Form
A|B
C|D

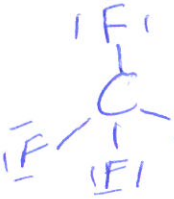
Detailed Solutions

Only CF_4 and HF are covalent compounds.

1|6
18|23

1. How many of the following five compounds exhibit only London dispersion forces and no other type of intermolecular forces?

$\underbrace{NaF,\ CaF_2,\ CrF_3,}_{\text{ionic}}$ $\boxed{CF_4}$, HF H-bonding



CF_4, 32e^-; nonpolar so only LDF.

[✓ a) 1] b) 2 c) 3 d) 4

e) 5; all only exhibit London dispersion forces.

$27.0\,g\,H_2O\left(\frac{1\,mol\,H_2O}{18.02\,g}\right)\left(\frac{2\,mol\,H}{1\,mol\,H_2O}\right)\left(\frac{1.008\,g}{1\,mol\,H}\right) = 3.021\,g\,H;\ 27.0 - 3.021 = 23.98\,g\,C$

2|7
19|24

2. A 27.0 g sample of an unknown hydrocarbon was burned in excess oxygen to form some CO_2 and 27.0 g of H_2O. Which of the following is a possible **molecular** formula?

$3.021\,g\,H\left(\frac{1\,mol\,H}{1.008\,g}\right) = 3.0\,mol\,H$ C_2H_3 is the empirical formula. Only

a) CH_4 b) C_2H_2 c) C_4H_3 [✓ d) C_4H_6] e) C_4H_{10}

$23.98\,g\,C\left(\frac{1\,mol\,C}{12.01\,g}\right) = 2.0\,mol\,C$ C_4H_6 is a whole number multiple of the empirical formula

3|8
20|25

3. How many moles of $O_2(g)$ in the presence of excess P (phosphorus) are needed to produce 14.2 g of P_4O_{10} (molar mass = 283.9 g/mol)? Assume this is a synthesis reaction. $4P(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$

a) 0.0500 mol b) 0.0625 mol c) 0.125 mol [✓ d) 0.250 mol] e) 0.500 mol

$14.2\,g\,P_4O_{10}\left(\frac{1\,mol\,P_4O_{10}}{283.9\,g}\right)\left(\frac{5\,mol\,O_2}{1\,mol\,P_4O_{10}}\right) = \boxed{0.250\,mol\,O_2}$

4|9
21|26

4. Which of the following statements is **true**?

$H_2O(l) \rightarrow H_2O(g)$ ΔH_{vap} reaction; $H_2O(s) \rightarrow H_2O(l)$ ΔH_{fus} reaction

T a) Because more intermolecular forces are broken when water vaporizes than when ice melts, $\Delta H_{vaporization}$ (in kJ/mol) should be greater than ΔH_{fusion} (in kJ/mol).
85% vs 15% IMF broken for two processes.

F b) As the size of a covalent molecule increases, the strength of the London dispersion forces ~~decreases~~ increases.

F c) Molecules which exhibit hydrogen bonding intermolecular forces have unusually ~~low~~ high melting points.

F d) A polar covalent compound will generally have a ~~lower~~ higher vapor pressure at some temperature than an ionic compound.

F e) In general, the strength of the intermolecular forces exhibited in the gaseous state are much ~~stronger~~ weaker than the intermolecular forces exhibited in the liquid or solid state.
IMF of gases are negligible.

