CHM 1045 Final Exam Review Sheet

The density of aluminum is 2.70×10^3 kg/m^3. Convert to g/cm^3 using sig figs: 2.70
Add 5.40 g of aluminum to 5.00 ml water and determine sample/total volume.
Review Examples 1.05, 1.06, and 1.07. $2.00 + 5.00 = 7.00$ cm^3

$(2.70 \times 10^3 \text{ kg/m}^3) \times (10^3 \text{ g/kg}) \times (10^{-2} \text{ m/cm})^3 =$
$(2.70 \times 10^3 \text{ kg/m}^3) \times (10^3 \text{ g/kg}) \times (10^{-6} \text{ m/cm}) = 2.70 \text{ g/cm}^3$

$(5.40 \text{ g of Al}) \div (2.70 \text{ g/cm}^3) = 2.00 \text{ cm}^3 \text{ of Al}$
$V_{total} = V_{Al} + V_{water} = 2.00 \text{ cm}^3 + 5.00 \text{ cm}^3 = 7.00 \text{ cm}^3$

A 24.31 g sample of Mg reacts completely with O_2 gas to form MgO.
Balance the reaction. Then, determine the moles and grams of gas that are consumed.
Review Examples 2.12, 3.13, and 3.15.

$Mg_{(s)} + (1/2)O_{2(g)} \rightarrow MgO_{(s)}$

$(24.31 \text{ g}) \div (24.3 \text{ g/mol}) = 1.00 \text{ mole Mg}$
$(1.00 \text{ mole Mg}) \times \left(\frac{0.5 \text{ mole O2}}{1 \text{ mol Mg}}\right) = 0.500 \text{ moles } O_2$
$(0.500 \text{ mole } O_2) \times (32.00 \text{ g/mol}) = 16.0 \text{ g } O_2$

Using Solubility Rules, write balanced molecular, complete ionic, and net ionic equations with phase subscripts for the aqueous reaction between lead (II) nitrate and sodium bromide. Review Example 4.01 and 4.02.

$Pb(NO_3)_{2(aq)} + 2NaBr_{(aq)} \rightarrow PbBr_{2(s)} + 2NaNO_{3(aq)}$
$Pb^{+2}_{(aq)} + 2NO_3{}^{-1}_{(aq)} + 2Na^{+1}_{(aq)} + 2Br^{-1}_{(aq)} \rightarrow PbBr_{2(s)} + 2Na^{+1}_{(aq)} + 2NO_3{}^{-1}_{(aq)}$
$Pb^{+2}_{(aq)} + 2Br^{-1}_{(aq)} \rightarrow PbBr_{2(s)}$

A reaction between acid and carbonate creates 0.00325 moles of gas at 742 mmHg and 22 ^oC. Determine the volume from the ideal gas law. (R = 0.08206 liter-atm/mole-K)
Review Examples 5.05 and 5.06. 0.0806 L

$CO_3{}^{-2}_{(aq)} + 2H^{+1}_{(aq)} \rightarrow CO_{2(g)} + H_2O_{(L)}$
PV = nRT and V=nRT/P
P = (742 mmHg) ÷ (760 mmHg/atm) = 0.976 atm
T = 22 + 273 = 295 K

$$V = \frac{(0.00325 \text{ mol})\left(0.08206 \frac{\text{liter-atm}}{\text{mole-K}}\right)(295 \text{ K})}{(0.976 \text{ atm})} = 0.0806 \text{ L} \times (10^3 \text{ mL/L}) = 80.6 \text{ mL}$$

A reaction, which absorbs 1.50 kJ/mole, creates 2.00 moles within
a calorimeter containing 1000.0 g of water initially at 50.00 ^oC.
Determine the final temperature. 49.28 ^oC
Review Examples 6.04 and 6.05.

