Chem 106 Exam 2. J-Term 2005

Name Key

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Useful information: Formal Charge = $E_{valence} - (E_{nonbonding} + \#_{bonds})$, $\lambda\nu = c$, c= 3.00 x 10^8 m/s,

$\lambda = \frac{h}{mv}$, $\frac{1}{\lambda} = R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$, $R_H = 0.01097\ nm^{-1}$ $1Hz = \frac{1}{s}$, h, $U = f \times \frac{Z_1 Z_2}{d^2}$

(1)(4 pts) A radio station broadcasts a radio signal with a frequency of 1500 kHz. What is the wavelength of this radiation? Is it an FM or AM station?

$1500\ kHz = 1.500 \times 10^6\ Hz = 1.500 \times 10^6 \frac{1}{s} = f$

$\lambda\nu = C$

$\lambda(1.500 \times 10^6 \frac{1}{s}) = 3.00 \times 10^8 \frac{m}{s}$

$\lambda = 200m$ AM station

(2)(2 pts) How is green light different from orange light?

green light has a different frequency

(3)(2 pts) How is a bright white light different from a dim white light?

the bright light is giving off more photons/minute.

(4)(2 points) Which second row element should have the highest 3rd ionization energy?

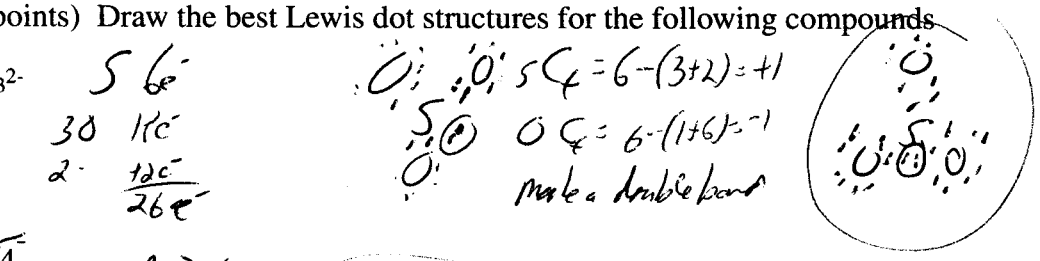
Be

(5)(2 points) Place the following in the order of increasing electron affinity:
B, Ga, N, Ba, Cs

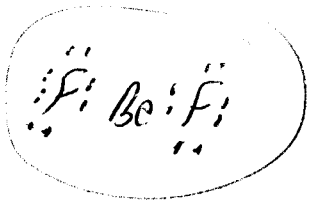
Cs Ba Ga B N

(6)(12 points) Draw the best Lewis dot structures for the following compounds

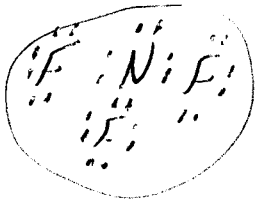
(a) SO_3^{2-} S 6e⁻ 3O 18e⁻ 2⁻ 2e⁻ 26e⁻



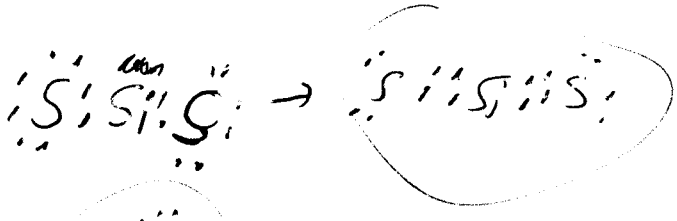
(b) ~~IBr_4^-~~ BeF_2 Be 2e⁻ 2F 14e⁻ 16e⁻



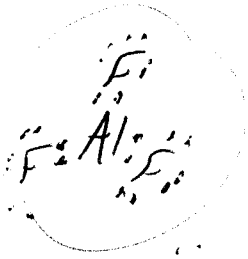
(c) NF_3 N 5e⁻ 3F 21e⁻ 26e⁻



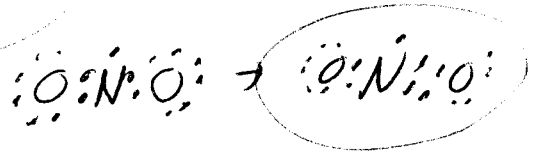
(d) SiS_2 Si 4e⁻ 2S 12e⁻ 16e⁻



(e) AlF_3 Al 3e⁻ 3F 21e⁻ 24e⁻



(f) NO_2 N 5e⁻ 2O 12e⁻ 17e⁻



(7)(2 points) Place the following in order of increasing lattice energy.
NaCl, Li_2S, CsI, MgO, Ca_3N_2

CsI, NaCl, Li_2S, MgO, Ca_3N_2

(8)(4 points) A neutron with a mass of 1.67×10^{-31} kg is moving at 25 m/s. What is its deBroglie wavelength?

