

1. (26 pts) Fill in the following table:

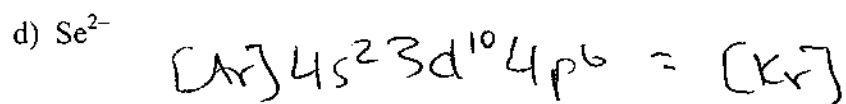
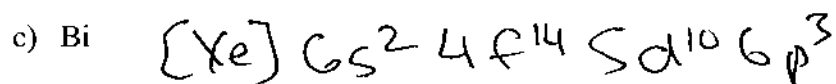
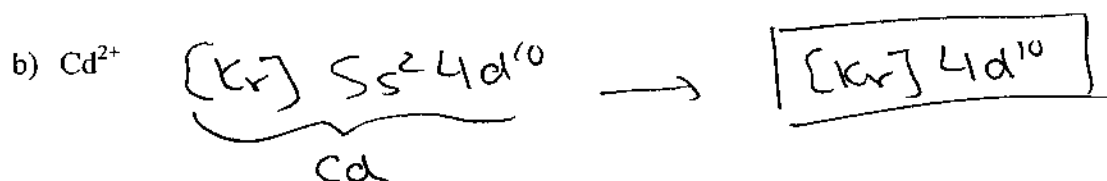
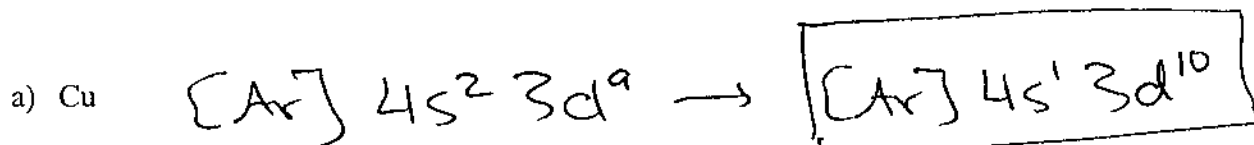
Bond Pairs	Lone Pairs	Total e <sup>-</sup> pairs	Name of Molecular Shape	Polar? (Yes or No) [Assume AX <sub>n</sub> , where n = number of bond pairs, A and X are atoms with differing electronegativities]
2	0	2	Linear	No
3	0	3	Trigonal Planar	No
2	1	3	Bent	Yes
4	0	4	Tetrahedral	No
3	1	4	Trigonal Pyramidal	Yes
2	2	4	Bent	Yes
5	0	5	Trigonal Bipyramidal	No
4	1	5	See Saw	Yes
3	2	5	T-shaped	Yes
2	3	5	Linear	No
6	0	6	Octahedral	No
5	1	6	Square Pyramidal	Yes
4	2	6	Square Planar	No

2. (8 pts) The human eye is a complex sensing device for visible light. The optic nerve needs a minimum of  $2.0 \times 10^{-17}$  J of energy to trigger a series of impulses that eventually reaches the brain. How many photons of blue light at 475 nm are needed?

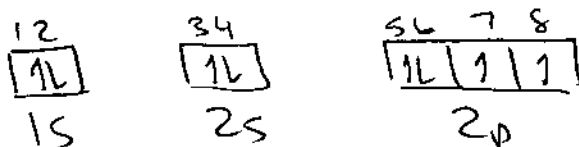
$$\begin{aligned}
 E_{\text{photon}} &= h\nu = h \frac{c}{\lambda} \\
 &= \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(3.00 \times 10^8 \text{ m/s})}{475 \times 10^{-9} \text{ m}} \\
 &= 4.18 \times 10^{-19} \text{ J/photon}
 \end{aligned}$$

$$(2.0 \times 10^{-17} \text{ J}) \left( \frac{1 \text{ photon}}{4.18 \times 10^{-19} \text{ J}} \right) = \boxed{48 \text{ photons}}$$

3. (16 pts) Use noble gas cores to give the electron configuration for each of the following:



4. (16 pts) Use orbital box notation to give the complete electron configuration for an atom of oxygen.



Label the electrons 1-8 in the orbital box diagram above, then fill in the table below with acceptable values for each quantum number:

electron #	n	l	$m_l$	$m_s$
1	1	0	0	+1/2
2	1	0	0	-1/2
3	2	0	0	+1/2
4	2	0	0	-1/2
5	2	1	-1	+1/2
6	2	1	-1	-1/2
7	2	1	0	+1/2
8	2	1	+1	+1/2

5. (14 pts) Answer true (T) or false (F) to each of the following:

F

The Schroedinger equation treats the electron as both a particle and a wave.

T

The Schroedinger equation can only be solved for 1-electron species.

T

The de Broglie wavelength of a particle increases as the mass of the particle decreases.

F

A neon gas light is a good example of black body radiation.

T

The visible portion of the electromagnetic spectrum is generally considered to be 400-700 nm.

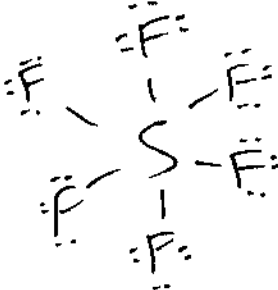
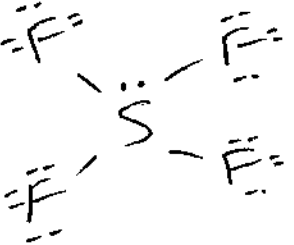

T

The Heisenberg Uncertainty Principle states that is impossible to simultaneously know both the position and the energy of an electron in an atom.

F

The photoelectric effect occurs when light strikes the surface of a metal and neutrons are ejected.

6. (24 pts) Fill in the following table

Compound	Lewis Structure	Name of Molecular Shape	Polar?
$SF_6$ $6 + 6(7)$ $= 48$		octahedral	No
$SF_4$ $6 + 4(7)$ $= 34$		see-saw	yes
$SF_2$		bent	yes



9. (10 pts) How many orbitals in an atom can have each of the following designations:

a) 5f      7

b) 2d      0

c)  $n = 2, m_l = 1$       1

d) 4p      3

e)  $n = 5$       25

10. (15 pts) Fill in each of the following blanks with either exothermic or endothermic. Be sure to indicate the phase (s, l, g) of each reactant and product when writing the subsequent balanced equations.

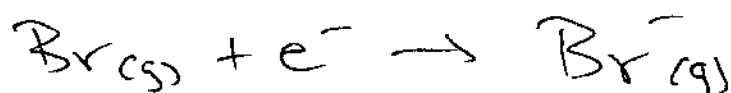
a) First ionization energies are always endothermic.

Write the balanced reaction for which  $\Delta H$  (or  $\Delta E$ ) is the first ionization energy for potassium:



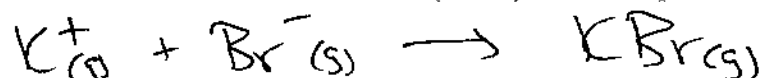
b) Electron affinities are always exothermic.

Write the balanced reaction for which  $\Delta H$  (or  $\Delta E$ ) is the ion pair energy for bromine:



c) Ion pair energies are always exothermic.

Write the balanced reaction for which  $\Delta H$  (or  $\Delta E$ ) is the ion pair energy for KBr:



**Remember to consider the pledge!!**