5|10
22|27

5. Consider the following reaction: $\frac{1.00\,g\,NH_3\,actual}{} \Big| \frac{1\,g\,theoretical}{0.750\,g\,actual} = 1.333\,g\,NH_3\,theoretical$

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

If the reaction has a 75.0% yield, how many grams of H_2 are needed to obtain an actual yield of 1.00 g of NH_3?

a) 0.178 g b) 0.133 g [✓ c) 0.237 g] d) 0.157 g e) 0.100 g

$1.333\,g\,NH_3\left(\frac{1\,mol\,NH_3}{17.03\,g}\right)\left(\frac{3\,mol\,H_2}{2\,mol\,NH_3}\right)\left(\frac{2.016\,g}{mol\,H_2}\right) = \boxed{0.237\,g\,H_2}$

Form
A|B
C|D

6|15
10|19

6. Consider the van der Waals gas equation where **a** and **b** are the van der Waals constants:

corrects for IMF; the bigger the a value, the stronger the IMF.

$$\left(P + \frac{\mathbf{a}n^2}{V^2}\right)(V - n\mathbf{b}) = nRT$$

corrects for volume of gas particles; the bigger the b value, the bigger the gas particles.

Which of the following statements concerning the van der Waals equation and real gases is **false**?

T a) A term is added to the measured pressure (P) in the van der Waals equation to correct for the effect of intermolecular forces in real gases.

T b) A term is subtracted from the measured volume (V) in the van der Waals equation to correct for the effect that real gas molecules have a finite volume.

[✓ c)] One would expect CH_4 to have a ~~larger~~ smaller **a** constant value in the van der Waals equation as compared to H_2O. H_2O forms the relatively strong H-bonding IMF; CH_4 is nonpolar and only exhibits LD forces. H_2O has bigger a value.

T d) One would expect Xe to have a larger **b** constant value in the van der Waals equation as compared to Ne. Xe is bigger (larger molar mass) than Ne. Xe has bigger b value.

T e) At high temperatures, the effect of intermolecular attractions in real gases are minimized and the gas behaves more ideally.

Let x = unknown gas: $\frac{rate_{CH_4}}{rate_x} = \frac{8}{4} = 2 = \sqrt{\frac{M_x}{M_{CH_4}}}$

7|16
11|20

7. The effusion rate of an unknown gas is determined to be 4 mL/min. Under the same conditions, the effusion rate of CH_4 is 8 mL/min. Which of the following could be the unknown gas?

$4 = \frac{M_x}{16}$, $M_x = 64$ g/mol; $x = SO_2$

a) H_2 (molar mass = 2 g/mol)
b) He (molar mass = 4 g/mol)
c) O_2 (molar mass = 32 g/mol)
[✓ d)] SO_2 (molar mass = 64 g/mol)

Assume compound is C_4H_8. $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

8|17
12|21

8. The alkenes are compounds composed of carbon and hydrogen having the general formula C_nH_{2n}, where n is some whole number greater than one. If 0.561 gram of any alkene is combusted in excess oxygen, what number of moles of H_2O is formed?

$0.561\text{ g } C_4H_8 \left(\frac{1\text{ mol } C_4H_8}{56.10\text{ g}}\right)\left(\frac{4\text{ mol } H_2O}{1\text{ mol } C_4H_8}\right) = 0.0400\text{ mol } H_2O$

[✓ a)] 0.0400 mol
b) 0.0600 mol
c) 0.0800 mol
d) 0.400 mol
e) 0.800 mol

Could assume any value of n in C_nH_{2n} and get the same answer.

9|18
13|22

9. How many of the following five compounds is/are **not** strong electrolytes?

Covalent PCl_5 nonelectrolyte
Covalent H_2CO_3 weak acid weak electrolyte
Covalent HNO_3 strong acid strong electrolyte
Covalent H_2O nonelectrolyte
Covalent $C_{12}H_{22}O_{11}$ nonelectrolyte

a) zero (All are strong electrolytes.)
b) one
c) two
d) three
[✓ e)] four (4 of the compounds are not strong electrolytes.)

Only HNO_3 is a strong electrolyte.

Form
$\frac{A|B}{C|D}$

At constant T+P, $V \propto n$. Since $V_{He} = 4V_{Ne}$, we must have 4 times as many moles of He as moles of Ne. If 1 mol Ne is present, we would have 4 mol He.

