Form

A	B
C	D

Exam 2 Detailed Key

At constant P and T, $V \propto n$ (Avogadro's law), so a balanced equation gives volume ratios as well as mole ratios.

CHEMISTRY 102C/102D Spring 2024

Exam II If H_2 limiting: $16.0\ L\ H_2\left(\frac{1\ L\ CH_3OH}{2\ L\ H_2}\right) = 8.00\ L\ CH_3OH$

If CO limiting: $25.0\ L\ CO\left(\frac{1\ L\ CH_3OH}{1\ L\ CO}\right) = 25.0\ L\ CH_3OH$

For the next two questions, consider the following reaction for the production of methanol (CH_3OH): Since H_2 reacted produces the smallest amount of product, it is limiting and 8.00 L CH_3OH can be produced.

$$CO(g) + 2\ H_2(g) \rightarrow CH_3OH(g)$$

$$n_{CH_3OH} = \frac{PV}{RT} = \frac{1.00\ atm(8.00\ L)}{0.08206(273\ K)} = 0.357\ mol\ CH_3OH \text{ can be produced}$$

1	14
22	9

1. How many moles of $CH_3OH(g)$ can be produced when 16.0 L of $H_2(g)$ are reacted with 25.0 L of CO(g), with all gases measured at STP? Assume 100% yield.

theoretical mass yield $= 0.357\ mol\ CH_3OH\left(\frac{32.04\ g}{1\ mol\ CH_3OH}\right) = 11.44\ g\ CH_3OH$

a) 0.357 mol b) 1.16 mol c) 0.558 mol d) 0.714 mol e) 0.279 mol

2	15
23	10

2. If 5.30 g of $CH_3OH(g)$ are actually produced at STP in the above reaction, what is the percent yield of the reaction?

$$\%\ yield = \frac{actual}{theoretical} \times 100 = \frac{5.30\ g}{11.44\ g} \times 100 = 46.3\%$$

a) 53.7% b) 23.9% c) 76.1% d) 3.13% e) 46.3%

$$2\ H_3PO_4(aq) + 3\ Sr(OH)_2(aq) \rightarrow 6\ H_2O(l) + Sr_3(PO_4)_2(s)$$

3	16
24	11

3. A 100.00 mL sample of a $Sr(OH)_2$ solution requires 28.40 mL of 0.150 *M* H_3PO_4 to react completely with it. Calculate the concentration of the $Sr(OH)_2$ solution.

$$mol\ Sr(OH)_2 = 0.02840\ L\left(\frac{0.150\ mol\ H_3PO_4}{1\ L}\right)\left(\frac{3\ mol\ Sr(OH)_2}{2\ mol\ H_3PO_4}\right) = 0.00639\ mol\ Sr(OH)_2$$

a) 0.128 *M* b) 0.0639 *M* c) 0.0213 *M* d) 0.107 *M* e) 0.0426 *M*

$$M_{Sr(OH)_2} = \frac{mol\ Sr(OH)_2}{Volume} = \frac{0.00639\ mol}{0.1000\ L} = 0.0639\ mol/L$$

For the next two questions, consider the following reaction involving two hypothetical elements A and B:

$$4.0\ mol\ A_2B_9\left(\frac{2\ mol\ A}{1\ mol\ A_2B_9}\right) = 8.0\ mol\ A \text{ reacted}$$

$$2\ A(g) + 3\ B_3(g) \rightarrow A_2B_9(g)$$

(Molar masses: A: 40.0 g/mol; A_2B_9: 125 g/mol)

mol A in excess = 11.0 mol A initial − 8.0 mol A reacted = 3.0 mol A in excess

Initially a reaction vessel contains 11.0 moles of A and 12.0 moles of B_3. Assuming the above reaction goes to completion with 100% yield, answer the following two questions.

Let x = molar mass of B in A_2B_9.

