

1. The two most abundant isotopes of chlorine are ^{35}Cl (34.99 amu) and ^{37}Cl (36.99 amu). What are their percent abundances? (Hint: Use value from periodic table)

- a) ^{35}Cl is 37%; ^{37}Cl is 63%
- b) ^{35}Cl is 23%; ^{37}Cl is 77%
- c) ^{35}Cl is 77%; ^{37}Cl is 23%**
- d) ^{35}Cl is 63%; ^{37}Cl is 37%
- e) ^{35}Cl is 50%; ^{37}Cl is 50%

$$35.45 = 34.99x + 36.99y$$

$$x + y = 1$$

$$-x \quad -x$$

$$y = 1 - x$$

$$35.45 = 34.99x + 36.99(1-x)$$

$$35.45 = 34.99x + 36.99 - 36.99x$$

$$-36.99 \quad -36.99$$

$$\frac{-1.64}{-2} = \frac{-2x}{-2}$$

$$x = 0.77$$

$$0.77 \times 100 = 77\%$$

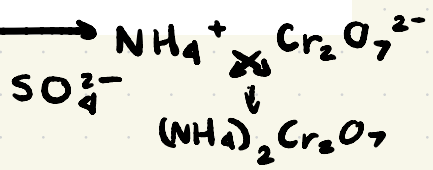
$$0.77 + y = 1 \Rightarrow y = 0.23$$

$$0.23 \times 100 = 23\%$$

2. Given the name of the compound, write its molecular formula.

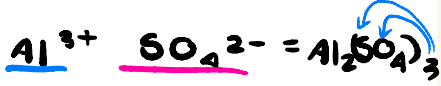
- a) Vanadium **V** nitride: $\text{V}^{+5} \text{N}^{-3} \rightarrow \text{V}_3\text{N}_5$
- b) Iron (i) nitrate: $\text{Fe}^{+1} \text{NO}_3^- = \text{FeNO}_3$
- c) Tin (iv) fluoride: $\text{Sn}^{+4} \text{F}^- = \text{SnF}_4$
- d) Copper (ii) phosphate: $\text{Cu}^{+2} (\text{PO}_4)^{3-} = \text{Cu}_3(\text{PO}_4)_2$
- e) Ammonium dichromate: $\text{NH}_4^+ \text{Cr}_2\text{O}_7^{2-} \rightarrow (\text{NH}_4)_2\text{Cr}_2\text{O}_7$

- ClO - hypo-x-ite
- ClO_2^- - ite
- ClO_3^- - ate
- ClO_4^- - per-x-ate



3. What are the moles of each ion and the number of each atom in 78.5 g of aluminum sulfate?

- I. 0.241 mol Al^{3+}
- II. 0.459 mol Al^{3+}**
- III. 0.987 mol SO_4^{2-}
- IV. 0.688 mol SO_4^{2-}**
- V. 2.76×10^{23} atoms Al
- VI. 5.47×10^{24} atoms Al
- VII. 4.14×10^{23} atoms S
- VIII. 6.3510^{25} atoms S
- IX. 1.66×10^{24} atoms O
- X. 9.32×10^{23} atoms O



- a) II, IV, V, VII, IX**
- b) I, III, VI, VIII, X
- c) I, II, IV, VI, VIII, X
- d) II, III, V, VII, IX
- e) None of the above

mass \leftrightarrow moles \leftrightarrow atoms

molar mass \leftrightarrow avogadro.

6.02×10^{23}

$$\text{molar mass} : (2 \times \text{Al}) + (3 \times \text{S}) + (12 \times \text{O})$$

$$\text{mm} = 2 \times 26.98 + (3 \times 32) + (12 \times 16)$$

$$\text{mm} = 342.15 \text{ g/mol}$$

$$78.5 \text{ g Al}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{342.15 \text{ g Al}_2(\text{SO}_4)_3} \times \frac{2 \text{ mol Al}^{3+}}{1 \text{ mol Al}_2(\text{SO}_4)_3} = 0.459 \text{ mol Al}^{3+}$$

$$78.5 \text{ g Al}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol molecule}}{342.15 \text{ g molecule}} \times \frac{3 \text{ mol SO}_4^{2-}}{1 \text{ mol Al}_2(\text{SO}_4)_3} = 0.688 \text{ mol SO}_4^{2-}$$

$$0.459 \text{ mol Al}^{3+} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol Al}^{3+}} = 2.76 \times 10^{23} \text{ atoms Al}$$

$$0.688 \text{ mol SO}_4^{2-} \times \frac{1 \text{ mol S}}{1 \text{ mol SO}_4^{2-}} \times \frac{6.02 \times 10^{23} \text{ atoms S}}{1 \text{ mol S}} = 4.14 \times 10^{23} \text{ atoms S}$$

$$0.688 \text{ mol SO}_4^{2-} \times \frac{4 \text{ mol O}}{1 \text{ mol SO}_4^{2-}} \times \frac{6.02 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} = 1.66 \times 10^{24} \text{ atoms O}$$