$1 \text{ mol Ne}\left(\frac{20 \text{ g Ne}}{\text{mol Ne}}\right) = 20 \text{ g Ne}$

$4 \text{ mol He}\left(\frac{4 \text{ g He}}{\text{mol He}}\right) = 16 \text{ g He}$

$\frac{10|25}{1|16}$

10. You are holding two balloons, one blue and one orange. The blue balloon contains He and is 4 times the volume of the orange balloon. The orange balloon contains Ne. Which of following best represents the mass ratio of He:Ne in the balloons? Assume constant temperature and pressure. $\frac{\text{mass He}}{\text{mass Ne}} = \frac{16 \text{ g}}{20 \text{ g}} = \frac{4}{5}$

[✓ a) 4:5] b) 2:4 c) 4:1 d) 1:4 e) 20:1

Because A has greater molar mass, equal masses will contain fewer moles of A as compared to moles of B.

$\frac{11|26}{2|17}$

11. Consider 2 reactants, A and B. The molar mass of A is greater than the molar mass of B. You add equal masses of A and B together and let them react. Which of the following statements (a-d) **must** be true?

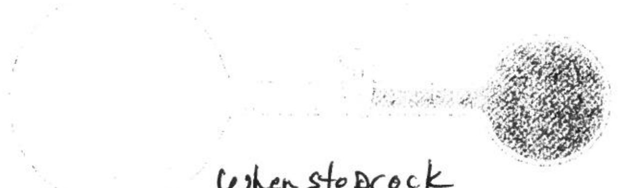
$xA + yB \rightarrow$
fewer moles of A   more moles of B

a) Reactant A **must** be limiting.
b) Reactant B **must** be limiting.
c) If the coefficient for B is greater than the coefficient of A in the balanced equation, then reactant B **must** be limiting.
[✓ d)] If the coefficient for A is greater than the coefficient of B in the balanced equation, then reactant A **must** be limiting. If $x > y$ and we have fewer moles A, then A must be limiting.
e) None of the above choices **must** be true.

$\frac{12|27}{3|18}$

12. A 9.00 L flask containing neon gas at 2.00 atm and a 3.00 L flask containing helium gas at 4.00 atm are connected by valve (see figure below): $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$, n+T constant for each gas, so $P_1V_1 = P_2V_2$.

For Ne:
$P_2 = \frac{P_1V_1}{V_2}$
$P_2 = \frac{2.00 \text{ atm}(9.00 \text{ L})}{12.00 \text{ L}}$
$P_2 = 1.50 \text{ atm}$
Partial pressure of Ne is 1.50 atm after stopcock opened.



When stopcock opened, final volume for both gases is $9.00 + 3.00 = 12.00 \text{ L}$.

For He:
$P_2 = \frac{P_1V_1}{V_2} = \frac{4.00(3.00)}{12.00}$
$P_2 = 1.00 \text{ atm}$
Partial pressure of He is 1.00 atm after stopcock opened.

After the valve between the two flasks is opened and the two gases have time to mix, which of the following statements regarding the partial pressures of Ne and He is **true**? Assume constant temperature and assume that no chemical reaction occurs between Ne and He.

[✓ a)] The partial pressure of neon is 1.50 times greater than the partial pressure of helium.
b) The partial pressure of neon is 2.00 times greater than the partial pressure of helium.
c) The partial pressure of helium is 1.50 times greater than the partial pressure of neon.
d) The partial pressure of helium is 2.00 times greater than the partial pressure of neon.
e) The partial pressures of helium and neon are equal.