4	17
25	12

4. If 4.0 moles of A_2B_9 are formed in the reaction, how many moles of A remain **unreacted**?

$125\ g/mol = 2(40) + 9x$, $x = 5.0\ g/mol$ = molar mass of B

a) 0 mol b) 1.0 mol c) 2.0 mol d) 3.0 mol e) 8.0 mol

5	18
26	13

5. What is the total mass of B_3 consumed in the reaction?

Molar mass of $B_3 = 3(50) = 150\ g/mol$

mol B_3 reacted = 12.0 mol B_3 (from problem)

In reaction, B_3 was limiting since A is in excess.

a) 60.0 g b) 180. g c) 45.0 g d) 15.0 g e) 120. g

$$mass\ B_3\ consumed = 12.0\ mol\ B_3\left(\frac{150\ g}{mol\ B_3}\right) = 180\ g\ B_3 \text{ reacted}$$

Form A/C B/D

When $HgCl_2$ and K_2S are mixed, the potential products are KCl and HgS. From solubility rules, HgS is the precipitate that forms while KCl is soluble.

Formula equation: $HgCl_2(aq) + K_2S(aq) \rightarrow HgS(s) + 2KCl(aq)$

Net ionic equation: $Hg^{2+}(aq) + S^{2-}(aq) \rightarrow HgS(s)$

b/18 | 1/23

6. Which of the following is the net ionic equation when 0.10 *M* solutions of $HgCl_2$ and K_2S are mixed together?

a) $HgCl_2(aq) + K_2S(aq) \rightarrow HgS(s) + 2\ KCl(aq)$
b) $HgCl_2(aq) + K_2S(aq) \rightarrow 2\ KCl(s) + HgS(aq)$
c) $Hg^{2+}(aq) + S^{2-}(aq) \rightarrow HgS(s)$
d) $K^+(aq) + Cl^-(aq) \rightarrow KCl(s)$
e) No reaction will occur.

total mol $Br^- = 0.0500L\left(\frac{3.00\ mol\ CaBr_2}{L}\right)\left(\frac{2\ mol\ Br^-}{1\ mol\ CaBr_2}\right) + 0.40000L\left(\frac{0.250\ mol\ KBr}{L}\right)\left(\frac{1\ mol\ Br^-}{1\ mol\ KBr}\right)$

7/19 | 2/24

7. A solution is made by mixing 50.0 mL of 3.00 *M* $CaBr_2$ with 400.0 mL of 0.250 *M* KBr. This mixture is diluted by adding water until the final solution volume is 800.0 mL. What is the molarity of the Br^- ions in the final solution?

total mol Br^- present = 0.300 mol + 0.100 mol = 0.400 mol Br^-

a) 0.125 *M* b) 0.250 *M* c) 0.500 *M* d) 0.750 *M* e) 1.00 *M*

$M_{Br^-} = \frac{\text{mol } Br^-}{\text{volume}} = \frac{0.400\ mol\ Br^-}{0.800\ L} = 0.500$

8/20 | 3/25

8. A bag of potato chips is packed and sealed in Los Angeles, California, and later shipped to Deming, New Mexico. In Deming it is noticed that the volume of the bag of potato chips has increased. Which of the following external conditions (a-c) could cause the volume of the bag of potato chips to increase in Deming as compared to Los Angeles? (Assume no gas molecules can enter or leave the sealed bag of potato chips and assume no chemical reaction occurs inside the bag.) A potato chip bag is a flexible container; it expands or contracts to keep $P_{inside} = P_{outside}$.

NO a) The temperature outside the bag decreased. As temp decreases, V decreases.

(yes) b) The pressure outside the bag decreased. As P decreases, V increases.

$V = \frac{nRT}{P}$ NO c) The moles of air molecules outside the bag increased. As P increases, V decreases. This will cause P to increase.

d) None of the above (a-c) could cause the volume of the bag of potato chips to increase.

9/21 | 4/26

9. Consider a 2.0 L sample of SO_2 gas and a 2.0 L sample of F_2 gas, both of which are at STP. Which of the following statements (a-d) about the two gas samples is **true**?

At constant temp, the average kinetic energy of the two gas samples are the same ($KE_{Ave} = 3/2RT$),

F a) The F_2 molecules and SO_2 molecules collide with the container walls of their respective containers, on average, with identical frequency. F_2 molecules collide more frequently because they have faster velocity.

$V = \frac{nRT}{P}$

F b) The moles of F_2 molecules is ~~greater than~~ equal the moles of SO_2 molecules. At constant T+P, equal volumes contain equal number of molecules.

