Chemistry 121 **MIDTERM 2** **Oct 29 2012** **Name:** _____

Section: _____

Units must be included in answers where necessary. Show all your work! All the goodies you could possibly want are included on the last page. **Total marks = 31**

1. Give the electronic configuration for: **[3 marks]**

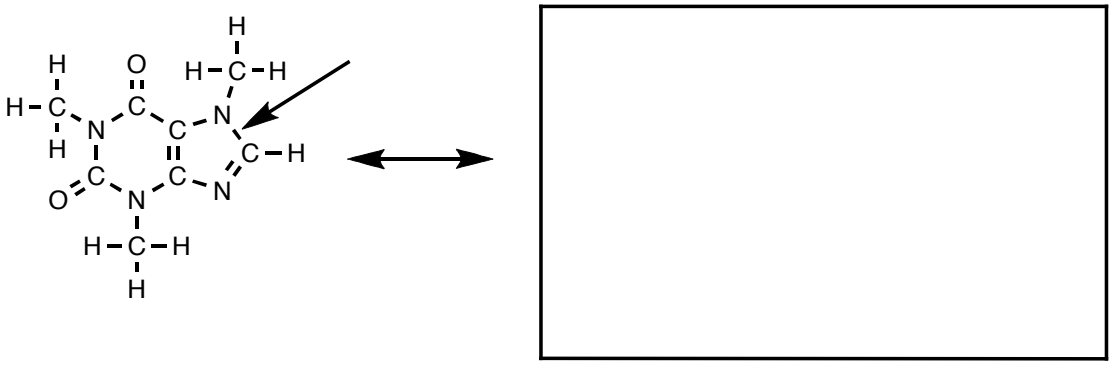
a) Se _____

b) Ni^{3+} _____

c) Pb _____

2. Calculate the wavelength of the light emitted/absorbed by a hydrogen atom when its electron is excited from the n = 1 to the n = 3 principal energy level. **[2 marks]**

3. Consider the structure of caffeine shown below. **[4 marks]**



a) How many sigma bonds are in this molecule? _____

b) How many pi bonds? _____

c) Describe the arrowed bond in terms of atomic orbital overlap (e.g. sp^3-p) _____

d) Fill in the above box with one resonance structure of caffeine.

4. Circle the element/ion that: **[4 marks]**

a. has the **largest** atomic radius:	$_{5}B$	$_{13}Al$	$_{16}S$	$_{15}P$	$_{14}Si$
b. has the **greatest** ionization energy:	$_{55}Cs$	$_{31}Ga$	$_{83}Bi$	$_{19}K$	$_{33}As$
c. has the **largest** ionic radius:	$_{17}Cl^{-}$	$_{19}K^{+}$	$_{16}S^{2-}$	$_{12}Mg^{2+}$	$_{15}P^{3-}$
d. is the **most** electronegative	$_{38}Sr$	$_{16}S$	$_{51}Sb$	$_{34}Se$	$_{50}Sn$

5. For the two compounds below: **[12 marks]**

a) Draw the Lewis structure. Determine all formal (atomic) charges for the structure.
b) Name the electronic geometry (EG).
c) Name the molecular geometry (MG).
d) Name the hybridization on the central atom.
e) State whether the molecule is polar.

Electronegativities: As 2.0, Cl 3.0, F 4.0, O 3.5, H 2.1, lone pair 3.7

Formula	Lewis Structure	EG name	MG name	Hybridization	Polar? (Y or N)
AsF_4^-					
$HClO_2$					

6. Calculate the wavelength of a ball (mass = 0.10 kg) travelling at a $^{1}/_{10}$ the speed of light. **[1 mark]**

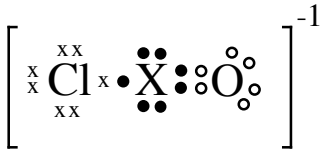
7. How many electrons can exist at: **[3 marks]**

a) n = 4 and l = 2 _____

b) n = 4, l = 4, ml = -2, ms = $^{1}/_{2}$ _____

c) n = 4 and ml = 2 _____

8. Identify the unknown element X which could exist in the Lewis structure below. Explain your reasoning. **[2 marks]**



Equations

Constants

$R_H = 2.18 \times 10^{-18}$ J Planck's constant = 6.626×10^{-34} J·s speed of light = 3.00×10^{8} m·s^{-1}

$R = 8.314$ J mol^{-1}K^{-1} = 0.08206 L atm mol^{-1}K^{-1} $N_A = 6.022 \times 10^{23}$ atoms mol^{-1}

Conversions 1 J = 1 kg·m^2 s^{-2} K = °C + 273

THE PERIODIC TABLE OF THE ELEMENTS

IA					VIIIA Group Number							IIIA	IVA	VA	VIA	VIIA	VIII
1 H 1.008	IIA				26 Fe 55.85	Atomic Number Symbol* Atomic Mass											2 He 4.003
3 Li 6.941	4 Be 9.012					*Synthetic elements are hollow faced. The most stable isotope (if any exists) is shown.						5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	IIIB	IVB	VB	VIB	VIIB	|←	VIIIB	→|	IB	IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.91)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57-71 See Lanth-anides	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0	89-103 See Actin-ides	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 Ds (271)	111 Rg (272)	112 Uub (285)	113 Uut ( )	114 Uuq (289)	115 Uup ( )	116 Uuh (292)	117 Uus ( )	118 Uuo (294)

Lanthanides	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (144.9)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	89 Ac 227.0	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237.0)	94 Pu (244.1)	95 Am (243.1)	96 Cm (247.1)	97 Bk (247.1)	98 Cf (251.1)	99 Es (252.1)	100 Fm (257.1)	101 Md (258.1)	102 No (259.1)	103 Lr (262.1)

Symbols - IUPAC 1997. Symbols for elements above 109 are still in contention.