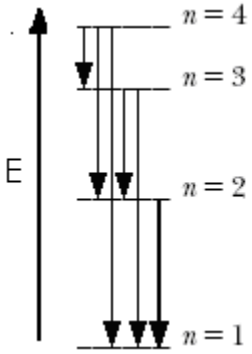
Chem 111 – Spring 2017 Name: _____
Exam #3A

1. Consider light of 330 nm and of 650 nm.

| | | | |
|---|---|---|---|
| Which has higher frequency? | 330 nm | or | 650 nm |
| Which has greater photon energy? | 330 nm | or | 650 nm |
| Which is in the visible spectrum? | 330 nm | or | 650 nm |

2.
Consider the energy level diagram of transitions inside a hydrogen atom and answer the following questions.




a. Are these transitions absorptions or emissions? _____

b. Which transition involves light of the longest wavelength?

from n = _____ to n = _____

c. Which transition involves light of the greatest frequency?

from n = _____ to n = _____

3. Which of the following subshells can exist? Circle all that apply:

1s, 1p, 2p, 2d, 5d, 3f, 9s

4. Why is a sodium atom larger than a lithium atom?

a) Na has a heavier nucleus

b) Li has fewer protons in its nucleus than Na

c) the Na 3s orbital is larger than the Li 2s orbital

d) Na has more electrons than Li

5. Why is a lithium atom larger than a fluorine atom?

a) F has a heavier nucleus

b) Li has fewer protons in its nucleus than F

c) the F electrons repel each other more than those in Li

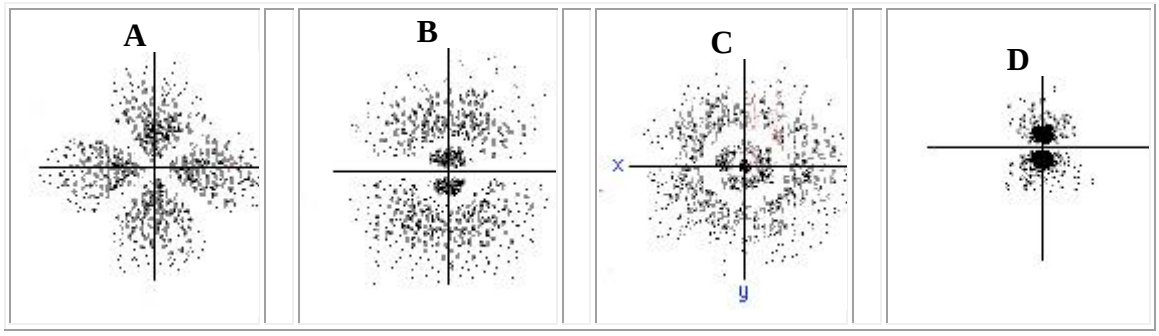
d) F has more electrons than Li

6.
Fill in the following chart regarding orbitals.

| Subshell | number of orbitals in subshell | number of electrons that subshell can hold |
|---|---|---|
| s | _____ | _____ |
| p | _____ | _____ |
| d | _____ | _____ |
| f | _____ | _____ |

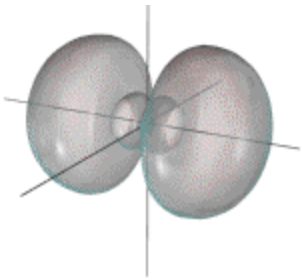
7. Match these subshells with the orbital images below. Not all subshells are used:

1s, 2s, 3s, 2p, 3p, 4p, 3d, 4d

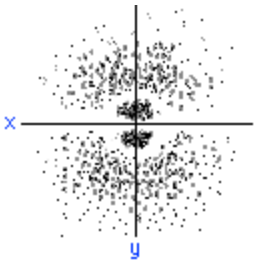



_____ _____ _____ _____

8.
For the following two orbitals, indicate the number of planar nodes and spherical nodes present.

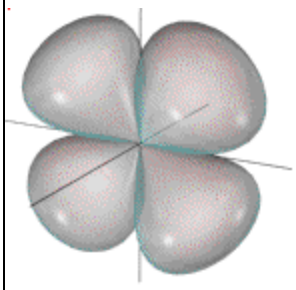


Boundary Surface

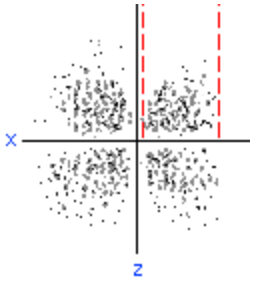



Dot Picture

Planar: _____ Spherical: _____



Boundary Surface




Dot Picture

Planar: _____ Spherical: _____

9. Give the electron configurations in spdf notation ($1s^2$, $2s^2$ …):

a. O:

b. Mg:

c: Fe:

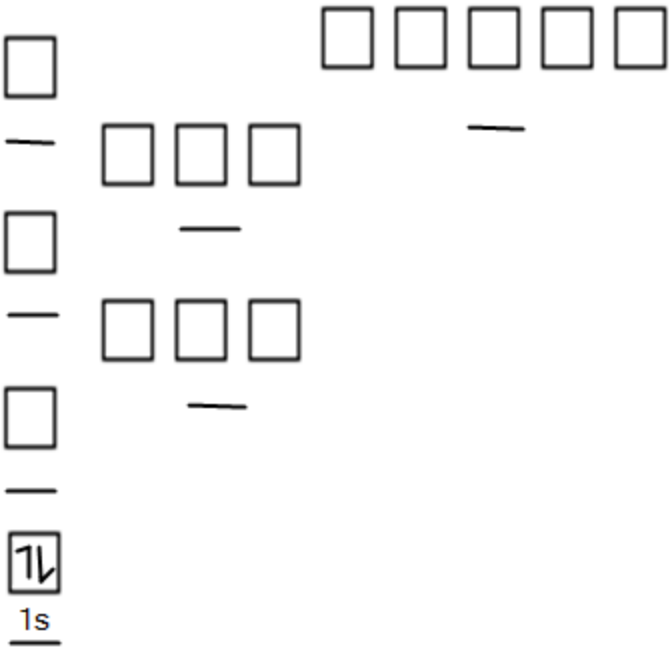
10.
In any format you prefer, indicate the electron configurations of the following *ions*:

a. the ion formed by K:

b. the ion formed by F:

c. the $Co^{3+}$ ion:

11. Fill in the following charts to show the electron configuration of S. You need to fill in electron arrows and fill in the blanks below the boxes with what is appropriate to go there. The 1s subshell is indicated as an example.




12.
For each pair, indicate which is higher in energy:

a. the 2p orbitals of B or the 2p orbitals of O

b. the 3s orbital of Na or the 2s orbital of Li

13.
For each pair, indicate which is larger:

a. ionization energy of Li or ionization energy of Na

b. ionization energy of B or ionization energy of N

c. radius of C or radius of F

d. radius of $Mg^{2+}$ or radius of $O^{2-}$

e. the energy to remove a second electron from $Na^{+}$ or the energy to remove a second electron from $Mg^{+}$

14.
What is the driving force causing the formation of a covalent bond between two atoms?

a) the desire to form an octet

b) attraction of electrons from one atom to electrons of the other atom

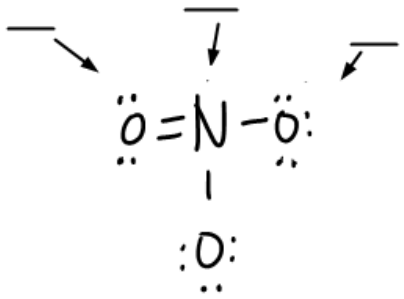
c) attraction of electrons from one atom to the nucleus of the other atom

d) gravitational attraction between the two nuclei

15. Draw the resonance structures for $SO_2$.

What is the average sulfur – oxygen bond order? _____

16. Calculate the formal charge for N and the oxygen atoms on the left and right:



17.
Draw Lewis Dot structures for the following:

| | |
|---|---|
| $CS_2$ | $PF_3$ |
| $IF_3$ | $BCl_3$ |

18.
a) Circle any bonds that are polar: H – F F – F H – O

b) Which bond is longer: H – C or H – Si

c) Which bond is longer: C – C or C ≡ C

d) Which bond has
greater bond energy: C – C or C ≡ C

19. Consider ultraviolet light of 232 nm wavelength.

a. What is the frequency of this light?

_____ Hz

b. What is the energy of a single photon of this light?