F c) The average kinetic energy of the SO_2 molecules is greater than the average kinetic energy of the F_2 molecules. They are equal since both gases are at T = 273K.

T d) The SO_2 molecules collide with the container walls of their respective containers, on average, more forcefully than the F_2 molecules. The heavier SO_2 molecules have more forceful collisions. Must be true for the pressures in the 2 gases to be equal to each other.

e) None of the statements (a-d) are true.

If the average kinetic energies of the SO_2 and F_2 gas samples are the same, then the lighter F_2 molecules must be moving faster on average.

orm
r | B
C | D

$Al(s) + 3I_2(s) \rightarrow 2AlI_3(s)$

$I_2: 2(126.9) = 253.8\ g/mol$ = molar mass of I_2

$AlI_3: 26.98 + 3(126.9) = 407.7\ g/mol$

10 | 19
14 | 5

10. Consider the synthesis reaction between aluminum (Al) and iodine (I_2) to form aluminum iodide (AlI_3). What mass of I_2 is required to produce 10.0 g of AlI_3 assuming excess aluminum is present?

mass I_2 = $10.0\ g\ AlI_3 \left(\frac{1\ mol\ AlI_3}{407.7}\right)\left(\frac{3\ mol\ I_2}{2\ mol\ Al}\right)\left(\frac{253.8\ g}{mol\ I_2}\right) = 9.34\ g\ I_2$

a) 6.23 g b) 4.89 g c) 18.7 g d) 10.0 g (e) 9.34 g

mass $Tl_2SO_4 = 0.1824\ g\ TlI \left(\frac{1\ mol\ TlI}{331.3\ g}\right)\left(\frac{1\ mol\ Tl_2SO_4}{2\ mol\ TlI}\right)\left(\frac{504.9\ g}{mol\ Tl_2SO_4}\right) = 0.1390\ g\ Tl_2SO_4$

11 | 20
15 | 6

11. A 0.486-g pesticide sample contains a mixture of Tl_2SO_4 with some other non-thallium containing compounds. The sample is dissolved in water and an excess of KI is added, producing a precipitate of thallium(I) iodide. If 0.1824 g of TlI was produced, calculate the mass percent of Tl_2SO_4 in the original pesticide sample. The molar mass of Tl_2SO_4 is 504.9 g/mol, the molar mass of KI is 166.0 g/mol, the molar mass of TlI is 331.3 g/mol, and the molar mass of Tl is 204.4 g/mol.

the mol ratio between Tl_2SO_4 and TlI must be 1 to 2 to balance Tl.

a) 22.1% b) 57.2% (c) 28.6% d) 64.7% e) 32.4%

mass % $Tl_2SO_4 = \frac{0.1390\ g\ Tl_2SO_4}{0.486\ g\ pesticide} \times 100 = 28.6\%\ Tl_2SO_4$

12 | 21
16 | 7

12. Which of the answers (a-d) **always** correctly completes the following sentence.
All of the answers (a-d) can be true, but they don't have to be. Limiting reagent problems depend on alot of variables that all must be known. Answers a-d are these variable that all must by known to solve a limiting reactant problem.
The limiting reactant in a reaction:

a) is the reactant for which there is the smallest amount in grams present. maybe
b) is the reactant which has the smallest coefficient in the balanced equation. maybe
c) is the reactant with the smallest molar mass. maybe
d) is the reactant for which there is the smallest number of moles present. maybe
(e) None of the above (a-d) always correctly completes the sentence.

13 | 22
17 | 8

13. How many of the following four statements (I-IV) about gases is/are **true**?

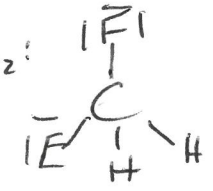
T I. A non-ideal gas will more nearly behave like an ideal gas at low pressures.
T II. Real gases deviate from ideal gases because real gas molecules have a volume and real gas molecules exert intermolecular forces.
T III. The effect of attractive forces between gas particles can be minimized by heating the gas.
F IV. 1.00×10^{23} gas molecules placed in a closed 5.0 liter container at 150. K would behave more ideally than the same number of molecules placed in a closed 50.0 liter container at the same temperature. The gas in a larger container will have the lower pressure and will behave more ideally.