4. You have a concentrated stock solution of HCl. The concentration is 8.2 M and there is 1.5 L of stock solution. 752 mL of stock solution are taken and diluted to 1.2 L in a volumetric flask. 65 mL of this new solution are taken and diluted to 125 mL in another volumetric flask. What is the final concentration?

- a) 2.7 M
- b) 6.2 M
- c) 8.2 M
- d) 3.4 M
- e) 4.5 M

$$M_1 V_1 = M_2 V_2 \dots M_3 V_3 = M_4 V_4$$

M = Molarity (M)
V = volume (L)



$$\frac{5.13 \text{ M} \times 0.065 \text{ L}}{0.125} = \frac{1.25 \text{ L} \times M}{1.25}$$

$$M_4 = 2.7 \text{ M}$$

$$8.2 \text{ M}, 752 \text{ mL} = 0.752 \text{ L} = V_1$$

$$1.2 \text{ L} = V_2$$

$$M_2$$

$$\frac{8.2 \text{ M} \times 0.752 \text{ L}}{1.2} = \frac{1.2 \text{ L} \times M}{1.2}$$

$$M_2 = 5.13 \text{ M}$$

$$M_3 = 5.13 \text{ M}$$

$$V_3 = 65 \text{ mL} = 0.065 \text{ L}$$

$$V_4 = 125 \text{ mL} = 0.125 \text{ L}$$

$$M_4 = ?$$

5. In an experiment, 25.0 mL of a gas with a pressure of 1.00 atm is contained in a balloon at 25.00°C. The balloon's temperature is adjusted until the pressure is 0.75 atm at a volume of 31.1 mL. What is the final temperature of the gas under the new conditions?

- a) 278°C
- b) 5°C
- c) 23°C
- d) 273°C

V_1	P_1	T_1
25.0 mL	1.00 atm	25.00°C
V_2	P_2	T_2
31.1 mL	0.75 atm	?

$$\frac{1 \times 0.025}{298.15} = \frac{0.75 \times 0.031}{T_2}$$

$$T_2 = 278 \text{ K}$$

$$278 - 273.15 \approx 5^\circ \text{C}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$P_1 = 1 \text{ atm}$$

$$V_1 = 0.025 \text{ L}$$

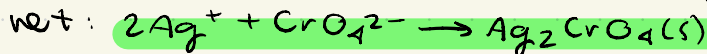
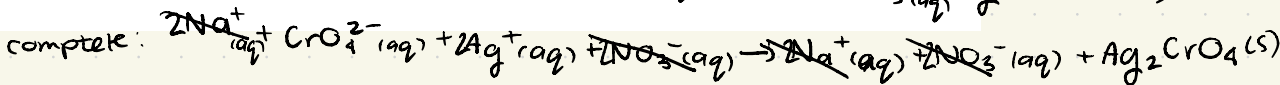
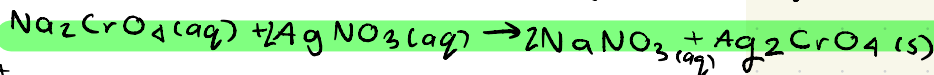
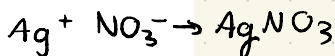
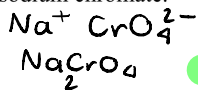
$$T_1 = 25 + 273.15 = 298.15 \text{ K}$$

