CHM151 Name:_____KEY_____

Sample Exam 2 – Chapters 4, 5, 7

Show ALL work for FULL credit!!

1. How many valence electrons are there in the molecule disilicon hexahydride, Si_2H_6?
   a. 8 b. 14 c. 18 d. 20

2. What is the correct electron domain geometry for nitrite ion, NO_2^-?
   a. linear b. bent c. tetrahedral d. trigonal planar

3. What is the correct molecular shape for ClF_3?
   a. tetrahedral b. trigonal bipyramidal c. T-shaped d. square pyramidal

4. What is the correct bond angle for a molecule that is tetrahedral in electron domain geometry and bent in molecular shape?
   a. <180° b. <90° c. <120° d. <109.5°

5. A triple bond consists of the following:
   a. 3 σ bonds b. 2 σ and 1 π bonds c. 1 σ and 1 π bond d. 1 σ and 2 π bonds

6. Predict the molecular shape for the molecule SF_4.
   a. square pyramidal b. trigonal planar c. see-saw d. tetrahedral

7. What is the overall polarity for nitrite ion, NO_2^- ?
   a. polar b. nonpolar

8. How many resonance structures are possible for nitrite ion, NO_2^- ?
   a. 1 b. 2 c. 3 d. 4

9. What is the hybridization for the central atom in the molecule ClF_3?
   a. sp^2 b. sp^3 c. sp^3d d. sp^3d^2

10. What is the molecular geometry (shape) for a molecule that has two lone pairs and four bonded atoms around the central atom?
    a. bent b. trigonal bipyramidal c. square planar d. see-saw

11. What is the formal charge on the carbon atom in cyanide ion, CN^{-1}?
    a. 0 b. +1 c. -1 d. -2

12. What is the correct Roman Numeral used for tin in $Sn(SO_4)_2$?
    a. I b. II c. III d. IV

13. What does the Greek prefix hepta- represent?
    a. 4 b. 5 c. 6 d. 7

14. If 0.25 moles of H_2 reacts with excess N_2, how many moles of NH_3 are produced in the combination reaction $3\ H_{2(g)} + N_{2(g)} \rightarrow 2\ NH_{3(g)}$?
    a. 0.25 mol b. 0.50 mol c. 0.38 mol d. 0.17 mol

15. What is the **precipitate** in the following reaction: $KCl_{(aq)} + Pb(NO_3)_{2\,(aq)} \rightarrow$

a. KCl b. KNO_3 c. PbK d. $PbCl_2$

16. What is the oxidizing agent in the reaction $N_{2(g)} + 3\ H_{2(g)} \rightarrow 2\ NH_{3(g)}$

a. H in $NH_{3\,(g)}$ b. N in $NH_{3\,(g)}$ c. $H_{2\,(g)}$ d. $N_{2\,(g)}$

17. What products are produced when $LiHCO_3$ (s) undergoes decomposition?

a. $Li_2O_{\,(s)}$ and $CO_{2\,(g)}$
b. $LiOH_{\,(s)}$ and $CO_{2\,(g)}$
c. $LiH_{\,(aq)}$ and $CO_{2\,(g)}$
d. $Li_2CO_{3\,(s)}$, $CO_{2\,(g)}$, and $H_2O_{\,(g)}$

18. Classify the following reaction: $CaO_{(s)} + CO_{2(g)} \rightarrow CaCO_{3(s)}$

a. combination b. combustion c. neutralization d. decomposition

19. What is the oxidation number for sulfur in the compound K_2SO_4?

a. +3 b. +6 c. +7 d. +4

20. Which one of the following metals will react with $Sn(NO_3)_{2(aq)}$?

a. $Cu_{(s)}$ b. $Ni_{(s)}$ c. $Sn_{(s)}$ d. $Pb_{(s)}$

21. Classify the following reaction: $2\ NaOH_{(aq)} + Sr_{(s)} \rightarrow 2\ Na_{(s)} + Sr(OH)_{2(aq)}$

a. combination b. combustion c. neutralization d. single replacement

22. If a student ran a chemical reaction calculated the theoretical yield to be 3.78 g. If the percent yield is 76.4%, what mass did the student actually obtain?

a. 2.89 g b. 4.95 g c. 20.2 g d. 0.202 g

23. Which one of the following solutions will react $Ag_{(s)}$?

a. $Al(NO_3)_{3(aq)}$ b. $HNO_{3(aq)}$ c. $Cu(NO_3)_{2(aq)}$ d. $Au(NO_3)_3$

24. What is the net ionic equation for the reaction of Na_2SO_4 (aq) and $AgNO_3$ (aq)?

b. Ag^+ (aq) + NO_3^- (aq) $\rightarrow AgNO_3$ (s)
c. $2\ Na^+$ (aq) + SO_4^{2-} (aq) $\rightarrow Na_2SO_4$ (s)
d. Na^+ (aq) + NO_3^- (aq) $\rightarrow NaNO_3$ (s)
e. $2\ Ag^+$ (aq) + SO_4^{2-} (aq) $\rightarrow Ag_2SO_4$ (s)