$\frac{P_{Ne}}{P_{He}} = \frac{1.50 \text{ atm}}{1.00 \text{ atm}} = 1.50$

Form work for A|B C|D

$64.69\ g\ C\left(\frac{1\ mol\ C}{12.01 g}\right) = 5.386\ mol\ C / 0.9793 = 5.5\ mol\ C$

$5.92 g\ H\left(\frac{1\ mol\ H}{1.008 g}\right) = 5.873\ mol\ H / 0.9793 = 6\ mol\ H$

$13.72 g\ N\left(\frac{1\ mol\ N}{14.01 g}\right) = 0.9793\ mol\ N / 0.9793 = 1\ mol\ N$

$15.67 g\ O\left(\frac{1\ mol\ O}{16.00 g}\right) = 0.9794\ mol\ O / 0.9793 = 1\ mol\ O$

13|1
23|11

13. If the molecules in 1.0 L sample of hydrogen gas and 1.0 L sample of oxygen gas and 1.0 L sample of carbon dioxide gas are all moving with the same average velocity, which gas sample is at the highest temperature? At any temperature, the larger CO_2 molecules would have a slower velocity as compared to the smaller H_2 and O_2 molecules. So the $CO_2(g)$ would have to be at the higher Temp. As T increases, average velocity increases.

a) H_2 b) O_2 [✓ c) CO_2]

d) The temperature is the same in all three of the gas samples.

14|2
24|12

14. Tryptophan is one of the 20 standard amino acids and contains 64.69% C, 5.92% H, 13.72% N, and 15.67% O by mass. What is the empirical formula of tryptophan? Assume 100.00g tryptophan. See top for work determining the mol ratios. From above, $C_{5.5}H_6NO$ are the mol ratios in 100.0g compound. Empirical formula = $\boxed{C_{11}H_{12}N_2O_2}$

a) $C_{12}H_{24}N_2O_2$ [✓ b) $C_{11}H_{12}N_2O_2$] c) $C_6H_{10}NO$

d) $C_{11}H_{12}NO$ e) $C_{12}H_{16}N_2O_2$

15|3
25|13

15. In each of the following pairs, which compound will have the higher boiling point?

$O=C=O$ nonpolar only LDF; $O=C=S$ polar

CO_2 vs. [✓ COS] LDF + dipole

Both are nonpolar. CH_4 vs. [✓ SiH_4] SiH_4 is bigger so SiH_4 has stronger LD forces.

[✓ KCl] vs. HI ionic forces much stronger than covalent forces (even H-bonding)

a) CO_2; SiH_4; KCl b) COS; CH_4; HI c) CO_2; CH_4; KCl

[✓ d) COS; SiH_4; KCl] e) CO_2; SiH_4; HI

COS is polar so has additional dipole forces not present in CO_2, also larger, so stronger LDF in COS.

16|4
26|14

16. Equal masses of three different gases, X, Y, and Z, are mixed in a sealed rigid container at constant temperature. If the molar mass of gas X is greater than either of the molar masses of gases Y or Z, which of the following statements about the partial pressure of gas X is **true**? Assume ideal gas behavior. If molar mass of X is largest, then we have fewer moles of X as compared to Y and Z. At constant V and T, P ∝ n. If we were to have equal moles of each gas, then 1/3 of the moles is due to each gas so partial pressure of each gas is 1/3 of P_{TOTAL}. Since we have fewer moles of X, the partial pressure of X must be less than 1/3 of the total pressure.

a) The partial pressure of gas X is equal to 1/3 of the total pressure.
[✓ b) The partial pressure of gas X is less than 1/3 of the total pressure.]
c) The partial pressure of gas X is greater than 1/3 of the total pressure.
d) The partial pressure of gas X may be equal to or less than or greater than 1/3 of the total pressure.

17|5
27|15

17. In a 3.00 liter rigid container at 25°C, 1.20 moles of O_2 gas and 1.60 moles of solid C (graphite) are reacted to form CO gas. After the reaction has gone to completion, what will be the final total pressure in the container at 25°C? C is limiting. Set-up BCA table to figure moles total of gas after rxn goes to completion.

a) 4.89 atm b) 13.0 atm c) 9.78 atm d) 20.0 atm [✓ e) 16.3 atm]

	$2C(s)$	+ $O_2(g)$	$\longrightarrow 2CO(g)$
B	1.60 mol	1.20 mol	0
C	−1.60	−0.80	+1.60
A	0	0.40 mol	1.60 mol

After rxn, we have 0.40 + 1.60 = 2.00 mol of gas.

$$P_{TOT} = \frac{n_{TOT}RT}{V} = \frac{2.00\ mol\ (0.08206)(298K)}{3.00L} = \boxed{16.3\ atm}$$

Form
A|B
C|D

The soluble compounds are $Ca(OH)_2$, K_2S, and $NaNO_3$. Only K_2S breaks up into 2 cations (K^+) for every 1 anion (S^{2-}).

