Chemistry 105-Fundamental Chemistry Name_____

Exam 3-Wednesday, 4 December 1996 Laboratory Section _____.

PLEASE ANSWER IN THE SPACE PROVIDED. SHOW ALL WORK WHEREVER POSSIBLE-ESPECIALLY STOICHIOMETRIC FACTORS AND UNIT CONVERSIONS. YOU DO NOT NEED TO SHOW MOLAR MASS CALCULATIONS. THERE WILL BE ABSOLUTELY NO TALKING DURING THIS EXAM PERIOD. IF YOU HAVE A QUESTION, RAISE YOUR HAND. IF YOU FINISH EARLY, BRING YOUR EXAM TO ME AND LEAVE QUIETLY. DURING THE LAST TEN MINUTES OF THE EXAM PERIOD, DO NOT LEAVE YOUR SEAT AND DO NOT SPEAK TO OTHERS UNTIL ALL PAPERS HAVE BEEN COLLECTED. INITIAL EACH PAGE SO THAT IF THE PAGES BECOME SEPARATED I CAN PIECE YOUR EXAM BACK TOGETHER. PLEASE USE A PEN. FILL YOUR STUDENT ID NUMBER IN THE SPACE PROVIDED. GOOD LUCK.

ID NUMBER _____.

Selected equations and constants:

$\nu = \frac{c}{\lambda}$ $E = \frac{hc}{\lambda}$ $E = h\nu$ $\Delta E_{atom} = 2.18 \times 10^{-18}\ J \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ $\lambda = \frac{h}{mv}$

Planck's constant (h) = $6.6260755 \times 10^{-34}$ J s
Speed of light in a vacuum (c) = 2.99792458×10^{8} m s^{-1}
mass of the electron = $9.1093897 \times 10^{-31}$ kg

$PV=nRT$
$M_1V_1=M_2V_2$

1J = 1 kg m^2 s^{-2}, 4 qts = 1 gal, 1.057 qts = 1L, 4.184 J = 1 cal, 2.54 cm = 1 in, 2000 lbs = 1 ton, 5280 ft = 1 mile, 453.6g = 1.00lb, 12 = dozen, 101.325 kps = 1 atm, 1.00 troy oz. = 1.10 avoirdupois [ordinary] oz., 16.0 avoirdupois oz. = 1.00 avoirdupois pound, R=0.08206L atm/K mol, 1atm=29.92 in=760torr=760mm Hg

1) (20 pts) Fill in the blank with the best answer.

The human eye is capable of detecting light that is of very low intensity. The intensity of light is directly related to the _____ of the light wave. If one were to consider light as a wave, light could further be characterized by its _____ and _____. Waves are only one way to consider light. Light may also act as a _____. Louis _____ advanced this idea by deriving an equation which allows for the calculation of a _____ for any moving object. It was _____ though, that perhaps gave us our best explanation of what light is. He postulated that light was made up of bundles of energy called _____. This postulation was made in the context of the _____ effect, the effect whereby electrons are ejected from a metal target upon bombardment by sufficient light energy. This experiment and the resultant theories give us our present day understanding of the nature of light.

A direct result of the study of light has been an increased understanding of the nature and the structure of the _____. Atomic absorption spectra and atomic _____ spectra are evidence that atoms absorb and emit light at particular frequencies. This in turn led to the idea of _____ energy levels within the atom. Thus, Bohr postulated that the orbit of the _____ did not decay and eventually collide with the nucleus of the atom. Furthermore, our theory of discrete energy levels in both atoms and light led _____ to propose the now famous equation $H\Psi = E\Psi$. This equation then provides us with our modern understanding of the structure of the atom through careful study of the solutions. The solutions are in the form of four numbers. The first, or _____ quantum number (n) can have integral values from one to infinity. The azimuthal quantum number (ℓ) takes on values of _____ to zero. The magnetic quantum number (m_l) can have values from _____ to zero to _____. And finally the _____ quantum number (m_s) can be $\pm 1/2$.

2) (3pts) Suppose that green light with a wavelength of 512 nm and an energy of 1.415×10^3 kJ/mol struck your eye. How many photons were striking your eye?

3) (3pts) An electron is accelerated to the speed of light in a particle accelerator. What would the wavelength of the particle be in nanometers?

4) (3pts) Determine the wavelength emitted when an electron in a hydrogen atom undergoes a transition from the sixth energy level to the fourth.

5) (3pts) Calculate the frequency for a photon with an energy of 3.15×10^{-15}J.

6) (8pts) Below are shown eight sets of quantum numbers. Place an "x" in the blank next to each set which is not valid.

5	3	-2	-1	_____
5	3	-3	1/2	_____
3	3	-3	1/2	_____
3	0	0	-1/2	_____
3	-1	-1	1/2	_____
3	1	-1	-1/2	_____
3	1	1	1/2	_____
3	2	2	3/2	_____

7) (8pts) Give the complete electron configuration for the following atoms or ions:

C (12)

S (16)

Sr (38)

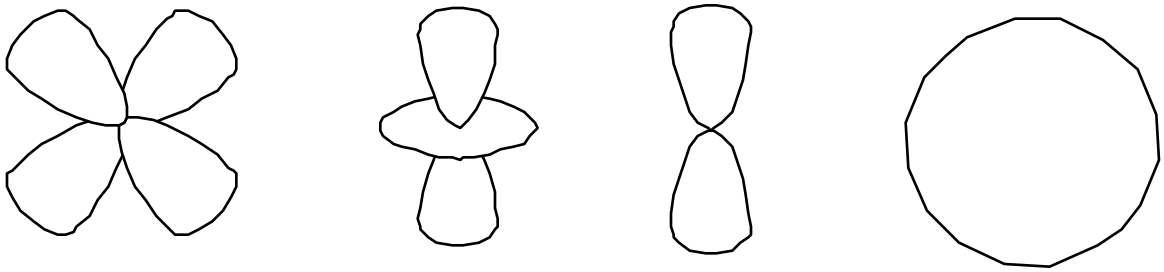
Ca^{2+} (18)

8) a) (2 pts)Give the electron configuration for the chlorine atom.

b) (4 pts) Draw an electron energy level diagram for the chlorine atom.

c) (1 pt) Give a valid set of quantum numbers for the twelfth electron placed into the diagram above.

9) (4 pts) The four diagrams below are examples of 90% probability contour plots. Indicate the orbital type for each by placing its letter designation on the orbital.



10) (6 pts) Circle the atoms which are paramagnetic: Al K Sn Ne

Briefly explain why the ones you circled are paramagnetic.

11) (9 pts) In each set of two atoms, circle the atom which has the greatest:

Ionization energy:	Li or O	C or I	Ca or Ba
Electron affinity	S or Ra	Na or Cl	N or Sb
Radius	C or Xe	He or Kr	Na or Ba

12) (2 pts) Now that you are all certified "Master Quantum Mechanics"...As completely as possible in the space provided, give a physical description of the carbon atom for which the symbol is ${}^{12}_{6}\mathrm{C}$.

13) (24 pts) Draw a Lewis structure in the space provided for each of the chemical species listed. Beside each structure give the name of the shape which the compound would adopt.

Formula	Lewis Structure	Shape
SO_2		
NH_4^+		
$CaSO_4$		
O_3		
NO_3^-		
IO_3^-		