Review Problems for 2nd Semester Physical Science Honors

Name KEY

1. Calculate the energy in eV of an electron in the n = 5 state for a hydrogen atom.

$E_5 = -\frac{13.6\,eV}{5^2}$

$E_5 = -0.544\,eV$

2. Calculate the energy in eV of an electron in the n = 2 state for a hydrogen atom.

$E_2 = -\frac{13.6\,eV}{2^2}$

$E_2 = -3.4\,eV$

3. Calculate the energy in eV of a photon that would be emitted as an electron falls from the n = 5 to the n = 2 state.

$E_{photon} = E_H - E_L$

$-0.544 - (-3.4)$

$E_{photon} = 2.856\,eV$

4. Calculate the energy in Joules of a photon that would be emitted as an electron falls from the n = 5 to the n = 2 state.

$\frac{2.856\,eV \mid 1.6\times10^{-19}\,J}{1\,eV}$

$E = 4.57\times10^{-19}\,J$

5. Determine the frequency of the photon from #4.

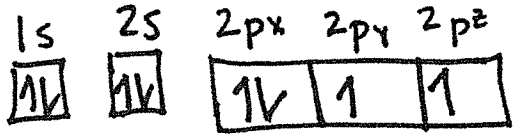
$F = \frac{E}{h}$ $\quad \frac{4.57\times10^{-19}\,J}{6.63\times10^{-34}\,J\cdot s}$

$f = 6.89\times10^{14}\,Hz$

6. Write the electron configuration for iron. 26 e⁻

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

7. Write the orbital box electron diagram for oxygen. 8e⁻



8. Calculate the average atomic mass of silicon given the following abundances.

Isotope	Mass in u	Percent Abundance
^{35}Cl	34.968852	75.78%
^{37}Cl	36.965902	24.22%

.7578 · 34.968852 = 26.[illegible]499

.2422 · 36.965902 = 8.531

35.03 u

9. A radioactive sample decays to 5 grams after 4 half lives. What was the mass of the original sample?

5 → 10 → 20 → 40 → 80

80 g

10. How much of a 185 gram sample remains after 42 hours if the half-life is 8.4 hours?

$\frac{42}{8.4}$ = 5 hL $\quad \frac{185}{2^5}$ = 5.78125 g

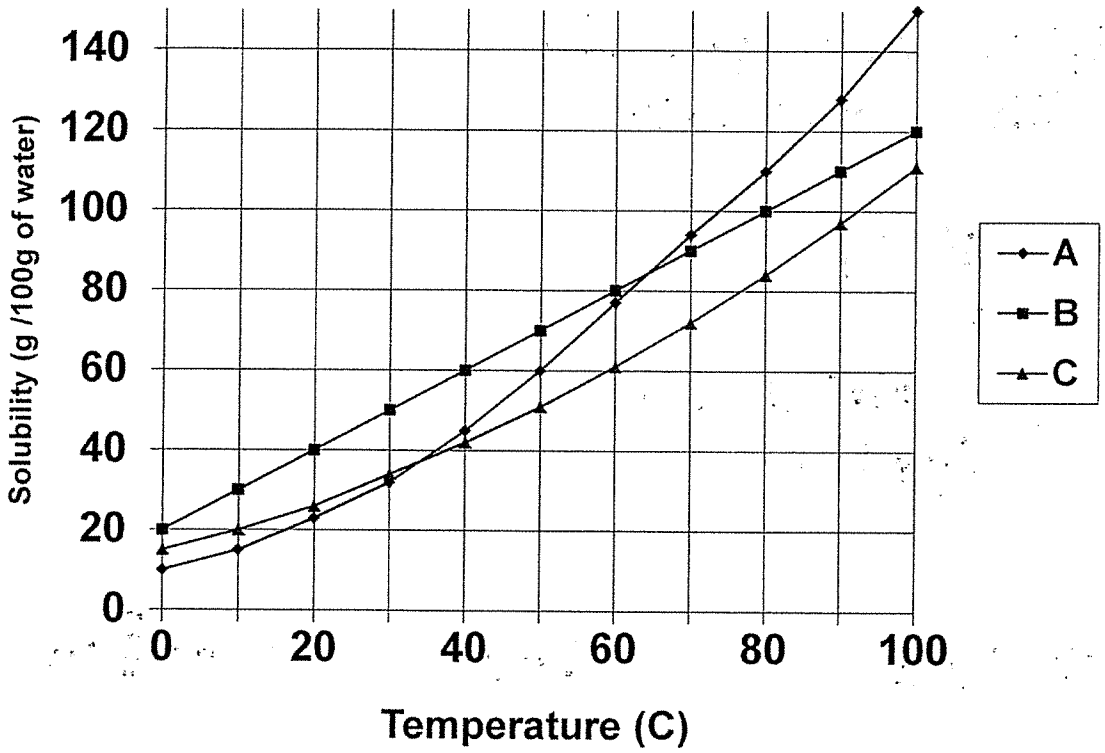
11. A 100 gram sample of a radioactive element has a half-life of 50 hours. How long will it take for this sample to decay to 6.25 grams?