18|11
14|7

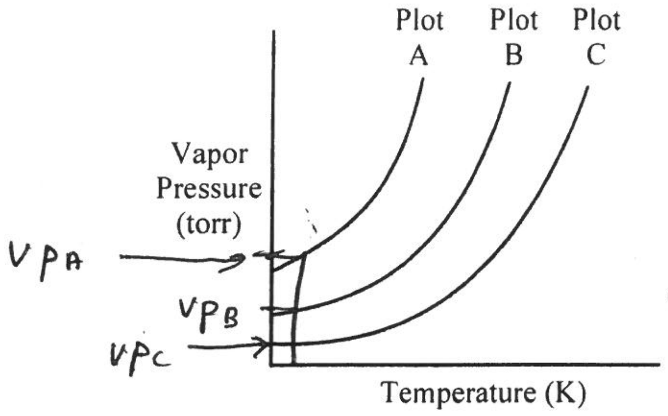
18. Consider a soluble ionic compound. When this compound is dissolved in water, it is found to produce two cations for every anion. Which of the following could be this compound?

$\nearrow Ca^{2+} + 2OH^-$ $\nearrow 2K^+ + S^{2-}$ $\nearrow Na^+ + NO_3^-$

a) Ag_2CrO_4 insoluble b) $Ca(OH)_2$ Soluble [✓ c)] K_2S soluble d) $NaNO_3$ soluble e) Hg_2Cl_2 insoluble

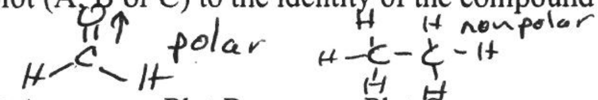
18|12
15|8

19. Consider the following vapor pressure vs. temperature plots for three different compounds.



At the temp indicated on plot, compound C has the lowest vapor pressure while compound A has the highest vapor pressure. Vapor pressure is inversely related to strength of IMF. The compound with strongest IMF is compound C and the compound with the weakest IMF is compound A.

If the three compounds are CH_2O, HF and CH_3CH_3, which of the following correctly matches the plot (A, B or C) to the identity of the compound? CH_3CH_3 exists as $H_3C–CH_3$.



H—F hydrogen bonding.

	Plot A	Plot B	Plot C
a)	HF	CH_2O	CH_3CH_3
[✓ b)]	CH_3CH_3	CH_2O	HF
c)	CH_3CH_3	HF	CH_2O
d)	HF	CH_3CH_3	CH_2O
e)	CH_2O	CH_3CH_3	HF

HF can H-bond and the other covalent compounds can't. Compound C = HF. CH_3CH_3 and CH_2O have about the same molar mass, but CH_2O has additional di. pol forces. Compound B = CH_2O

Compound A = CH_3CH_3

20|13
16|9

20. Consider an element designated as E. If 2.00 g of E reacts exactly with 10.10 g of chlorine (Cl_2) to form a compound with the formula ECl_4, what is the identity of E? $E + 2Cl_2 \rightarrow ECl_4$

$$\text{mol E} = 10.10 g\ Cl_2 \left(\frac{1 \text{mol } Cl_2}{70.90 g}\right)\left(\frac{1 \text{mol E}}{2 \text{mol } Cl_2}\right) = 0.07123 \text{ mol E}$$

a) Cl b) P [✓ c)] Si d) Al e) Ge

$$\text{molar mass } E = \frac{2.00 g\ E}{0.07123 \text{ mol E}} = 28.1 g/mol; \boxed{E = Si}$$

