Class
Id number

Name

Chemistry 123 : Exam 3B

The 76 pts exam consists of 6 questions and students have the whole class period to complete the exam. Answers must be written in the box provided or else no credit is provided. Use the empty space provided to do your work. A periodic table is provided at the end. Fill in your name along with your student ID number.

Problem 1 : Photoelectric Effect When light shines on a metal, electrons can be ejected from the surface of the metal in a phenomenon known as the photoelectric effect. You perform an experiment to eject electrons from iron (Fe) metal. It is known that a wavelength of 200 nm is the minimum energy to eject an electron from Fe. (16 pts)

(a) Determine the work function (Φ), or the minimum energy in J to eject an electron, of the Fe metal.

(b) How much energy in kJ is required to eject a mole of electrons from Fe metal? (Hint : One photon with enough energy ejects 1 electron.)

(c) Suppose a laser emits photons with an energy of 4.05 eV. Is this energy sufficient to eject an electron from Al metal? (Hint : 1 eV $= 1.602 \times 10^{-19}$ J)

(d) What is the velocity of the electron if a photon with a frequency 1.91×10^{15} Hz hits the surface of Al metal and ejects an electron? The mass of an electron is 9.109×10^{-31} kg.

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Problem 2 : Electron Configurations Write the electron configuration of the following atoms or ions. Your answer may be in the long or short forms. (12 pts)

(a) W

(b) Ca

(c) P^{3-}

(d) Cu

(e) Al^{3+}

(f) Se

Problem 3 : Periodic Trends Rank the following periodic trends. (12 pts)

(a) Electronegativity (Strongest to Weakest) : Ra, P, N, F, I

(b) Atomic Radius (Largest to Smallest) : O, Na, Ca, Cl, Cs

(c) First ionization energy (Highest to Lowest) : Li, Cl, Ar, He, Be

(d) Electron affinity (Highest to Lowest) : F, Cl, Br, I, At

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Problem 4 : Bohr's Model The Bohr's model was first developed to explain the emission and absorption of the hydrogen atom. (6 pts)

(a) What is the initial energy level of the electron if it absorbs a wavelength of 1,093 nm to a final energy state of 6 ?

(b) True/False. The Bohr model can accurately predict the emission and absorption of multi-electron atoms.

Problem 5 : Classical and Quantum Pictures of Energy Describe the difference between the classical and quantum pictures of energy. Which theory describes that energy is quantized or discrete steps ? You may include illustrations to support your answer. (6 pts)

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Problem 6 : Lewis Structures and VSEPR Model For the following compounds, draw the Lewis structure and include resonance structures if they exist. Determine the electronic arrangement and molecular geometry for the underlined atom. Determine whether the molecule is polar or nonpolar. (24 pts)

(a) $\underline{\text{Xe}}\text{F}_4$

(b) $\text{CH}_3\text{CH}_2\underline{\text{C}}\text{OOH}$

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(c) $\underline{O}_3$

(d) $\underline{S}O_4^{2-}$

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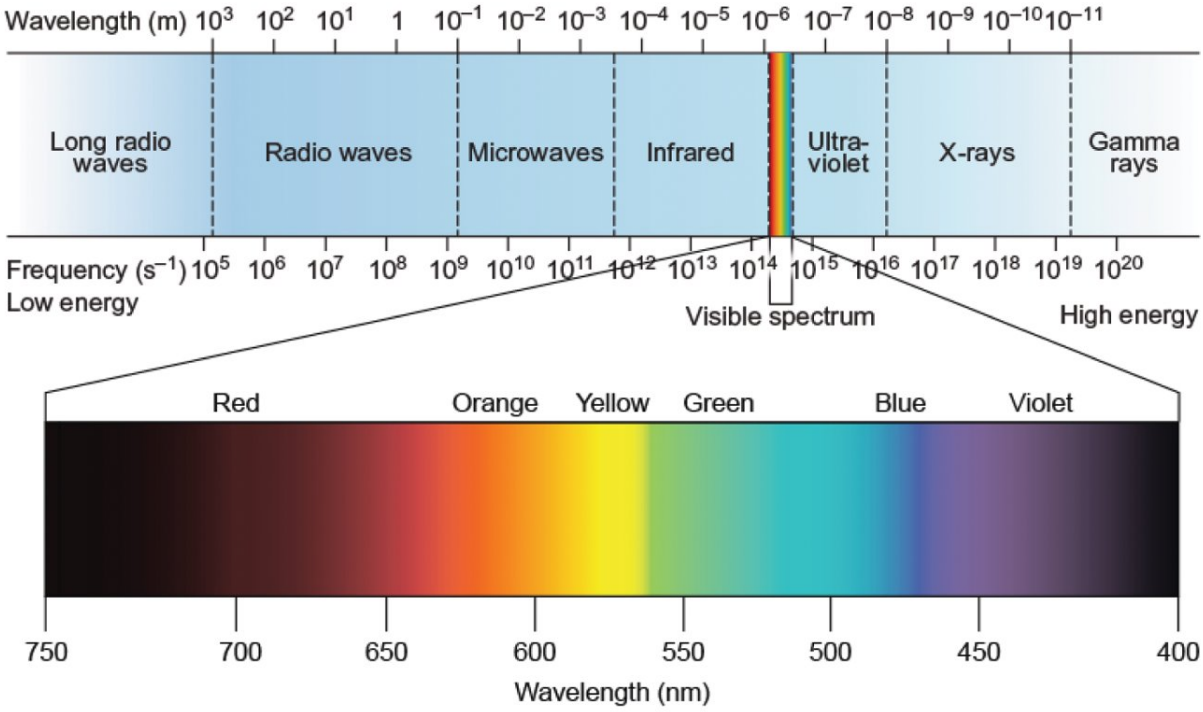
Chemistry 123 : Apppendix 2 - Formulas and Constants



$$c = \lambda\nu$$

$$E = h\nu = \frac{hc}{\lambda}$$

$$h = 6.626 \times 10^{-34}\ \text{J s}$$

$$c = 3.00 \times 10^{8}\ \text{m/s}$$

$$\text{KE} = h\nu - \Phi$$

$$\text{KE} = \frac{1}{2}mv^2$$

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$R_H = 1.097 \times 10^{7}\ \text{m}^{-1}$$

$$m_{\text{electron}} = 9.109 \times 10^{-31}\ \text{kg}$$

$$N_A = 6.022 \times 10^{23}\text{particles/mol}$$

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1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.94	4 Be Beryllium 9.012											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.085	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.630	33 As Arsenic 74.922	34 Se Selenium 78.97	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium [97]	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	53 Te Tellurium 127.60	53 I Iodine 126.904	54 Xe Xenon 131.293
55 Cs Cesium 132.905	56 Ba Barium 137.327	* 57 - 70	71 Lu Lutetium 174.967	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.997	80 Hg Mercury 200.592	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]
87 Fr Francium [223]	88 Ra Radium [226]	** 89 - 102	103 Lr Lawrencium [262]	104 Rf Rutherfordium [267]	105 Db Dubnium [270]	106 Sg Seaborgium [269]	107 Bh Bohrium [270]	108 Hs Hassium [270]	109 Mt Meitnerium [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [281]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [293]

*Lanthanide series	57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.242	61 Pm Promethium [145]	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.045
**Actinide series	89 Ac Actinium [227]	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium [237]	94 Pu Plutonium [244]	95 Am Americium [243]	96 Cm Curium [247]	97 Bk Berkelium [247]	98 Cf Californium [251]	99 Es Einsteinium [252]	100 Fm Fermium [257]	101 Md Mendelevium [258]	102 No Nobelium [259]