25. Calculate the moles available to react when a graduated cylinder contains 25.0 mL of 2.50 M H_2SO_4.

a. 0.0625 mol b. 62.5 mol c. 100. mol d. 0.0100 mol

26. Which of the following is considered a weak acid?

a. HCl (aq) b. HI (aq) c. HBr (aq) d. HF (aq)

27. What volume of a 9.00 M KCl solution is required to make 45.0 mL of a 2.50 M KCl solution?

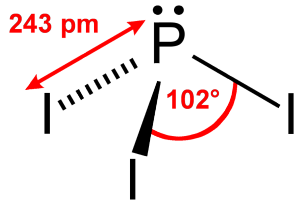
a. 162 mL b. 1010 mL c. 0.500 mL d. 12.5 mL

28. What is the coefficient for oxygen in the reaction: $2\ C_8H_{18(g)} + 25\ O_{2(g)} \rightarrow 16\ CO_{2(g)} + 18\ H_2O_{(g)}$?

a. 25 b. 2 c. 16 d. 18

29. Draw the correct Lewis Structure for ALL of the following molecules and answer the questions:

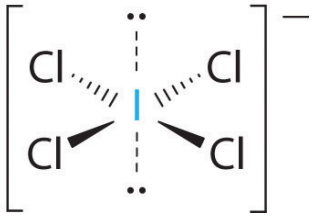
PI_3 # valence electrons: 26



EDG:tetrahedral Hybridization: sp^3

Shape: trigonal pyramidal Polar? Y/N

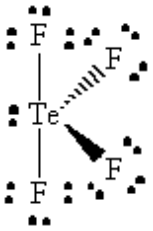
ICl_4^- # valence electrons: 36



EDG:octahedral Hybridization: sp^3d^2

Shape: square planar Polar? Y/N

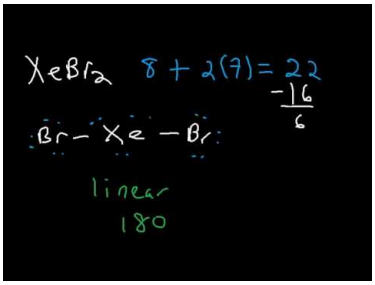
TeF_4 # valence electrons: 34



EDG:trigonal bipyramidal Hybridization: sp^3d

Shape: see-saw Polar? Y/N

$XeBr_2$ # valence electrons: 22



EDG: trigonal bipyramidal Hybridization: sp^3d

Shape: linear Polar? Y/N

30. Please name the following compounds *(spelling counts!)*:

a. KIO_2 potassium iodite

b. Co_3N_2 cobalt(II) nitride

c. K_3PO_4 potassium phosphate

d. TiS titanium(II) sulfide

e. P_4S_6 tetraphosphorus hexasulfide

f. IF_3 iodine trifluoride

g. $SrCO_3$ strontium carbonate

31. Please write the correct formula for the following compounds:

a. aluminum hydroxide $Al(OH)_3$

b. dinitrogen nonoxide N_2O_9

c. vanadium(IV) oxide VO_2

d. silver nitrate $AgNO_3$

e. sodium sulfite heptahydrate $Na_2SO_3 \cdot 7H_2O$

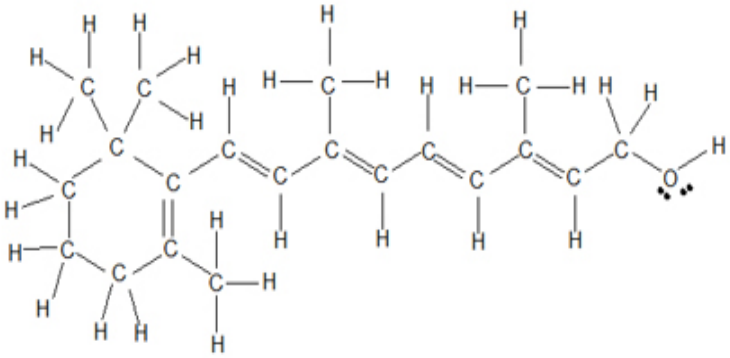
f. calcium fluoride CaF_2

g. sodium perchlorate $NaClO_4$

32. Answer the following questions regarding the structure for Retinol below:

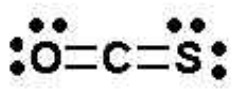
How many sigma, σ, bonds are there? __51__

How many pi, π, bonds are there? ___5_____



33. Draw three resonance structures for the molecule OCS (in that order) and evaluate each using formal charges.

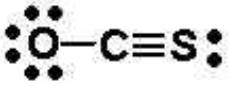
1



0 0 0

Best
Each element has a zero formal charge

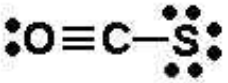
2



+1 0 -1

Worst
The more EN atom (oxygen) has a positive F.C.