21|14
17|10

21. A 5.00 g sample of iron reacts with oxygen in the air to form 6.91 g of ~~an oxide of~~ iron. What is the empirical formula for this compound?

mass O in compd = 6.91 g − 5.00 g = 1.91 g O

a) FeO b) Fe_2O c) Fe_2O_3 d) Fe_9O_{13} [✓ e)] Fe_3O_4

$$5.00 g\ Fe \left(\frac{1 \text{mol Fe}}{55.85 g}\right) = 0.08953 \text{ mol Fe} / 0.08953 = 1 \text{ mol Fe}$$

$$1.91 g\ O \left(\frac{1 \text{mol O}}{16.00 g}\right) = 0.1194 \text{ mol O} / 0.08953 = 1.33 \text{ mol O}$$

$$(Fe_1O_{1.33}) \times 3 = \boxed{Fe_3O_4} = \text{empirical formula}$$

Form
A|B
C|D

$P \cdot M = dRT$, $M = \frac{dRT}{P} = \frac{2.9\times10^{-3}\,g/L\,(0.08206)(1273\,K)}{10\,torr\left(\frac{1\,atm}{760\,torr}\right)}$

$M = 23\,g/mol$

From periodic table, this is sodium (Na).

22|19
4|1

22. At 1000°C and 10 torr, the density of a certain element in the gaseous state is 2.9×10^{-3} g/L. The element is:

a) Ne b) He c) Hg d) Ar [✓ e) Na]

---

molar mass $Fe_2O_3 = 2(55.85) + 3(16.00) = 159.7\,g/mol$

23|20
5|2

23. The chemical process of rusting is described by the following **unbalanced** equation:

$4\,Fe(s) + 3\,O_2(g) \rightarrow 2\,Fe_2O_3(s)$

If Fe limiting: $56\,g\,Fe\left(\frac{1\,mol\,Fe}{55.85\,g}\right)\left(\frac{2\,mol\,Fe_2O_3}{4\,mol\,Fe}\right)\left(\frac{159.7\,g}{mol\,Fe_2O_3}\right) = \boxed{80.\,g\,Fe_2O_3}$

The maximum amount of rust (Fe_2O_3) that can be produced from 56 g Fe and 32 g O_2 is:

If O_2 limiting: $32\,g\,O_2\left(\frac{1\,mol\,O_2}{32\,g}\right)\left(\frac{2\,mol\,Fe_2O_3}{3\,mol\,O_2}\right)\left(\frac{159.7\,g}{mol\,Fe_2O_3}\right) = 106\,g\,Fe_2O_3$

a) 160 g [✓ b) 80. g] c) 40. g d) 120 g e) 110 g

Fe is limiting (produced smallest amount of Fe_2O_3). 80. g Fe_2O_3 can be produced.

24|21
6|3

24. For which one of the following acid solutions will 100.0 mL of the acid solution exactly neutralize (react with) 50.0 mL of a 0.20 *M* $Ba(OH)_2$ solution? $H^+ + OH^- \rightarrow H_2O$

mol OH^- present $= 0.0500\,L\left(\frac{0.20\,mol\,Ba(OH)_2}{L}\right)\left(\frac{2\,mol\,OH^-}{mol\,Ba(OH)_2}\right) = 0.020\,mol\,OH^-$ present

a) 0.050 *M* HCl b) 0.10 *M* HNO_3 c) 0.40 *M* HBr

we need 0.020 mol H^+ to react with 0.020 mol OH^-. Only answer e has 0.020 mol H^+.

d) 0.20 *M* H_2SO_4 [✓ e) 0.10 *M* H_2SO_3]

mol H^+ from answer e: $0.1000\,L\left(\frac{0.10\,mol\,H_2SO_3}{L}\right)\left(\frac{2\,mol\,H^+}{1\,mol\,H_2SO_3}\right) = 0.020\,mol\,H^+$

