assignment 4 Name_____
PHYS 0109
(Gen Chem)

A few equations

$c = \lambda\nu$

$E_{photon} = h\nu$

$KE = h\nu - \phi$

$\Delta E = -R_H(1/n_f^2 - 1/n_i^2)$

$\lambda = h/(mv)$

A few constants

$R_H = 2.18 \times 10^{-18}$ J

$h = 6.626 \times 10^{-34}$ J • s

$c = 2.9979 \times 10^{8}$ m/s

$m_e = 9.11 \times 10^{-31}$ kg

$m_p = 1.6 \times 10^{-27}$ kg

n has integral values 1,2,3...

l has integral values from 0 to n-1

m_l has integral values between (and including) l to $-l$

m_s can be $+1/2$ or $-1/2$

0 °C = 273.15 K

1. The Bohr model of the hydrogen atom (mark each statement true or false)

a. __T__ was the first model based on physical relationships that successfully accounted for the line spectrum of the hydrogen atom.

b. __F__ explains why the energy of an electron is quantized.

c. __F__ successfully accounted for the line spectrum of multielectron atoms like helium.

2. Using the noble gas shorthand write the ground state electron configuration for Sb.

[Kr] $5s^2 4d^{10} 5p^3$

3. Determine the number of unpaired electrons in the following unexcited atoms or ions.

a. Br __1__ b. F^- __0__ c. S __2__ d. Al __1__ f. P __3__

4. Use the following information to determine the heat of formation, $\Delta H_f°$, for CH_3CH_2OH (l).

$$CH_3CH_2OH(l) \longrightarrow H_2(g) + CH_3CHO(g) \qquad \Delta H = 112 \text{ kJ}$$

$$2\ CH_3CHO(g) + 5\ O_2(g) \longrightarrow 4\ CO_2(g) + 4\ H_2O(g) \qquad \Delta H = -2210 \text{ kJ}$$

For $CO_2(g)$ $\Delta H_f° = -393.5$ kJ/mol, and for $H_2O(g)$ $\Delta H_f° = -242$ kJ/mol.

Target rxn

$$2\ C(s) + {}^1/_2\ O_2(g) + 3\ H_2(g) \longrightarrow CH_3CH_2OH\ (l)$$

$$H_2(g) + CH_3CHO(g) \longrightarrow CH_3CH_2OH(l) \qquad -112 \text{ kJ}$$

$${}^4/_2\ CO_2(g) + {}^4/_2\ H_2O(g) \longrightarrow {}^2/_2\ CH_3CHO(g) + {}^5/_2\ O_2(g) \qquad (2210)/2 \text{ kJ}$$

$$2\ H_2(g) + O_2(g) \longrightarrow 2\ H_2O(g) \qquad 2(-242) \text{ kJ}$$

$$2\ C(s) + 2\ O_2(g) \longrightarrow 2\ CO_2(g) \qquad 2(-393.5) \text{ kJ}$$

$$2\ C(s) + {}^1/_2\ O_2(g) + 3\ H_2(g) \longrightarrow CH_3CH_2OH\ (l) \qquad -278 \text{ kJ}$$

5. Quantum mechanics (mark each statement true or false)

a. __F__ treats electrons as particles that orbit a nucleus in a wavelike pattern.

b. __T__ quantizes the energy of an electron by treating the electron as a standing wave.

6. In a hydrogen atom, a photon with wavelength equal to 1874.5 nm is emitted as an electron moves from the n=4 level to which level?

$E_{photon} = h\nu$ and $c = \lambda\nu$; therefore, $E_{photon} = hc/\lambda$

$$E_{photon} = \frac{(6.626 \times 10^{-34}\ \text{J•s})\ (2.9979 \times 10^{8}\ \text{m•s}^{-1})}{1874.5 \times 10^{-9}\ \text{m}}$$

$$E_{photon} = 1.07519 \times 10^{-19}\ \text{J}$$

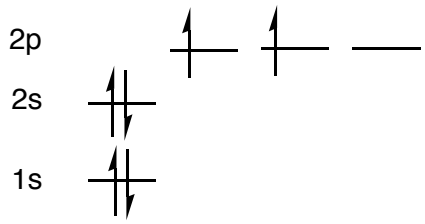
$$\Delta E_{electron} = -1.07519 \times 10^{-19}\ \text{J}$$

$$\Delta E_{electron} = -R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$$-1.07519 \times 10^{-19}\ \text{J} = -2.18 \times 10^{-18}\ \text{J}\left(\frac{1}{n_f^2} - \frac{1}{16}\right)$$

$$n = 3$$

7. Draw an energy level diagram for the electrons of a C atom. Remember to label all the energy levels.



8. To release 520 kJ of energy how many grams of propane, $CH_3CH_2CH_3$, must be burned? $\Delta H_{combustion} = -2044$ kJ/mol.

$$-520 \text{ kJ} * \frac{1 \text{ mol } C_3H_8}{-2044 \text{ kJ}} * \frac{44.09 \text{ g } C_3H_8}{1 \text{ mol } C_3H_8} = 11 \text{ g } C_3H_8$$