100 → 50 → 25 → 12.5 → 6.25 : 4 hL

50 · 4 = 200 hrs

12. Answer the following questions from the solubility graph shown below.

Solubility Graph



a. Which substance has the highest solubility at 90 °C? A

b. How many grams of solute C are needed to make a saturated solution of 200 grams of water at 80 °C?

$\frac{85\text{ g solute}}{100\text{ g } H_2O} = \frac{?}{200\text{ g}}$

170 g solute C

c. A saturated solution of B is made with 300 grams of water at 40 °C. The solution is cooled to 10 °C. How much of the solute crystallizes at the lower temperature?

40° C = 180 g
10° C = 90 g

180 - 90

90 g solute B

d. A saturated solution of A is made using 1250 grams of water at 50 °C. The solution is then heated to 100 °C. How many grams of A must be added to the solution to keep it saturated?

$\frac{60\text{ g A}}{100\text{ g } H_2O} = \frac{?\text{ g A}}{1250\text{ g}}$

$\frac{150\text{ g A}}{100\text{ g } H_2O} = \frac{?\text{ g A}}{1250\text{ g}}$

750 g @ 50° C

1875 g @ 100° C

1875 - 750 =

1125 g solute A

13. Write the names of the following compounds in the space provided.

I a. Na_3PO_3 sodium phosphite

I b. $Mg(ClO_2)_2$ magnesium chlorite

C c. P_2O_5 diphosphorus pentoxide

I d. Ag_2CO_3 silver carbonate

14. Write the formulas for the following compounds.

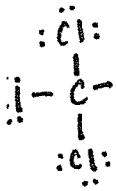
I a. Iron (II) sulfite $FeSO_3$

I b. Lead (II) oxide PbO

C c. Trinitrogen heptoxide N_3O_7

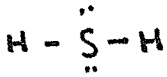
I d. Silver phosphite Ag_3PO_3

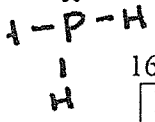
15. Determine the shape of the following molecules.



a. CCl_4 tetrahedral

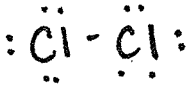
c. H_2S bent



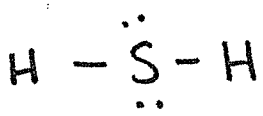
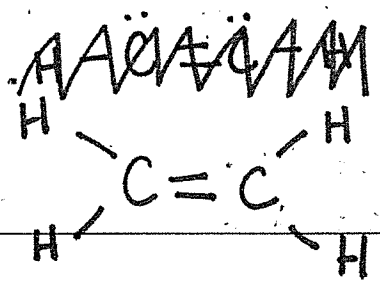


