eV only
   (B) 3 eV or 7 eV only
   (C) 2 eV, 3 eV, or 7 eV
   (D) 3 eV, 4 eV, or 7 eV

7. The ground-state energy level for He^+ is –54.4 eV. How much energy must the electron in the ground state of He^+ absorb in order to be excited to the next higher energy level?

   (A) 13.6 eV
   (B) 27.2 eV
   (C) 40.8 eV
   (D) 68.0 eV

8. What would happen to the energy of a photon if its wavelength were reduced by a factor of 2 ?

   (A) It would decrease by a factor of 4.
   (B) It would decrease by a factor of 2.
   (C) It would increase by a factor of 2.
   (D) It would increase by a factor of 4.

9. In an exothermic nuclear reaction, the difference in mass between the reactants and the products is m, and the energy released is Q. In a separate exothermic nuclear reaction in which the mass difference between reactants and products is $m/4$, how much energy will be released?

(A) $Q/4$
(B) $Q/2$
(C) $(Q/4)c^2$
(D) $(Q/2)c^2$

10. What's the missing particle in the following nuclear reaction?

$$^{2}_{1}\mathrm{H} + {}^{63}_{29}\mathrm{Cu} \longrightarrow {}^{64}_{30}\mathrm{Zn} + (?)$$

(A) Proton
(B) Neutron
(C) Electron
(D) Positron

11. What's the missing particle in the following nuclear reaction?

$$^{196}_{78}\mathrm{Pt} + {}^{1}_{0}\mathrm{n} \longrightarrow {}^{197}_{78}\mathrm{Pt} + (?)$$

(A) Proton
(B) Electron
(C) Positron
(D) Gamma

Section II: Free Response

1. The Bohr model of electron energy levels can be applied to any one-electron atom, such as doubly ionized lithium (Li^{2+}). The energy levels for the electron are given by the equation

$$E_n = \frac{Z^2}{n^2}(-13.6 \text{ eV})$$

where Z is the atomic number. The emission spectrum for Li^{2+} contains four spectral lines corresponding to the following wavelengths:

11.4 nm, 13.5 nm, 54.0 nm, 72.9 nm

(a) What's the value of Z for Li^{2+}?

(b) Identify which energy-level transitions give rise to the four wavelengths cited.

(c) Can the emission spectrum for Li^{2+} contain a line corresponding to a wavelength between 54.0 nm and 72.9 nm? If so, calculate its wavelength. If not, briefly explain.

(d) What is the next shortest wavelength in the emission spectrum (closest to, but shorter than, 11.4 nm)?