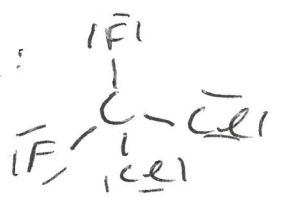
a) 0 (none) b) 1 c) 2 (d) 3

e) 4 (All of the statements are true.)

rm

B
C D

CF_2H_2: 

CF_2Cl_2: 

CHEMISTRY 102C/102D
Exam II

Both compounds are polar, so both have dipole forces as well as London dispersion forces.

14 | 5
9 | 18

14. Difluoromethane, CF_2H_2, has been considered as a replacement for the chlorofluorocarbon freon, CF_2Cl_2. The boiling point of CF_2H_2 is −56°C and the boiling point of CF_2Cl_2 is −29°C. Which of the following statements concerning these two compounds is **false**? (Carbon is the central atom in both molecules.)

F a) CF_2H_2 exhibits hydrogen bonding intermolecular forces. Must have N–H or O–H or F–H covalent bond in molecule to H-bond. CF_2H_2 does not have any of these 3 special covalent bonds.

T b) Both compounds are gases at room temperature. Both gases have a boiling point below room temp (~20°C), so both substances are gases at room temp.

T c) CF_2Cl_2 exhibits stronger London dispersion forces as compared to CF_2H_2. CF_2Cl_2 has a larger molar mass so CF_2Cl_2 exhibits stronger London dispersion forces than the smaller CF_2H_2.

T d) Overall, CF_2Cl_2 exhibits stronger intermolecular forces as compared to CF_2H_2. since boiling point of CF_2Cl_2 is larger than bp for CF_2H_2, the strength of the intermolecular forces in CF_2Cl_2 must be stronger.

Consider the following information for the next two questions. 50.00 mL of 1.00 *M* $AgNO_3$ is mixed with 25.00 mL of 1.00 *M* K_3PO_4 and a precipitate forms.

15 | 6
10 | 19

$3AgNO_{3(aq)} + K_3PO_{4(aq)} \rightarrow Ag_3PO_{4(s)} + 3KNO_{3(aq)}$

15. How many moles of precipitate can form assuming the reaction has 100% yield?

If $AgNO_3$ limits: $0.05000\,L\left(\frac{1.00\,mol\,AgNO_3}{L}\right)\left(\frac{1\,mol\,Ag_3PO_4}{3\,mol\,AgNO_3}\right) = 0.0167\,mol\,Ag_3PO_4$ can be produced

If K_3PO_4 limits: $0.02500\,L\left(\frac{1.00\,mol\,K_3PO_4}{L}\right)\left(\frac{1\,mol\,Ag_3PO_4}{1\,mol\,K_3PO_4}\right) = 0.0250\,mol\,Ag_3PO_4$ can form

a) 0.0500 mol b) 0.0375 mol c) 0.0250 mol (d) 0.0167 mol e) 0.0100 mol

since $AgNO_3$ reactant produces the smallest amount of precipitate, it is limiting and 0.0167 mol Ag_3PO_4 can form

16 | 7
11 | 20

16. Calculate the concentration of phosphate (PO_4^{3-}) anions in the mixture after the reaction has gone to completion.

mol PO_4^{3-} initially $= 0.02500\,L\left(\frac{1.00\,mol\,K_3PO_4}{L}\right)\left(\frac{1\,mol\,PO_4^{3-}}{1\,mol\,K_3PO_4}\right) = 0.0250\,mol\,Ag_3PO_4$ initially

a) 0 *M* (b) 0.11 *M* c) 0.25 *M* d) 0.50 *M* e) 0.75 *M*

mol PO_4^{3-} tied up in $Ag_3PO_4 = 0.0167\,mol\,Ag_3PO_4\left(\frac{1\,mol\,PO_4^{3-}}{1\,mol\,Ag_3PO_4}\right) = 0.0167\,mol\,PO_4^{3-}$

mol excess $PO_4^{3-} = 0.0250\,mol - 0.0167 = 0.0083\,mol$ excess PO_4^{3-}

$\frac{0.0083\,mol}{0.05+0.025\,L} = 0.11\,M\ PO_4^{3-}$

17 | 8
12 | 21

17. An ideal gas in a container occupies a volume of 10.0 L at 38°C and 0.20 atm. If the gas sample is cooled to 7°C and the volume is decreased to 3.60 L, what is the new pressure of the gas sample? $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$, $P_2 = P_1\left(\frac{V_1}{V_2}\right)\left(\frac{T_2}{T_1}\right)$ $n_1 = n_2 =$ constant