$$P_2 = 0.75 \text{ atm}$$

$$V_2 = 0.031 \text{ L}$$

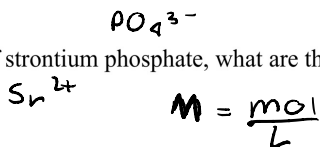
$$T_2 = ? \text{ K}$$

6. Write the balanced molecular and net ionic equations for the combination of silver nitrate and sodium chromate.



7. Given 2.68 M of strontium phosphate, what are the mols of phosphate ion in 689 mL?

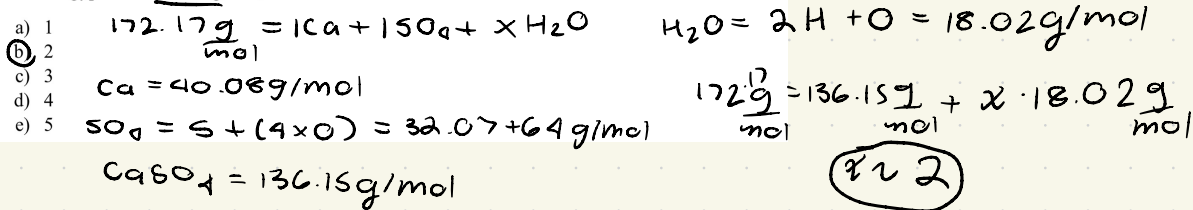
- a) 9.81 mol
- b) 3.69 mol
- c) 7.78 mol
- d) 2.43 mol
- e) 6.75 mol



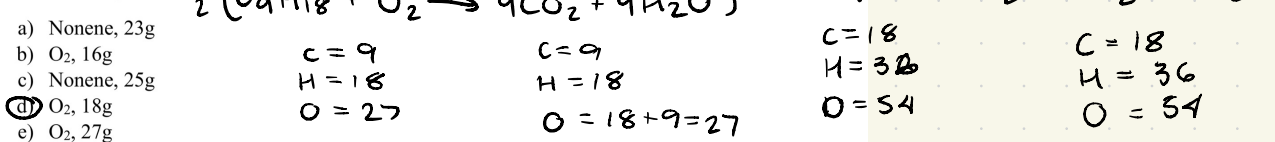
$$689 \text{ mL Sr}_3(\text{PO}_4)_2 \times \frac{1 \text{ L Sr}_3(\text{PO}_4)_2}{1000 \text{ mL Sr}_3(\text{PO}_4)_2} \times \frac{2.68 \text{ mol Sr}_3(\text{PO}_4)_2}{1 \text{ L}} \times \frac{2 \text{ mol PO}_4^{3-}}{1 \text{ mol Sr}_3(\text{PO}_4)_2} =$$

$$3.69 \text{ mol PO}_4^{3-}$$

8. Gypsum is a common hydrate salt. It has the general formula $\text{CaSO}_4 \cdot x\text{H}_2\text{O}$. If the molar mass of gypsum is 172.17 g/mol, what is x?



What is the mass of CO_2 if 8.2g of nonene (C_9H_{18}) and 20g of O_2 are combusted? And which is the limiting reactant?



$8.2 \text{g C}_9\text{H}_{18} \frac{1 \text{ mol C}_9\text{H}_{18}}{126 \text{ g C}_9\text{H}_{18}} \frac{18 \text{ mol CO}_2}{2 \text{ mol C}_9\text{H}_{18}} \frac{44.01 \text{ g CO}_2}{1 \text{ mol CO}_2} = 25.77 \text{ g CO}_2$

$20 \text{ g O}_2 \frac{1 \text{ mol O}_2}{32 \text{ g O}_2} \frac{18 \text{ mol CO}_2}{27 \text{ mol O}_2} \frac{44.01 \text{ g CO}_2}{1 \text{ mol CO}_2} = 18.3 \text{ g CO}_2$

10. Consider n moles of Argon, an ideal gas, at a density of 5.00 g/L and a pressure of 2.00 atm. What is the closest value to the temperature (in K) of this gas?

- a) 172 K
 b) 273 K
 c) 304 K
 d) 195 K

$PV = nRT$

$mm = \frac{\text{mass}}{\text{mol}}$ $d = \frac{\text{mass}}{V}$ $V = \frac{\text{mass}}{d}$