25|22
7|4

25. When 70. mL of 3.0 *M* sodium carbonate is added to 30. mL of 1.0 *M* sodium bicarbonate ($NaHCO_3$), the resulting concentration of Na^+ is:

mol Na^+ present $= 0.070\,L\left(\frac{3.0\,mol\,Na_2CO_3}{L}\right)\left(\frac{2\,mol\,Na^+}{1\,mol\,Na_2CO_3}\right) + 0.030\,L\left(\frac{1.0\,mol\,NaHCO_3}{L}\right)\left(\frac{1\,mol\,Na^+}{1\,mol\,NaHCO_3}\right)$

a) 2.0 *M* b) 2.4 *M* c) 4.0 *M* [✓ d) 4.5 *M*] e) 7.0 *M*

mol $Na^+ = 0.42\,mol + 0.030\,mol = 0.45\,mol\,Na^+$ $[Na^+] = \frac{0.45\,mol\,Na^+}{0.100\,L} = \boxed{4.5\,M}$

26|23
8|5

26. Iron(II) sulfate reacts with potassium hydroxide in aqueous solution to form a precipitate. The net ionic equation for this reaction is:

Formula equation $= FeSO_4(aq) + 2\,KOH(aq) \rightarrow Fe(OH)_2(s) + K_2SO_4(aq)$

K^+ and SO_4^{2-} are spectator ions.

a) $Fe^{2+}(aq) + SO_4^{2-}(aq) \rightarrow FeSO_4(s)$
b) $2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$
[✓ c) $Fe^{2+}(aq) + 2\,OH^-(aq) \rightarrow Fe(OH)_2(s)$]
d) $2\,Fe^{3+}(aq) + 3\,SO_4^{2-}(aq) \rightarrow Fe_2(SO_4)_3(s)$
e) $K^+(aq) + Fe^{2+}(aq) \rightarrow K(s) + Fe^{3+}(aq)$

$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2(s)$ is net ionic equation (get rid of spectator ions).

$Ba^{2+} + CO_3^{2-} \rightarrow BaCO_3(s)$

27|24
9|6

27. A 20.0 mL sample of 0.200 *M* K_2CO_3 solution is added to 30.0 mL of 0.400 *M* $Ba(NO_3)_2$ solution. Barium carbonate precipitates. Calculate the concentration of barium ions (Ba^{2+}) in solution **after** precipitation has gone to completion.

initial moles $CO_3^{2-} = 0.0200\,L\left(\frac{0.200\,mol\,K_2CO_3}{L}\right)\left(\frac{1\,mol\,CO_3^{2-}}{1\,mol\,K_2CO_3}\right) = 0.0040\,mol\,CO_3^{2-}$

a) 0.150 *M* [✓ b) 0.160 *M*] c) 0.200 *M*

initial moles $Ba^{2+} = 0.0300\,L\left(\frac{0.400\,mol\,Ba(NO_3)_2}{L}\right)\left(\frac{1\,mol\,Ba^{2+}}{1\,mol\,Ba(NO_3)_2}\right) = 0.0120\,mol\,Ba^{2+}$

d) 0.240 *M* e) 0.267 *M*

	Ba^{2+}	$+\ CO_3^{2-}$	$\rightarrow BaCO_3(s)$
Before	0.0120 mol	0.0040 mol	0
Change	−0.0040	−0.0040	+0.0040
After	0.0080 mol	0	0.0040

$[Ba^{2+}] = \frac{\text{moles excess } Ba^{2+}}{\text{total volume}}$

$[Ba^{2+}] = \frac{0.0080\,mol\,Ba^{2+}}{0.0500\,L} = \boxed{0.16\,M}$

Form

A	B
C	D

$V_A = \frac{n_A R T_A}{P_A} = \frac{1 mol (0.08206)(300K)}{0.4 atm} = 61.5\ L$

$V_B = \frac{n_B R T_B}{P_B} = \frac{1 mol (0.08206)(3000K)}{0.2 atm} = 1230\ L$

$V_B = 20(V_A)$ $\frac{1230 L}{61.52} = 20$

28/28
28/28

28. Consider the following two gas samples:

Sample A	**Sample B**
contents = $Cl_2(g)$	contents = $O_2(g)$
n = 1 mol	n = 1 mol
T = 300 K	T = 3000 K
P = 0.4 atm	P = 0.2 atm

Gas behaves most ideally at high T, low P.