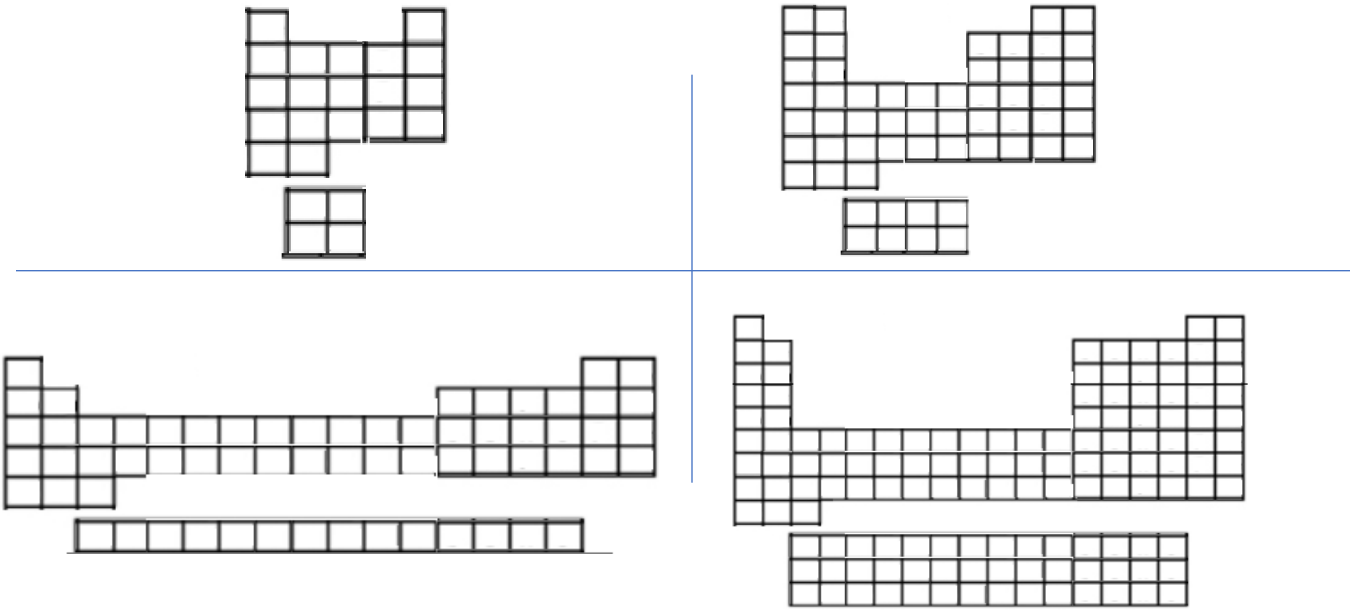
_____ J

c. Does this light have enough energy to break a P-O bond (which is a crucial bond in the linkage of DNA chains)? A P-O bond has an energy of 335 kJ/mol.

Show work

yes or no

20.
Question 5 asked about how many orbitals existed in different subshells. Imagine if, instead of what actually occurs, every subshell has two orbitals. That is regardless of the type of subshell (s, p, d, f, etc.) that subshell would have two orbitals. What would the periodic table look like if this were true? Circle the best option below.

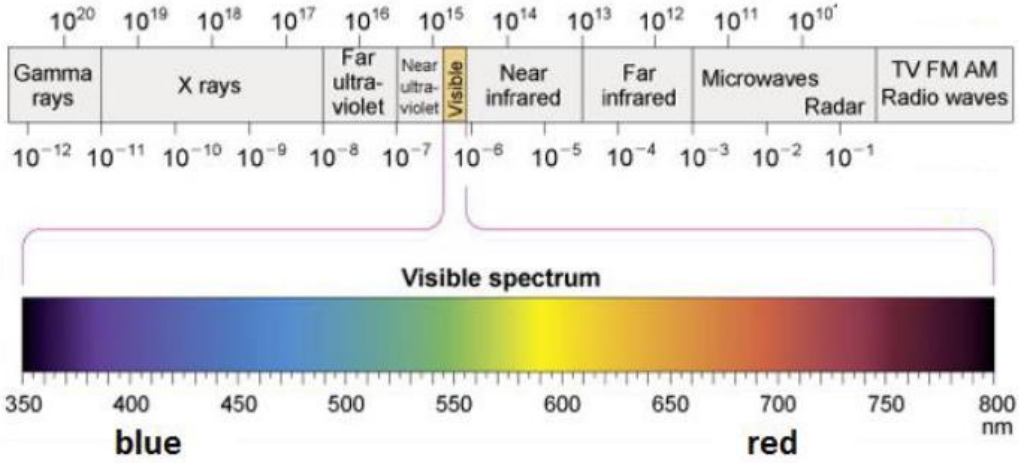


Some Equations and Constants for your use:

$$\lambda \times \nu = c \qquad E = h\nu \qquad E_n = \frac{-2.18 \times 10^{-18}\ J}{n^2}$$

Avog # = $6.022 \times 10^{23}$

$c = 3.00 \times 10^{8}$ m/s  $h = 6.626 \times 10^{-34}$ J • s




# PERIODIC TABLE OF THE ELEMENTS

| 1 1A | | | | | | | | | | | | 13 3A | 14 4A | 15 5A | 16 6A | 17 7A | 18 8A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 H 1.008 | 2 2A | | | | | | | | | | | | | | | | 2 He 4.003 |
| 3 Li 6.941 | 4 Be 9.012 | | | | | | | | | | | 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 3B | 4 4B | 5 5B | 6 6B | 7 7B | 8 8B | 9 8B | 10 8B | 11 1B | 12 2B | 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 47.88 | 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 65.39 | 31 Ga 69.72 | 32 Ge 72.61 | 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 (98) | 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 La 138.9 | 72 Hf 178.5 | 73 Ta 180.9 | 74 W 183.8 | 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) | 89 Ac (227) | 104 Rf (261) | 105 Db (262) | 106 Sg (263) | 107 Bh (262) | 108 Hs (265) | 109 Mt (266) | 110 Ds (269) | 111 Rg (272) | 112 Uub (277) | | 114 Uuq (???) | | 116 Uuh (???) | | 118 Uuo (???) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 Ce 140.1 | 59 Pr 140.9 | 60 Nd 144.2 | 61 Pm (145) | 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 |
| 90 Th 232.0 | 91 Pa 231.0 | 92 U 238.0 | 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) | 103 Lr (262) |