$mm \cdot \text{mol} = \text{mass}$ $V = \frac{mm \cdot \text{mol}}{d}$

$d = \frac{mm \cdot P}{R \cdot T}$

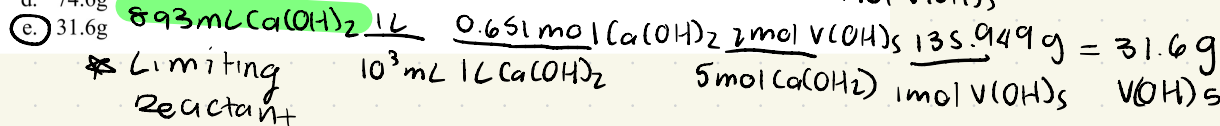
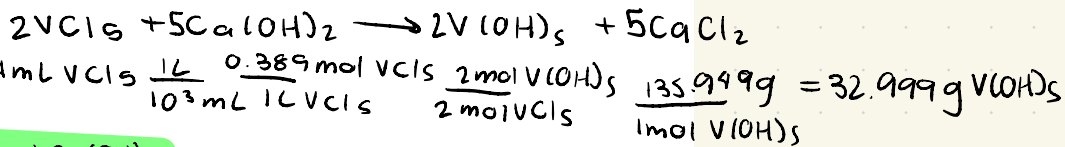
$\frac{d \cdot R \cdot T}{d \cdot R} = \frac{mm \cdot \text{mol} \cdot P}{d \cdot R}$

$T = \frac{39.9 \frac{\text{g}}{\text{mol}} \times 2 \text{ atm} \times 2 \text{ mol}}{5.00 \frac{\text{g}}{\text{L}} \times 0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}} = 196 \text{ K}$

$mm = 135.949 \frac{\text{g}}{\text{mol}}$

11. What is the mass of $\text{V}(\text{OH})_5$ formed when 624 mL of 0.389 M VCl_5 reacts with 893 mL of 0.651 M of $\text{Ca}(\text{OH})_2$?

- a) 30.6g
 b) 98.2g
 c) 33.0g
 d) 74.6g
 e) 31.6g



12. Using the question 11's chemical reaction, how many mL are left over of the excess reactant?

- a) 30mL
 b) 90mL
 c) 512mL
 d) 26mL
 e) 410mL

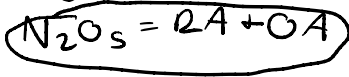
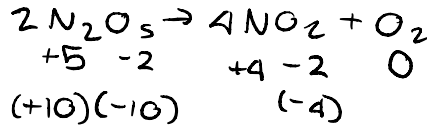
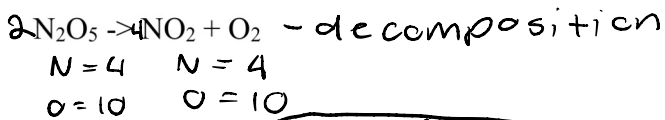
$31.6 \text{ g V}(\text{OH})_5 \frac{1 \text{ mol V}(\text{OH})_5}{135.949 \text{ g}} \frac{2 \text{ mol VCl}_5}{2 \text{ mol V}(\text{OH})_5} \frac{1 \text{ L VCl}_5}{0.389 \text{ mol VCl}_5} \frac{1000 \text{ mL}}{1 \text{ L}} = 597 \text{ mL VCl}_5 \text{ used}$

$624 \text{ mL} - 597 \text{ mL} = 27 \text{ mL left over}$

13. Balance and identify the type of reaction, oxidizing agent, and reducing agent of each equation:

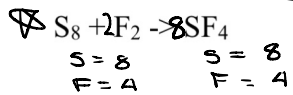
$$O = -2$$

$$H = \pm 1$$

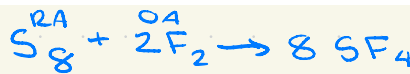
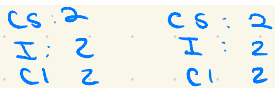
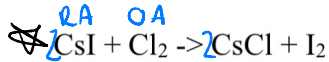


N: +5 \rightarrow +4 getting reduced = oxidizing agent
O: -2 \rightarrow 0 getting oxidized = reducing agent

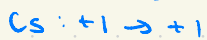
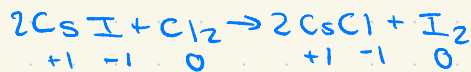
OIL RIG



combination rxn:
2 react \rightarrow 1 prod



S: 0 \rightarrow +4 loose e^- = oxidized = reducing agent
F: 0 \rightarrow -1 gain e^- = reduced = ox. agent



Cl: 0 \rightarrow -1 gets reduced = ox agent

I: -1 \rightarrow 0 gets oxidized = red agent

actual yield

14. Given the reaction $Fe_3O_4 + 4H_2 \rightarrow 3Fe + 4H_2O$, if 0.250g H_2 makes 1.49 g of H_2O , what is the percent yield?

