Fall 2001: PSC2121 Homework Assignments
Solutions due Oct 25, Ch. 11 and 12

Ch. 11:

3. Of the fundamental forces, only the electric force can be repulsive.
Gravity, for example, is always attractive.

10. Sliding across the seat transfers electrons from one material to another.
This causes a charge difference between you and the car that
is discharged via the shock when you touch the door handle.

11. In conductors some of the electrons are free to move from one atom to the next
allowing for an easy flow (conduction) of charge. In insulators, the elections are
tightly bound to each atom and can not easily move.

12. (a) good conductors: copper, gold, silver, aluminum, all metals
(b) good insulators: glass, wood, plastic, rubber

15. The electric force $F = K q_1 q_2/r^2$. For each electron $q = -1.6\times10^{-19}$ C. $r = 10^{-9}$ m, so
$F = (9\times10^9 \text{ Nm/C}^2)(-1.6\times10^{-19} \text{ C})^2 / (10^{-9} \text{ m})^2 = (9 \times 2.56) \times 10^{9-38}/10^{-18} \text{ N} =$ **2.3×10^{-10} N.**

32. R = V/I. Here I = 0.500 A and V = 9.0 V, so R = (9.0 V)/(0.5 A) = **18 Ω.**

33. Power P = IV, so I = P/V = (60 W)/(120 V) = **0.5 A.**

34. From problem 33, I = Q/t = 0.5 A, so the total charge Q that flows in 1 second,
Q = I t = (0.5 A)(1.0 s) = 0.5 C. In terms of the number of electrons,
$N_{electron} = Q/q_{electron} = (0.5 \text{ C})/(1.6\times10^{-19} \text{ C}) =$ **3.125×10^{18} electrons/s.**

37. The fuse protects the house wiring from overheating if too much current flows.
Using a fuse with a larger current rating increases the danger of a house fire.

40. (a) For parallel resistors $1/R_{tot} = 1/R_1 + 1/R_2 + 1/R_3 + \ldots$
Here, $1/R_{tot}$ = 1/(220 Ω) + 1/(440 Ω) + 1/(660 Ω) = 1/(220 Ω)(1 + 1/2 + 1/3) = 1/(220 Ω)(11/6)
so R_{tot} = (220 Ω) (6/11) = **120 Ω.**
(b) I = V/R = (110 V)/(120 Ω) = **0.9 A.**
(c) Each lamp has the same voltage so each current is I = V/R .
I_1 = (110 V) / (220 Ω) = **0.5 A.**
I_2 = (110 V) / (330 Ω) = **0.3333 A.**
I_3 = (110 V) / (660 Ω) = **0.1667 A.**
Notice that for parallel circuits the sum of the currents through the individual branches equal the total.

43. (a) For series resistors add the individual resistances, $R_{tot} = R_1 + R_2 + R_3 + \ldots$
Here we have 5 equal resistors of 20 Ω, so Rtot = 5×(20 Ω) = **100 Ω.**

(b) For parallel resistors, $1/R_{tot} = 1/R_1 + 1/R_2 + 1/R_3 + \ldots$
Here, $1/R_{tot}$ = 5×1/(20 Ω) = 1/(4 Ω), so R_{tot} = **4 Ω.**

Adding resistors in series increases the resistance, adding in parallel decreases the resistance.

44. For resistors connected in series the SAME current flows through each resistor.
$R_{tot} = R_1 + R_2 + R_3 = (5\ \Omega) + (10\ \Omega) + (15\ \Omega) = 30\ \Omega$.
$I = V/R_{tot} = (9.0\ V) / (30\ \Omega) =$ **0.3 A.**

46. Energy (work) = Power x time.
For the TV set, energy = (250 W)(1 hr) = 250 W-hr.
For the toaster, energy = (1200 W)(10 min) = (1200 W)(1/6 hr) = 200 W-hr.
The TV set uses more energy.

48. P = I V = (20 A) (240 V) = 4800 W = 4.8 kW.
Cost for 1 hour = (4.8 kW-hr) ($0.10/kW-hr) = **$0.48**

50. A. (b) B. (c) C. (d) D. (b) E. (b) F. (c) G. (d) H. (a) I. (c) J. (b)

Ch. 12:

8. Spectral lines provide a characteristic fingerprint of each element. The corresponding light frequencies represent the differences in atomic energy levels.

10. Radioactivity is the emission of particles and radiation due to the decay of an unstable atom into a more stable atom. X-rays are high energy electromagnetic radiation (photons) that are typically generated when high energy electrons strike a solid.

11. Rutherford shot alpha particles (Helium nuclei) at thin metal foils and observed in which direction the scattered particles were deflected. Most went straight through indicating much empty space within the metal. Some, however, were scattered straight back and at all angles indicating small concentrations of positive charge.

12. Although hydrogen has a single electron, the atom can exist in many different energy states. Transitions between two states produces a different spectral line for each pair of states.

16. If yellow light can produce the photoelectric effect (where electrons are ejected from the metal), then blue light with higher frequency and greater energy will also eject electrons.

17. For photons, $E = hf = hc/\lambda$. $\lambda = 5500\ Å \times (10^{-10}\ m/Å) =$ **5.5×10^{-7} m.**
$E = (6.63\times10^{-34}\ J\text{-}s)\ (3\times10^{8}\ m/s) / (5.5\times10^{-7}\ m) =$ **3.62×10^{-19} J.**

20. For photons, $E = hf$, so **doubling f will double E.**

21. For photons, $E = hc/\lambda$, so **doubling λ will reduce E to 1/2** its previous value.

26. For particles the de Broglie wavelength $\lambda = h/mv$
$= (6.63\times10^{-34}\ J\text{-}s) / (0.5\ kg)(15\ m/s) =$ **8.84×10^{-35} m.**
too small to be observed!

37. A. (b) B. (d) C. (c) F. (a) G. (d) H. (c) I. (a) J. (b)