$q_{rxn} = (\Delta H)(n) = (+1.50 \text{ kJ/mole}) \times (2.00 \text{ moles}) = +3.00 \text{ kJ}$ (positive b/c endothermic)
$q_{water} = -\,q_{rxn} = -\,3.00 \text{ kJ} \times (1000 \text{ J/kJ}) = -\,3.00 \times 10^3 \text{ J}$ (negative b/c water gives up heat)
$q = sm\Delta T$
$\Delta T = q/sm = \frac{-3.00\times 10^3 \text{ J}}{\left(4.184 \frac{\text{J}}{\text{g C}}\right)(1000.0 \text{ g})} = -\,0.717\ ^oC$ (negative b/c water gives up heat)
$\Delta T = T_f - T_i$
$T_f = T_i + \Delta T = 50.00\ ^oC + (-\,0.717\ ^oC) = 49.28\ ^oC$

$E = hc/\lambda = h\nu$ $h = 6.63 \times 10^{-34}$ J·s $c = \nu\lambda$
If λ = 200 nm, then find E and ν. 9.95×10^{-19} J and $1.50 \times 10^{15}\ s^{-1}$
Review Examples 7.02 and 7.03.

200 nm < 360 nm The photon is ultraviolet and is not visible (no color).
$\lambda = (200 \text{ nm}) \times (10^{-9} \text{ m/nm}) = 2.00 \times 10^{-7}$ m
$\nu = c/\lambda = (3.00 \times 10^8 \text{ m/s}) \div (2.00 \times 10^{-7} \text{ m}) = 1.50 \times 10^{15}\ s^{-1}$
$E = hc/\lambda = h\nu = (6.63 \times 10^{-34} \text{ J·s}) \times (1.50 \times 10^{15}\ s^{-1}) = 9.95 \times 10^{-19}$ J

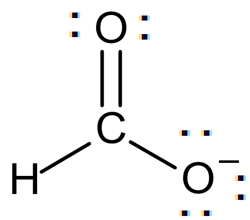
What is Hund's rule? How do three electrons fit in a p subshell?
Review Example 8.04.

Electrons do not spin-pair in an orbital unless they have to.
They prefer to be one e- per orbital wherever possible.
So, one e- will be in each of the three p orbitals of that subshell.
And, the three e-'s will all have the same spin (same ms value).

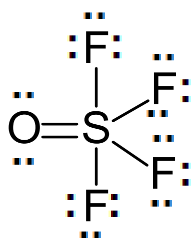
What is the Pauli exclusion principle? Which quantum numbers
are the same and which are not the same for electrons in an orbital?
Review Example 8.01.

No two e-'s can have all four quantum numbers in common.
So, the maximum is three quantum numbers in common.
If two e-'s are in the same orbital, they are also in the same subshell and same shell.
So, they have n (shell), L (subshell), and mL (orbital) in common,
and only the ms values will be different (+1/2 and −1/2).

Write the Lewis structure for formate anion ($HCOO^{-1}$). Determine the number of bonding and nonbonding e^{-1} pairs around C and write the AXE formula.
Determine molecular geometry, bond angles, and hybridization.
Review Example 9.07 and the Molecular Geometry Tables.
Do the same for OSF_4 trigonal bipyramidal with O equatorial
Review Figures 7.16 and 7.19.



Total # of valence e-'s = 1 + 4 + 6*2 + 1 = 18 (negative charge adds one more e-)
C is AX_3E_0 , which is trigonal planar with ~120^o bond angles.
X + E = 3 + 0 = 3 = s + p + d
Because s is always 1, we have p = 2 and d = 0,
so the hybridization is s^1p^2 (or sp^2)
Row 2 elements do not have a d subshell, and
cannot go beyond an octet in their valence shell.



Total # of valence e-'s = 4*7 + 6 + 6 = 40 (which is five octets)
S is AX_5E_0 , which is trigonal bipyramidal with both 90^o and 120^o bond angles.
X + E = 5 + 0 = 5 = s + p + d
Because s is always 1, and the maximum for p is 3, we must have d = 1,
so the hybridization is $s^1p^3d^1$ (or sp^3d).
That means that S is using one of the d orbitals to hold two more e-'s
than an octet (8), so it has 10 e-'s in its hybridized subshell.
Along with the 2 unhybridized (d) e-'s in its Π bond,
S has a total of 12 e-'s in its valence shell.
Row 3 elements (S and P) have the 3d subshell available,
and can go beyond an octet.