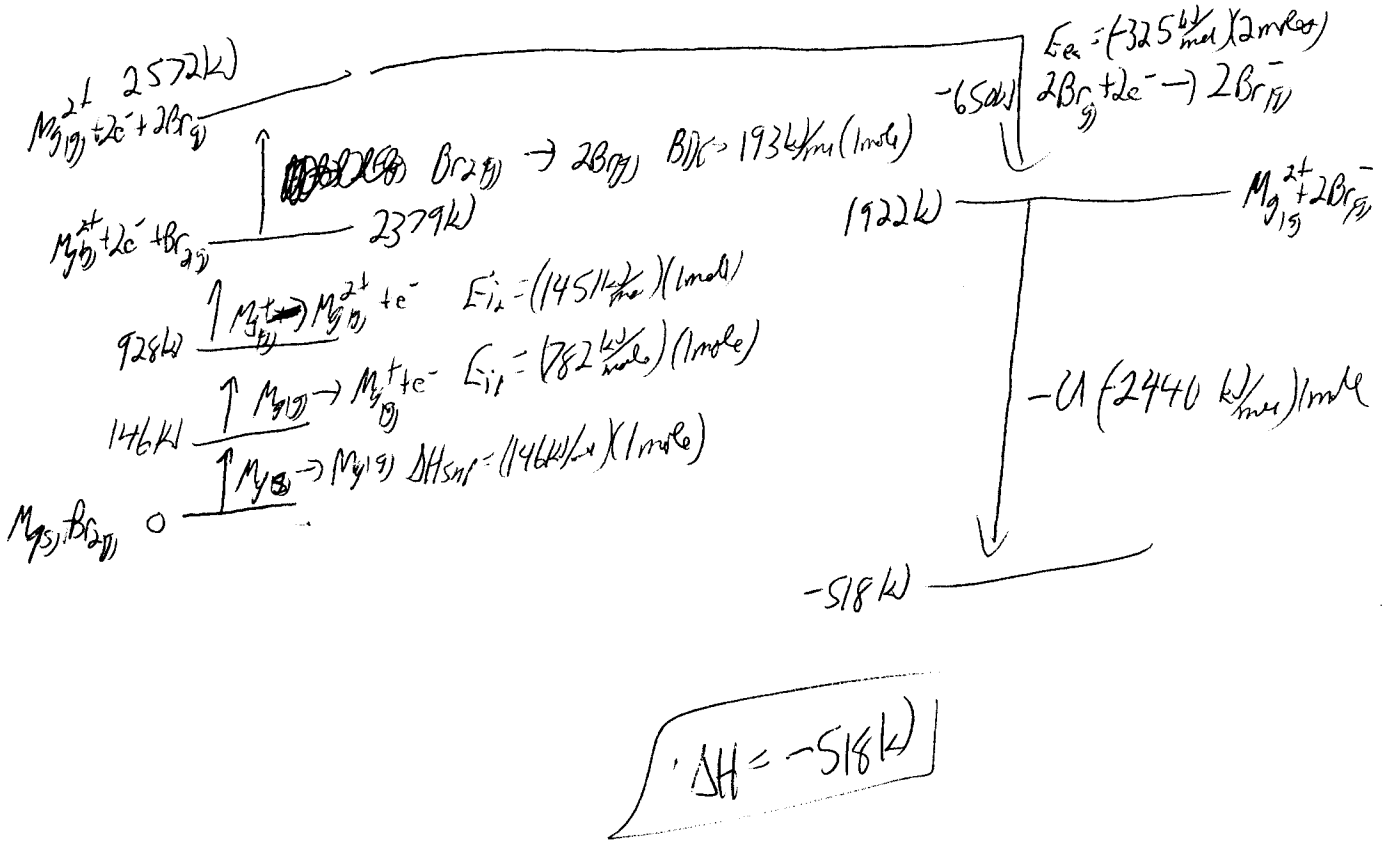
$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}\ kg\,m^2/s}{(1.67 \times 10^{-31}\ kg)(25\ m/s)} = 1.6 \times 10^{-4}\ m$

(10)(8 points) (8 points) Create a Born-Haber cycle to find the ΔH for the reaction below using the following information.

$Mg(s) + Br_2(g) \text{ -----> } MgBr_2(s)$ $\Delta H = ??$

Br_2 bond dissociation energy = 193 kJ/mole

Mg $\Delta H_{sublimation}$ = 146 kJ/mole
Mg (g): E_{i1} = 782 kJ/mole, E_{i2} = 1451 kJ/mole
Br(g) Electron Affinity = -325 kJ/mole
U for the reaction is 2440 kJ/mole



Extra Credit(4 points): A small radio requires 200 J of energy to play for 1 hour. If the radio was solar powered, how many photons of 500 nm light would be required to power the radio for one hour?

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$\frac{3.00 \times 10^{8} m/s}{500 \times 10^{-9} m} = 6.00 \times 10^{14} 1/s$

$E = h\nu = (6.626 \times 10^{-34} Js)(6.00 \times 10^{14} 1/s) = 3.95 \times 10^{-19} J/photon$

$\frac{200 J}{3.95 \times 10^{-19} J/photon} = 5.03 \times 10^{20} photons$

(9)(4 points) An electron in a hydrogen atom falls from the n=6 to the n=1 level. What is the wavelength of light emitted in this process?

$$\frac{1}{\lambda} = 0.01097 \frac{1}{nm}\left(\frac{1}{1^2} - \frac{1}{6^2}\right) \quad \boxed{94\,nm} = \lambda$$