CHEM 1101 – October 2014 – Midterm 1 B - 75 minutes

SPREAD OUT YOUR WORK – TURN OFF YOUR CELL PHONES

KEEP THE TEST PAPER – HAND IN ONLY THE BOOKLET

20% 1. Manganese has an ionization energy of 717 kJ/mol. Determine the wavelength of electromagnetic radiation needed (the maximum effective wavelength) to cause magnesium to exhibit the photoelectric effect. **Give the value in nanometers.**

25% 2. Electromagnetic radiation with a wavelength of 33.0 nm will cause electrons to be emitted from the surface of gold metal with a kinetic energy of 5.20×10^{-18} J.

a) Determine the work function of gold

b) Determine the work function of gold in electronvolts (see data page)

c) Determine the work function of gold in kJ/mol

15% 3. a) Rank the following in order of **increasing** atomic size (atomic radius):

Cl, F, K, Mg, Ne, P, S, Si

b) Rank the same elements from part a in order of **increasing** ionization energy:
Cl, F, K, Mg, Ne, P, S, Si

c) For Sulfur, S, write the chemical equations showing the **first** and **second** electron affinity reactions.

20% 4. a) Give the electron configuration for gold, $_{79}$Au

b) List the valence subshell(s) for gold

Show the orbital diagram for the valence subshell(s)

Give the full set of quantum numbers for all electrons in the valence subshell(s).

c) List the highest energy subshell for gold,

Show the orbital diagram for the highest energy subshell if different from above

Give the full set of quantum numbers for all electrons in the highest energy subshell if different from above.

d) Give the electron configuration for the Au(I) ion

20% 5. For the phosphate ion, PO_4^{3-}

a) Show the Lewis Diagram

b) Draw and name the molecular geometry

F - for electronegativity

Increasing ionization energy →

← Increasing atomic size

$E = h\nu$ $\quad h = 6.626 \times 10^{-34}$ J·s

$E = hc/\lambda$ $\quad c = 3.00 \times 10^{8}$ m/s

$1\ eV = 1.6022 \times 10^{-19}$ J

Avogadro's Number: 6.02×10^{23}

The periodic table

www.webelements.com

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Hydrogen 1 **H** 1.008																		Helium 2 **He** 4.0026
Lithium 3 **Li** 6.94	Beryllium 4 **Be** 9.0122												Boron 5 **B** 10.81	Carbon 6 **C** 12.011	Nitrogen 7 **N** 14.007	Oxygen 8 **O** 15.999	Fluorine 9 **F** 18.998	Neon 10 **Ne** 20.180
Sodium 11 **Na** 22.990	Magnesium 12 **Mg** 24.305												Aluminium 13 **Al** 26.982	Silicon 14 **Si** 28.085	Phosphorus 15 **P** 30.974	Sulfur 16 **S** 32.06	Chlorine 17 **Cl** 35.45	Argon 18 **Ar** 39.948
Potassium 19 **K** 39.098	Calcium 20 **Ca** 40.078(4)		Scandium 21 **Sc** 44.956	Titanium 22 **Ti** 47.867	Vanadium 23 **V** 50.942	Chromium 24 **Cr** 51.996	Manganese 25 **Mn** 54.938	Iron 26 **Fe** 55.845(2)	Cobalt 27 **Co** 58.933	Nickel 28 **Ni** 58.693	Copper 29 **Cu** 63.546(3)	Zinc 30 **Zn** 65.38(2)	Gallium 31 **Ga** 69.723	Germanium 32 **Ge** 72.63	Arsenic 33 **As** 74.922	Selenium 34 **Se** 78.96(3)	Bromine 35 **Br** 79.904	Krypton 36 **Kr** 83.798(2)
Rubidium 37 **Rb** 85.468	Strontium 38 **Sr** 87.62		Yttrium 39 **Y** 88.906	Zirconium 40 **Zr** 91.224(2)	Niobium 41 **Nb** 92.906(2)	Molybdenum 42 **Mo** 95.96(2)	Technetium 43 **Tc** [97.91]	Ruthenium 44 **Ru** 101.07(2)	Rhodium 45 **Rh** 102.91	Palladium 46 **Pd** 106.42	Silver 47 **Ag** 107.87	Cadmium 48 **Cd** 112.41	Indium 49 **In** 114.82	Tin 50 **Sn** 118.71	Antimony 51 **Sb** 121.76	Tellurium 52 **Te** 127.60(3)	Iodine 53 **I** 126.90	Xenon 54 **Xe** 131.29
Caesium 55 **Cs** 132.91	Barium 56 **Ba** 137.33	57-70 *	Lutetium 71 **Lu** 174.97	Hafnium 72 **Hf** 178.49(2)	Tantalum 73 **Ta** 180.95	Tungsten 74 **W** 183.84	Rhenium 75 **Re** 186.21	Osmium 76 **Os** 190.23(2)	Iridium 77 **Ir** 192.22	Platinum 78 **Pt** 195.08	Gold 79 **Au** 196.97	Mercury 80 **Hg** 200.59	Thallium 81 **Tl** 204.38	Lead 82 **Pb** 207.2	Bismuth 83 **Bi** 208.98	Polonium 84 **Po** [208.98]	Astatine 85 **At** [209.99]	Radon 86 **Rn** [222.02]
Francium 87 **Fr** [223.02]	Radium 88 **Ra** [226.03]	89-102 **	Lawrencium 103 **Lr** [262.11]	Rutherfordium 104 **Rf** [265.12]	Dubnium 105 **Db** [268.13]	Seaborgium 106 **Sg** [271.13]	Bohrium 107 **Bh** [270]	Hassium 108 **Hs** [277.15]	Meitnerium 109 **Mt** [276.15]	Darmstadtium 110 **Ds** [281.16]	Roentgenium 111 **Rg** [280.16]	Copernicium 112 **Cn** [285.17]	Ununtrium 113 **Uut** [284.18]	Flerovium 114 **Fl** [289.19]	Ununpentium 115 **Uup** [288.19]	Livermorium 116 **Lv** [293]	Ununseptium 117 **Uus** [294]	Ununoctium 118 **Uuo** [294]