b. PH_3 pyramidal

d. Cl_2 linear



16. Draw the correct Lewis dot structure for:

H_2S	C_2H_4
2 + 6 = 8 e⁻ 	8 + 4 = 12 

17. Calculate the formula mass for Carbon Tetrachloride. CCl_4

C 1 · 12.011 = 12.011

Cl 4 · 35.453 = 141.812

153.823 amu

18. What is the percent by mass of sulfur in potassium sulfate? K_2SO_4

K 2 · 39.098 = 78.196/174.257 = 44.9%

S 1 · 32.065 = 32.065/174.257 = 18.4%

O 4 · 15.999 = 63.996/174.257 = 36.7%

%S = 18.4%

19. A 2.5 gram sample of magnesium reacts with excess oxygen gas to form solid magnesium oxide.

a. Which reactant is the limiting reactant? magnesium

b. What type of reaction is this? synthesis

c. Write a balanced equation for this reaction, including all appropriate state symbols.

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

d. Calculate the amount of magnesium oxide produced by this reaction.

$$\frac{2.5\text{g Mg}}{1} \left| \frac{1\text{ mol Mg}}{24.305\text{g Mg}} \right. = \frac{.103\text{ mol Mg}}{1} \left| \frac{2\text{ mol MgO}}{2\text{ mol Mg}} \right. = .103\text{ mol MgO}$$

$$\frac{.103\text{ mol MgO}}{1} \left| \frac{40.304\text{ g MgO}}{1\text{ mol}} \right. = 4.15\text{ g MgO}$$

*pretend the reaction happens - ignore activity series

20. A 3.20 gram sample of zinc is placed into a beaker containing 7.50 gram of aluminum nitrate in an aqueous solution.

a. Write a balanced equation for this reaction, including the state symbols.

$3Zn_{(s)} + 2Al(NO_3)_{3(aq)} \rightarrow 3Zn(NO_3)_{2(aq)} + 2Al_{(s)}$

b. What is the formula mass of aluminum nitrate? 212.994 g/mol

Al - 1 · 26.982 = 26.982
N - 3 · 14.007 = 42.021
O - 9 · 15.999 = 143.991

c. What is the limiting reactant? zinc

$3.20\text{ g Zn} \left|\frac{1\text{ mol Zn}}{65.39\text{ g Zn}}\right. \quad .049\text{ mol Zn} \left|\frac{2\text{ mol Al}}{3\text{ mol Zn}}\right. = .033\text{ mol Al}$

$7.50\text{ g Al(NO}_3)_3 \left|\frac{1\text{ mol}}{212.994}\right. \quad .035\text{ mol Al(NO}_3)_3 \left|\frac{2\text{ mol Al}}{2\text{ mol Al(NO}_3)_3}\right. = .035\text{ mol Al}$

d. How much of the excess reactant remains? .47 g $Al(NO_3)_3$

$.049\text{ mol Zn} \left|\frac{2\text{ mol Al(NO}_3)_3}{3\text{ mol Zn}}\right. \quad .033\text{ mol Al(NO}_3)_3 \left|\frac{212.994}{1\text{ mol}}\right. = 7.03\text{ g used}$

7.50 - 7.03 = .47 g $Al(NO_3)_3$ left

e. Calculate the amount of each product that is produced.

$.033\text{ mol Al} \left|\frac{26.982}{1\text{ mol}}\right. = .890\text{ g Al produced}$

$.049\text{ mol Zn} \left|\frac{3\text{ mol Zn(NO}_3)_2}{3\text{ mol Zn}}\right. = .049\text{ mol Zn(NO}_3)_2$

$.049\text{ mol Zn(NO}_3)_2 \left|\frac{189.398\text{ g}}{1\text{ mol Zn(NO}_3)_2}\right. = 9.28\text{ g Zn(NO}_3)_2\text{ produced}$