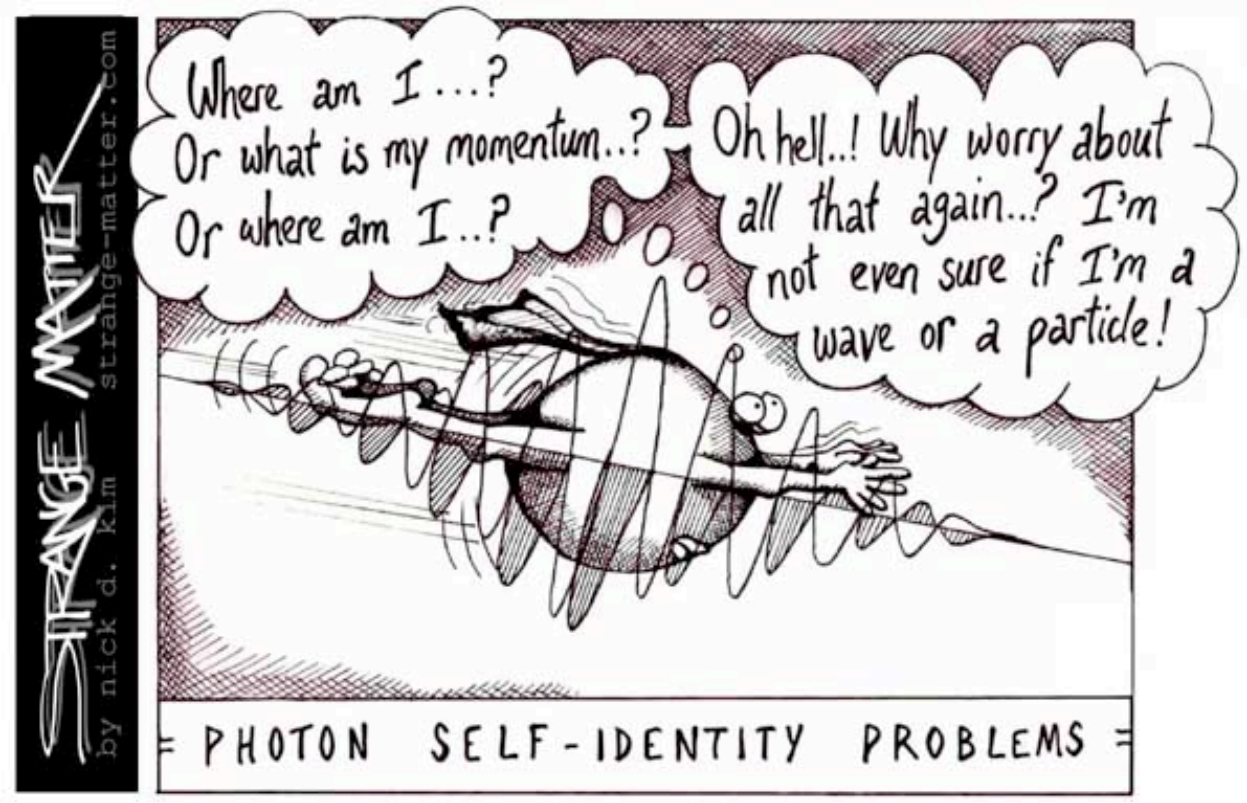
Chemistry 142
Winter 2007
Exam 1a

Name:_____

Take a deep breath, and relax! First, answer the questions you know how to do and then work on the more difficult problems. Don't forget to show all your work, so I can give you as much partial credit as possible.

Good Luck!

Andy



Q1. The light from a Neodynium YAG laser can be used to perform eye surgery. If the frequency of the light is $5.635 \times 10^{14}\ s^{-1}$, then what is its wavelength?(5 pts.)

Q2. What frequency of light is emitted by a hydrogen atom that undergoes a transition from $n = 5$ to $n = 2$? What wavelength is this? (10 pts.)

Q3. Louis de Broglie was the first person to propose (in 1924) that particles could possess wave-like properties. He was awarded the Nobel Prize for physics in 1929 for this work. His hypothesis was essentially confirmed in 1927 by two American physicists, Clinton Davisson and Lester Germer, who noticed that slow moving electrons were diffracted by a crystalline nickel surface.

If the wavelength of the electrons in their experiments was 9.2×10^{-11} m, then at what speed must the electron have been traveling? The mass of an electron is 9.109×10^{-31} kg. (8 pts.)

Louis Victor de Broglie
(1892-1987)

Q4. The following table contains the values of the four quantum number for each electron in an atom of beryllium in an **excited state**. Fill in the missing numbers in the table with acceptable possibilities. (7 pts)

	n	l	m_l	m_s
Electron 1	3		–2	
Electron 2	2	0		$+\frac{1}{2}$
Electron 3	2	0		
Electron 4		3		$-\frac{1}{2}$

Q5. Write the **full** ground state electron configuration for the following atoms/ions: (15 pts.)

a) Si

b) C^{2+}

c) Ti^{2+}

d) Cu

e) Br

Q6. Draw an **orbital diagram** for the following atoms (12 pts.)

a) S

b) V

Q7. Sketch the $3d_{xy}$ orbital. (3 pts.)

Q8. Sketch the $2p_x$ orbital. (3 pts.)

Q9. Why do member of the halogens (group VIIA) have similar chemical properties? (5 pts.)

Q10. Explain why an atom of sulfur is smaller than an atom of aluminum. (6 pts.)

Q11. A particular element has the following ionization energies:

1st IE = 801 kJ/mol, 2nd IE = 2430 kJ/mol, 3rd IE = 3660 kJ/mol, 4th IE = 25000 kJ/mol

Predict which element it is most likely to be if the choices are: Li, Be, B, C, N, O, F, or Ne. Explain your choice carefully. (8 pts.)

Q12. Write a chemical equation corresponding to the 2nd ionization energy of silicon. (4 pts.)

Q13. The current periodic table is organized by atomic number, Z. Explain what the atomic number is a measure of for an atom. (5 pts.)

Q14. Write the formula for four species that are isoelectronic with the Cl^- ion. (6 pts.)

Q15. Is a magnesium atom diamagnetic or paramagnetic. Explain clearly. (6 pts.)

Useful Information

$E = h\nu$ $\quad c = \nu\lambda$ $\quad E_n = -R_H(1/n^2)$

$c = 3.00 \times 10^8$ m/s $\quad h = 6.626 \times 10^{-34}$ J·s $\quad R_H = 2.180 \times 10^{-18}$ J

$\lambda = h/mu$

Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1																	*18*
1 H 1.01	*2*											*13*	*14*	*15*	*16*	*17*	2 He 4.00
3 Li 6.94	4 Be 9.01											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	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	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 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92160	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 [98]	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba* 137.33	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po [210]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra** [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 [269]	111 [272]	112 [277]	113	114 [285]	115	116 [289]	117	118 [293]

*	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
**	89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]