Key: Element Name / Atomic number / **Symbol** / Atomic weight (mean relative mass)

I.E. ↑ ↓ size

*lanthanoids	Lanthanum 57 **La** 138.91	Cerium 58 **Ce** 140.12	Praseodymium 59 **Pr** 140.91	Neodymium 60 **Nd** 144.24	Promethium 61 **Pm** [144.91]	Samarium 62 **Sm** 150.36(2)	Europium 63 **Eu** 151.96	Gadolinium 64 **Gd** 157.25(3)	Terbium 65 **Tb** 158.93	Dysprosium 66 **Dy** 162.50	Holmium 67 **Ho** 164.93	Erbium 68 **Er** 167.26	Thulium 69 **Tm** 168.93	Ytterbium 70 **Yb** 173.05
**actinoids	Actinium 89 **Ac** [227.03]	Thorium 90 **Th** 232.04	Protactinium 91 **Pa** 231.04	Uranium 92 **U** 238.03	Neptunium 93 **Np** [237.05]	Plutonium 94 **Pu** [244.06]	Americium 95 **Am** [243.06]	Curium 96 **Cm** [247.07]	Berkelium 97 **Bk** [247.07]	Californium 98 **Cf** [251.08]	Einsteinium 99 **Es** [252.08]	Fermium 100 **Fm** [257.10]	Mendelevium 101 **Md** [258.10]	Nobelium 102 **No** [259.10]

Symbols and names: the symbols and names of the elements, and their spellings are those recommended by the International Union of Pure and Applied Chemistry (IUPAC - http://www.iupac.org/). Names have yet to be proposed for elements 113, 115, 117, and 118 and so those used here are IUPAC's temporary systematic names. In some countries, the spellings **aluminum**, **cesium**, and **sulphur** are usual.
Group labels: the numeric system (1–18) used here is the current IUPAC convention.
Atomic weights (mean relative masses): these are the IUPAC 2009 values and given to 5 significant figures. The last significant figure of each value is considered reliable to ±1 except where a larger uncertainty is given in parentheses. Representative values for those elements having an atomic weight interval are given (H, Li, B, C, N, O, Si, S, Cl, Tl). Elements for which the atomic weight is given within [brackets] have no stable nuclides and are represented by the element's longest lived isotope reported in the IUPAC 2009 values.