(a) 0.50 atm b) 0.20 atm c) 0.92 atm d) 0.11 atm e) 1.7 atm

$P_2 = 0.20\,atm\left(\frac{10.0\,L}{3.60\,L}\right)\left(\frac{280\,K}{311\,K}\right) = 0.50\,atm$

18 | 9
13 | 22

18. A compound containing carbon, hydrogen and oxygen that is responsible for the odor of pineapples is found to have 62.04% C and 10.41% H by mass. The empirical formula of this compound is:

In 100.00 g compound: $100.00 - 62.04\,g\,C - 10.41\,g\,H = 27.55\,g\,O$

a) CH_2O b) $C_6H_{12}O_2$ (c) C_3H_6O d) $C_6H_{10}O_2$ e) C_3H_5O

$62.04\,g\,C\left(\frac{1\,mol\,C}{12.01\,g}\right) = 5.166\,mol\,C / 1.722 = 3\,mol\,C$

$10.41\,g\,H\left(\frac{1\,mol\,H}{1.008\,g\,H}\right) = 10.33\,mol\,H / 1.722 = 6\,mol\,H$

$27.55\,g\,O\left(\frac{1\,mol\,O}{16.00\,g}\right) = 1.722\,mol\,O / 1.722 = 1\,mol\,O$

C_3H_6O is the empirical formula

Form
A|B
C|D

19|23
5|1

19. Which of the following statements (a-d) about hydrogen bonding intermolecular forces is **true**?
Ionic forces are stronger than all of types of Covalent IMF.

F a) Compounds that can H-bond have higher boiling points than ionic compounds.

F b) A compound must contain a C–H, N–H, O–H, or F–H covalent bond in the molecule in order to H–bond. NO

F c) Given two covalent compounds having about the same molar mass, the compound that can H–bond will have the ~~higher~~ lower vapor pressure as compared to a compound that cannot H–bond. Strength of IMF and vapor pressure are inversly proportional to strength of intermolecular forces.

F d) H–bonding is a form ~~of London dispersion forces~~ dipole-dipole due to polar H-O bonds.

e) None of the above statements (a-d) are true.

$\frac{rate_{N_2}}{rate_x} = \sqrt{\frac{M_x}{M_{N_2}}}$, $1.73 = \sqrt{\frac{M_x}{28.02}}$, $1.73^2 = 2.993 = \frac{M_x}{28.02}$

20|24
6|2

20. The diffusion rate of N_2 gas is 1.73 times greater than the diffusion rate of a certain noble gas (both gases are at the same temperature). What is the noble gas?
$M_x = 2.993(28.02) = 83.9$ g/mol; this is Kr.

a) He b) Ne c) Ar d) Kr e) Xe

21|25
7|3

21. Which of the following three statements (I-III) about gases is/are **true**?

F I. Equal ~~masses~~ volumes of ideal gases at the same temperature and pressure contain equal numbers of molecules. $PV = nRT$

T II. At constant pressure and moles, as the temperature of a gas sample increases, the volume of the container holding the gas increases. Charles's Law

T III. On average, an H_2 molecule has a faster average velocity than a N_2 molecule at the same temperature. At same temperature, the smaller H_2 molecules must be moving faster (on average) than N_2 molecules.

a) I and II b) II and III c) I and III d) I, II, and III

e) Only statement I is true.

$PV = nRT$; when V and T are constant, $P \propto n$.

22|26
8|4

22. Nitrogen dioxide, NO_2, decomposes by the following unbalanced reaction:
2 mol gas → 1 + 2 = 3 mol gas.

$$2\,NO_2(g) \rightarrow 1\,N_2(g) + 2\,O_2(g)$$

Because the moles of gas increased by a factor of 1.5 (2 mol → 3 mol), the pressure in the container must also increase by a factor of 1.5.