- a. 52.3%
- b. 66.7%
- c. 95.2%
- d. 12.4%
- e. 75.3%

$0.25g H_2 \frac{1 \text{ mol } H_2}{2g H_2} \frac{4 \text{ mol } H_2O}{4 \text{ mol } H_2} \frac{18.02g}{1 \text{ mol}} = 2.25g H_2O$ - theoretical

$\therefore \text{yield} = \frac{\text{actual}}{\text{theoretical}} = \frac{1.49}{2.25} \times 100 = 66.7\%$

15. Given 7.13×10^{19} Ca atoms, what is the mass of calcium in grams?

- a. 5.23×10^{-3}
- b. 6.35×10^{-3}
- c. 4.74×10^{-3}
- d. 9.24×10^{-3}
- e. 4.93×10^{-3}

$7.13 \times 10^{19} \text{ Ca atoms} \frac{1 \text{ mol Ca}}{6.02 \times 10^{23} \text{ atoms}} \frac{40.08g}{1 \text{ mol Ca}}$

$= 4.74 \times 10^{-3} g$

16. Given 1 mol, what is the mass percent of each element in $C_6H_{12}O_6$?

- I. 60% C
 II. 40% C
 a. I, IV, VI
 b. II, IV, VI
 c. I, IV, V
 d. II, III, VI
 e. II, IV, V
- III. 6.7% H
 IV. 8.4% H
- V. 31.6% O
 VI. 53.3% O

$$C: \frac{6 \times 12g}{180.096} \times 100\% = 39.97\%$$

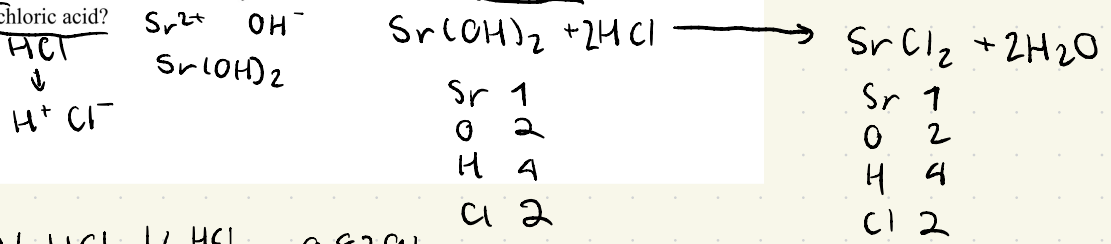
$$H: \frac{12 \times 1g}{180.096} \times 100\% = 6.7\%$$

$$O: \frac{6 \times 16}{180.096} \times 100\% = 53.3\%$$

1 mol $C_6H_{12}O_6$ start w/ mm = 180.096g

17. What volume of 0.6143 M of strontium hydroxide would neutralize 72.59 mL of a 0.8291 M solution of hydrochloric acid?

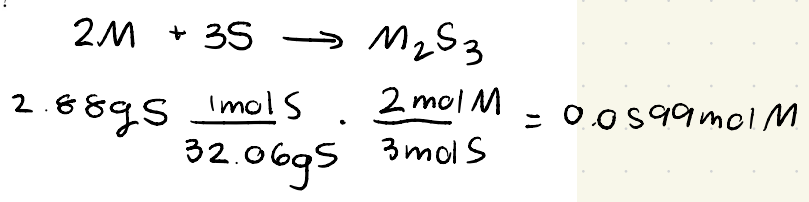
- a. 62.43mL
 b. 48.99mL
 c. 75.12mL
 d. 36.25mL
 e. 95.13mL



$$72.59 \text{ mL HCl} \times \frac{1 \text{ L HCl}}{1000 \text{ mL HCl}} \times \frac{0.8291 \text{ mol HCl}}{1 \text{ L HCl}} \times \frac{1 \text{ mol Sr(OH)}_2}{2 \text{ mol HCl}} \times \frac{1 \text{ L}}{0.6143 \text{ mol Sr(OH)}_2} \times \frac{1000 \text{ mL Sr(OH)}_2}{1 \text{ L Sr(OH)}_2} = 48.99 \text{ mL Sr(OH)}_2$$