3



-1 0 +1

34. Write a balanced reaction for the **decomposition** of solid manganese (II) chloride, $MnCl_2$ (s).

$$MnCl_2(s) \xrightarrow{\Delta} Mn(s) + Cl_2(g)$$

35. Calculate the molarity of a calcium nitrate solution made by dissolving 100.0 g of $Ca(NO_3)_2$ in enough water to fill a volumetric flask to the 5.00 L mark.

$$100.0\text{ g } Ca(NO_3)_2 \times \frac{1\text{ mole } Ca(NO_3)_2}{164.088\text{ g}} = 0.6094\text{ moles } Ca(NO_3)_2$$

$$M = \frac{0.6094\text{ mol } Ca(NO_3)_2}{5.00\text{ L}}$$

$M = 0.122\text{ M } Ca(NO_3)_2$

36. Write the molecular equation, total ionic equation, and net ionic equation for the reaction of aqueous H_2SO_4 with aqueous KOH.

a. Molecular Equation:

____H_2SO_4 (aq) + _2__KOH (aq) → 2 H_2O(l) + K_2SO_4(aq)

b. Total Ionic Equation:

$2H^+(aq) + SO_4^{2-}(aq) + 2K^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2K^+(aq) + SO_4^{2-}(aq)$

c. Net Ionic Equation:

$2H^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l)$

37. A student performed a titration of 29.5 mL of 1.33 M H_2SO_4 with 16.8 mL of NaOH. What is the molarity of the NaOH?

____H_2SO_4 (aq) + __2__NaOH (aq) → __2__ H_2O (l) + ____ Na_2SO_4 (aq)

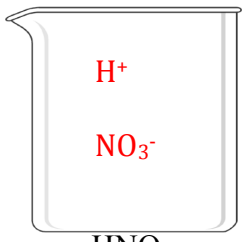
0.0295 L H2SO4$\left(\frac{1.33 \text{ mol } H_2SO_4}{1 \text{ L } H_2SO_4}\right)\left(\frac{2 \text{ mol NaOH}}{1 \text{ mol } H_2SO_4}\right)$ = 0.07847 mol NaOH

M = $\frac{0.07847 \text{ mol NaOH}}{0.0168 \text{ L}}$ = 4.67 M NaOH

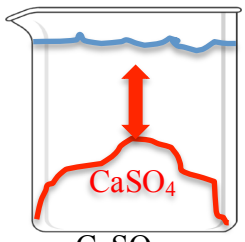
38. Classify each of the following as a nonelectrolyte, a weak electrolyte, or a strong electrolyte:

a.	$Al_2(SO_4)_3$	nonelectrolyte	weak electrolyte	strong electrolyte
b.	K_2CrO_4	nonelectrolyte	weak electrolyte	strong electrolyte
c.	$C_6H_{12}O_6$	nonelectrolyte	weak electrolyte	strong electrolyte
d.	$Fe(OH)_3$	nonelectrolyte	weak electrolyte	strong electrolyte

39. Show the beaker drawings for the following compounds once they are placed in water:



HNO_3



$CaSO_4$

40. What mass of Al_2O_3 (s) is produced when 18.53 grams of solid Al is combined with 10.22 L of O_2 gas at STP?

__3__ O_2 (g) + __4__ Al (s) $\xrightarrow{\Delta}$ __2__ Al_2O_3 (s)

18.53 g Al $\left(\frac{1 \text{mol Al}}{26.98 \text{ g Al}}\right)\left(\frac{2 \text{ mol } Al_2O_3}{4 \text{ mol Al}}\right)\left(\frac{101.96 \text{ g } Al_2O_3}{1 \text{ mol } Al_2O_3}\right)$ = 35.0 g Al_2O_3

10.22 L O_2 $\left(\frac{1 \text{mol } O_2}{22.41 \text{ L } O_2}\right)\left(\frac{2 \text{ mol } Al_2O_3}{3 \text{ mol } O_2}\right)\left(\frac{101.96 \text{ g } Al_2O_3}{1 \text{ mol } Al_2O_3}\right)$ = **31.0 g Al_2O_3**

41. Identify the type of reaction and predict products for the following reactions. Be sure to balance the final equation and write in the correct physical states. If no reaction occurs write NR.

a. combustion Type _6__C_6H_6(l) + _6_O_2(g) → 6 CO_2(g) + H_2O(g)

b. No Rxn Type ____Ag(s) + ____$AlCl_3$(aq) → No Products

c. decomposition Type ____Fe_2O_3(s) → 4 Fe(s) + 3 O_2(g)

d. neutralization Type _2_HBr(aq) + ____$Ba(OH)_2$(aq) → H_2O(l) + $BaBr_2$(aq)

e. single repalcement Type _2__$Ni(NO_3)_3$(aq) + _3__Zn(s) → 3 $Zn(NO_3)_2$(aq) + 2 Ni(s)