If 3.0 atm of pure $NO_2(g)$ are decomposed initially, what is the final total pressure in the reaction container? Assume the above reaction goes to completion and assume a constant temperature and container volume.

a) 4.5 atm b) 6.0 atm c) 9.0 atm d) 3.0 atm e) 1.5 atm

$\frac{P_2}{P_1} = \frac{n_2}{n_1}$, $\frac{P_2}{P_1} = \frac{3\text{ mol}}{2\text{ mol}}$, $P_2 = \frac{3}{2}P_1 = \frac{3}{2}(3.0\text{ atm}) = 4.5$ atm

Form A|B C|D

C_2H_5OH is a covalent compound which is not an acid. So it is a non electrolyte.

23 | 10
1 | 14

23. The compounds below are classified as either a strong electrolyte, a weak electrolyte, or a nonelectrolyte. Which compound is **incorrectly** classified?

F a) Ethanol, C_2H_5OH, is a ~~strong~~ non electrolyte. = covalent compound that is not an acid

T b) Fingernail polish remover, C_3H_6O, is a nonelectrolyte.

T c) Vinegar, $HC_2H_3O_2$, is a weak electrolyte. = weak acid

T d) Slaked lime, $Ca(OH)_2$, is a strong electrolyte. = soluble ionic compound

T e) Washing soda, Na_2CO_3, is a strong electrolyte. = soluble ionic compound

Can't have K^+ present since nothing forms a precipitate with K^+ since no precipitate forms with KCl, can't have Ag^+ or Pb^{2+} or Hg_2^{2+}

29 | 11
2 | 15

24. Separate samples of a solution of an unknown soluble ionic compound are treated with KCl, Na_2SO_4 and NaOH. A precipitate forms only when Na_2SO_4 is added. Which one of the following cations could the solution contain? So from precipitate that forms with Na_2SO_4, both Ca^{2+} or Ba^{2+} could be present. ions present

a) K^+ b) Ag^+ c) Ba^{2+} d) Hg_2^{2+} e) Pb^{2+}

Only Ba^{2+} answer is listed.

25 | 12
3 | 16

25. Determine the density of uranium hexafluoride (UF_6) gas at 60.°C and 745 torr. Uranium is element #92.

$T = 60 + 273 = 333\ K$; $P \cdot M = dRT$ $d = \frac{P \cdot M}{RT}$

a) 12.6 g/L b) 2.54 g/mL c) 8.97 g/L

UF_6: $238 + 6(19) = 352\ g/mol$

d) 6.74 g/mL e) 0.0269 g/L

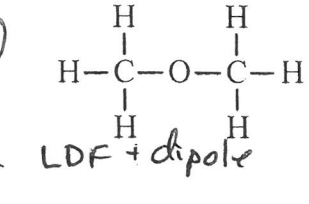
$$d = \frac{745\ torr\left(\frac{1\ atm}{760\ torr}\right)(352\ g/mol)}{0.08206(333K)} = 12.6\ g/L$$

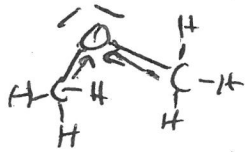
26 | 13
4 | 17

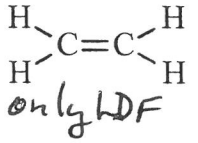
26. Which of the following four organic compounds has the **lowest** vapor pressure at −50°C?

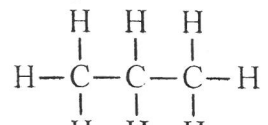
Lowest vapor pressure has the strongest intermolecular forces. The largest molar mass compounds are answers b and d. Since molar masses of b and d are about the same, the strength of the LD forces (are similar), the hydrocarbons in answer a, c, and d only have nonpolar C–C and/or nonpolar C–H bonds. These three compounds in a, c, and d only have LDF. CH_3OCH_3 is polar, so it has additional dipole forces. Therefore, CH_3OCH_3 has the stronger IMF and the lower vapor pressure.

a) CH_4 only LDF

b) 
LDF + dipole


CH_3OCH_3 is polar

c) 
only LDF

d) 
only LDF

All of Cl in compound ends up as Cl in AgCl.