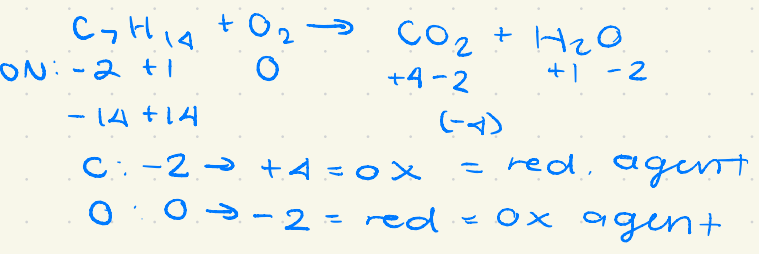
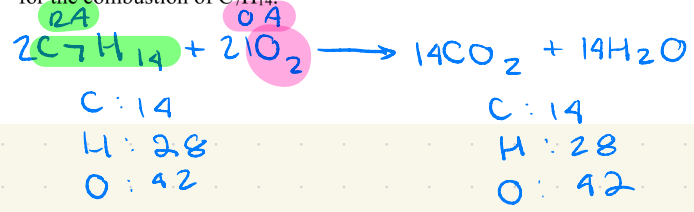
18. An unknown metal M reacts with sulfur to make M_2S_3 . If 1.62g of M reacts with 2.88g of sulfur, what is M and the name of M_2S_3 ?

- a. V; vanadium (iii) sulfide
 b. Fe; iron (iii) sulfide
 c. Au; gold (iii) sulfide
 d. Al; aluminum sulfide
 e. Cr; chromium (iii) sulfide



$$\text{mm} = \frac{g}{\text{mol}} = \frac{1.62 \text{ g}}{0.0599 \text{ mol}} = 27.05 = Al^{3+}$$

19. Balance the equation and identify the oxidation numbers, oxidizing agent, and reducing agent for the combustion of C_7H_{14} .



20. What is the empirical formula of a compound that is 40% C, 6.71% H, and 53.3% O? What is the molecular formula given that the molar mass is 240.24 g/mol?

- a. CH₂O; C₉H₁₈O₉
- b. C₂H₂O; C₁₆H₈O₈
- c. CH₂O; C₈H₁₆O₈
- d. CHO₂; C₉H₉O₁₈
- e. CH₂O; C₆H₁₂O₆

$$40 \text{ g C} \frac{1 \text{ mol}}{12 \text{ g}} = \frac{3.33}{3.33} \text{ mol C} \sim 1$$

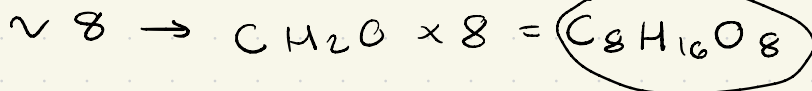
$$6.71 \text{ g H} \frac{1 \text{ mol}}{1 \text{ g}} = \frac{6.71}{3.33} \text{ mol H} \sim 2$$

$$53.3 \text{ g O} \frac{1 \text{ mol}}{16 \text{ g}} = \frac{3.33}{3.33} \text{ mol O} \sim 1$$

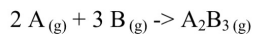
empirical:
CH₂O

empirical m.m =
12 + 2 + 16 = 30 $\frac{\text{g}}{\text{mol}}$

$$\frac{240 \text{ g/mol}}{30 \text{ g/mol}} \sim 8$$



21. Consider the following reaction in a closed reaction flask:



If 1.20 atm of gas A is allowed to react with 1.20 atm of gas B, and the reaction goes to completion at constant temperature and volume, what is the total pressure (in atm) in the reaction flask at the end of the reaction?

- a. 0.4 atm
- b. 0.8 atm
- c. 1.2 atm
- d. 2.4 atm

$$1.20 \text{ atm A} \frac{1 \text{ mol A}_2\text{B}_3}{2 \text{ mol A}} = 0.6 \text{ atm A}_2\text{B}_3$$

$$1.20 \text{ atm B} \frac{1 \text{ mol A}_2\text{B}_3}{3 \text{ mol B}} = 0.4 \text{ A}_2\text{B}_3 \leftarrow \text{product formed}$$

↑
limiting reactant

$$0.4 \text{ atm A}_2\text{B}_3 \frac{2 \text{ mol A}}{1 \text{ mol A}_2\text{B}_3} = 0.8 \text{ atm A}_2 \text{ used}$$

$$1.20 - 0.8 = 0.4 \text{ mol A}_2 \text{ left over}$$

<u>initial P</u>	<u>final P</u>
1.2 atm A	0.4 atm A
1.2 atm B	0 atm B
0 atm A ₂ B ₃	0.4 atm A ₂ B ₃

$$0.4 + 0.4 = 0.8 \text{ atm total}$$