Which of the following statements is **true** regarding these two gas samples?

Gas B is at higher temp and lower P. Gas B behaves most ideally.

T [✓ a)] The gas in sample B should behave more ideally than the gas in sample A.

F b) The volume of the gas in sample B is ~~five~~ 20 times larger than the volume of the gas in sample A. see above for work

$KE_{Ave} = \frac{3}{2}RT$

F c) The average kinetic of the gas molecules in Sample A is larger than the average kinetic energy of the gas molecules in Sample B. B at higher temp.

F d) The average velocity of the gas molecules in Sample A is greater than the average velocity of the gas molecules in Sample B. Gas B (O_2) is smaller in size and at higher temp. Gas B has fastest average velocity.

F e) The number of gas molecules in Sample A is larger than the number of gas molecules in Sample B. Both contain 1.0 mol (6.022×10^{23}) gas molecules.

$Pb^{2+} + 2Cl^- \rightarrow PbCl_2(s)$

29/29
29/29

29. A 5.00 g sample of an unknown metal chloride compound is dissolved in 50.0 mL of solution. To this solution, 70.0 mL of 0.400 *M* $Pb(NO_3)_2$ is added in order to precipitate all of the chloride ion as $PbCl_2(s)$. Calculate the mass percent of chloride ion in the metal chloride compound.

mass $Cl^- = 0.0700 L \left(\frac{0.400 mol\ Pb(NO_3)_2}{L}\right)\left(\frac{1 mol\ Pb^{2+}}{1 mol\ Pb(NO_3)_2}\right)\left(\frac{2 mol\ Cl^-}{1 mol\ Pb^{2+}}\right)\left(\frac{35.45 g}{mol\ Cl}\right) = 1.985 g\ Cl^-$

a) 0.0993% b) 14.0% c) 19.9% d) 28.0% [✓ e)] 39.7%

mass % Cl $= \frac{1.985 g\ Cl^-}{5.00 g\ compound} \times 100 = \boxed{39.7\%\ Cl^-}$

30/30
30/30

30. You mix 75.0 mL of 0.100 *M* aqueous Na_3PO_4 with 100.0 mL of 0.100 *M* aqueous $Ca(NO_3)_2$. Once the reaction has gone to completion, how many moles of precipitate can form? $2Na_3PO_4(aq) + 3Ca(NO_3)_2(aq) \rightarrow Ca_3(PO_4)_2(s) + 6NaNO_3(aq)$

a) 0.00250 mol [✓ b)] 0.00333 mol c) 0.00375 mol
d) 0.00500 mol e) 0.00750 mol

If Na_3PO_4 limiting: $0.0750 L\left(\frac{0.100 mol\ Na_3PO_4}{L}\right)\left(\frac{1 mol\ Ca_3(PO_4)_2}{2 mol\ Na_3PO_4}\right) = 0.00375 mol\ Ca_3(PO_4)_2$

If $Ca(NO_3)_2$ limiting: $0.100 L\left(\frac{0.100 mol\ Ca(NO_3)_2}{L}\right)\left(\frac{1 mol\ Ca_3(PO_4)_2}{3 mol\ Ca(NO_3)_2}\right) = \boxed{0.00333 mol\ Ca_3(PO_4)_2}$

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

Since $Ca(NO_3)_2$ reactant produces the smallest amount of precipitate, $Ca(NO_3)_2$ is limiting and 0.00333 mol $Ca_3(PO_4)_2$ can form.