$$\text{mass Cl} = 1.950\text{ g AgCl}\left(\frac{1\text{ mol AgCl}}{143.35\text{ g}}\right)\left(\frac{1\text{ mol Cl}}{1\text{ mol AgCl}}\right)\left(\frac{35.45\text{ g Cl}}{\text{mol Cl}}\right) = 0.4822\text{ g Cl}$$

$$\text{mass\% Cl} = \frac{0.4822\text{ g Cl}}{1.000\text{ g compound}} \times 100 = 48.22\%$$

27. An unknown organic compound contains only C, H, and Cl. When a 1.500 g-sample of the compound was combusted, 0.3678 g of H_2O was formed. In a separate experiment, all of the chlorine in a 1.000 g-sample of the same unknown compound was reacted by suitable methods to form 1.950 g of AgCl. Determine the mass percent of chlorine in the unknown compound. The molar mass of AgCl = 143.35 g/mol.

a) 16.25% Cl b) 23.45% Cl c) 38.92% Cl
d) 48.22% Cl e) 57.84% Cl

All of H in compound ends up as H in H_2O.

$$\text{mass H} = 0.3678\text{ g } H_2O\left(\frac{1\text{ mol } H_2O}{18.02\text{ g}}\right)\left(\frac{2\text{ mol H}}{1\text{ mol } H_2O}\right)\left(\frac{1.008\text{ g H}}{\text{mol H}}\right) = 0.04115\text{ g H}$$

$$\text{mass\% H in compound} = \left(0.04115\text{ g H}/1.500\text{ g cmpd}\right)\times 100 = 2.743\%\text{ H}$$

28. An unknown organic compound contains only C, H, and Cl. When a 1.500 g-sample of the compound was combusted, 0.3678 g of H_2O was formed. In a separate experiment, all of the chlorine in a 1.000 g-sample of the same unknown compound was reacted by suitable methods to form 1.950 g of AgCl. Determine the empirical formula of the unknown compound.

In 100.00 g of cmpd:

mass %C = 100.00 − 48.22% Cl − 2.743% H = 49.04 %C

$$49.04\text{ g C}\left(\frac{1\text{ mol C}}{12.01\text{ g C}}\right) = 4.083\text{ mol C}/1.360 = 3\text{ mol C}$$

$$2.743\text{ g H}\left(\frac{1\text{ mol H}}{1.008\text{ g}}\right) = 2.721\text{ mol H}/1.360 = 2\text{ mol H}$$

$$48.22\text{ g Cl}\left(\frac{1\text{ mol Cl}}{35.45\text{ g}}\right) = 1.360\text{ mol Cl}/1.360 = 1\text{ mol Cl}$$

C_3H_2Cl is empirical formula.

a) $C_2H_3Cl_2$ b) $C_4H_6Cl_3$ c) C_3H_2Cl d) CH_3Cl_2 e) C_2H_5Cl

29. F_2 boils at a temperature very close to the boiling point of one of the following substances. Which substance below has a boiling point similar to that of F_2?

F_2 is nonpolar with a molar mass of 38 g/mol. A nonpolar compound with a molar mass similar to 38 g/mol will have a bp close to F_2. The best choice is Ar, which has a molar mass of 40 g/mol.

a) HF b) Cl_2 c) Ne d) HCl e) Ar

30. A compound composed of element X and chlorine has a formula of XCl_6 and is 13.10% X by mass. Which of the following is the identity of X?

In 100.00 g compound, we have 13.10 g X and 100.00 − 13.10 = 86.90 g Cl

$$\text{mol X in 100.00 g cmpd} = 86.90\text{ g Cl}\left(\frac{1\text{ mol Cl}}{35.45\text{ g}}\right)\left(\frac{1\text{ mol X}}{6\text{ mol Cl}}\right) = 0.40856\text{ mol X}$$

(from XCl_6 formula)

$$\text{molar mass} = \frac{\text{mass}}{\text{moles}} = \frac{13.10\text{ g X}}{0.40856\text{ mol X}} = 32.06\text{ g/mol} \Rightarrow X = S$$

a) Mo b) Cr c) Xe d) Se e) S

31. My answers for this Chemistry 102 exam should be graded with the answer sheet associated with:

a) Form A b) Form B c) Form C d) Form D e) Form E