# La clé de Hebden Chemistry 11 – A Workbook for Students

# ANSWERS TO UNIT V: THE MOLE CONCEPT

1. Since oxygen is $\frac{88.9\ g}{11.1\ g}$ = 8 times heavier than hydrogen (which has a mass of 1), oxygen has a mass of 8.

3. Since nitrogen is $\frac{46.7\ g}{53.3\ g}$ = 0.876 times heavier than oxygen, nitrogen has a mass of 0.876 x 8 = 7.

Finally, since carbon is $\frac{42.9\ g}{57.1\ g}$ = 0.751 times heavier than oxygen, carbon has a mass of 0.751 x 8 = 6.

2. Since there is 3 times the volume of chlorine gas compared to nitrogen, the reaction involves 3 times as many chlorine molecules as nitrogen molecules. Therefore, the formula is **$NCl_3$**. The name of the compound is nitrogen trichloride.

3. The volume of oxygen is twice the volume of sulphur so that the product contains twice as many oxygen atoms as sulphur atoms. The formula of the product is $SO_2$, sulphur dioxide.

4. The volume of fluorine is three times the volume of chlorine so that the formula contains three times as many fluorine atoms as chlorine atoms: $ClF_3$, chlorine trifluoride.

5. Since the volume of oxygen is five times the volume of unknown gas X, there are five times as many oxygen molecules as gas X molecules; that is, $5 \times 3.0 \times 10^{23} = 1.5 \times 10^{24}$ molecules.

6. (a) 1 N = 1 x 14.0 = 14.0 g
1 O = 1 x 16.0 = 16.0 g
molar mass = **30.0 g**

(b) 2 H = 2 x 1.0 = 2.0 g
1 O = 1 x 16.0 = 16.0 g
molar mass = **18.0 g**

(c) 1 N = 1 x 14.0 = 14.0 g
3 H = 3 x 1.0 = 3.0 g
molar mass = **17.0 g**

(d) 1 C = 1 x 12.0 = 12.0 g
2 O = 2 x 16.0 = 32.0 g
molar mass = **44.0 g**

(e) 1 C = 1 x 12.0 = 12.0 g
4 H = 4 x 1.0 = 4.0 g
molar mass = **16.0 g**

(f) 1 Ag = 1 x 107.9 = 107.9 g
1 N = 1 x 14.0 = 14.0 g
3 O = 3 x 16.0 = 48.0 g
molar mass = **169.9 g**

(g) 1 Ca = 1 x 40.1 = 40.1 g
2 O = 2 x 16.0 = 32.0 g
2 H = 2 x 1.0 = 2.0 g
molar mass = **74.1 g**

(h) 1 Al = 1 x 27.0 = 27.0 g
3 N = 3 x 14.0 = 42.0 g
9 O = 9 x 16.0 = 144.0 g
molar mass = **213.0 g**

(i) 1 Fe = 1 x 55.8 = 55.8 g
3 Cl = 3 x 35.5 = 106.5 g
molar mass = **162.3 g**

(j) 1 Sn = 1 x 118.7 = 118.7 g
2 C = 2 x 12.0 = 24.0 g
4 O = 4 x 16.0 = 64.0 g
molar mass = **206.7 g**

(k) 1 Sn = 1 x 118.7 = 118.7 g
4 C = 4 x 12.0 = 48.0 g
8 O = 8 x 16.0 = 128.0 g
molar mass = **294.7 g**

(l) 3 N = 3 x 14.0 = 42.0 g
12 H = 12 x 1.0 = 12.0 g
1 P = 1 x 31.0 = 31.0 g
4 O = 4 x 16.0 = 64.0 g
molar mass = **149.0 g**

(m) 2 C = 2 x 12.0 = 24.0 g
4 H = 4 x 1.0 = 4.0 g
2 O = 2 x 16.0 = 32.0 g
molar mass = **60.0 g**

(n) 4 C = 4 x 12.0 = 48.0 g
10 H = 10 x 1.0 = 10.0 g
molar mass = **58.0 g**

(o) 1 Ni = 1 x 58.7 = 58.7 g
16 H = 16 x 1.0 = 16.0 g
2 O = 2 x 16.0 = 32.0 g
4 N = 4 x 14.0 = 56.0 g
2 Cl = 2 x 35.5 = 71.0 g
molar mass = **233.7 g**

(p) 2 Al = 2 x 27.0 = 54.0 g
3 S = 3 x 32.1 = 96.3 g
12 O = 12 x 16.0 = 192.0 g
molar mass = **342.3 g**

7. (a) 3 Co = 3 x 58.9 = 176.7 g
2 As = 2 x 74.9 = 149.8 g
16 O = 16 x 16.0 = 256.0 g
16 H = 16 x 1.0 = 16.0 g
molar mass = **598.5 g**

(b) 1 Pb = 1 x 207.2 = 207.2 g
4 C = 4 x 12.0 = 48.0 g
12 H = 12 x 1.0 = 12.0 g
7 O = 7 x 16.0 = 112.0 g
molar mass = **379.2 g**

(c) 1 Mg = 1 x 24.3 = 24.3 g
1 S = 1 x 32.1 = 32.1 g
11 O = 11 x 16.0 = 176.0 g
14 H = 14 x 1.0 = 14.0 g
molar mass = **246.4 g**

(d) 1 K = 1 x 39.1 = 39.1 g
1 Al = 1 x 27.0 = 27.0 g
2 S = 2 x 32.1 = 64.2 g
20 O = 20 x 16.0 = 320.0 g
24 H = 24 x 1.0 = 24.0 g
molar mass = **474.3 g**

8. (a) mass = $1.00 \text{ mol} \times \frac{53.5 \text{ g}}{1 \text{ mol}} = \mathbf{53.5 \text{ g}}$

(b) mass = $4.50 \text{ mol} \times \frac{53.5 \text{ g}}{1 \text{ mol}} = \mathbf{241 \text{ g}}$

(c) mass = $3.25 \text{ mol} \times \frac{137.5 \text{ g}}{1 \text{ mol}} = \mathbf{447 \text{ g}}$

(d) mass = $0.00355 \text{ mol} \times \frac{142.0 \text{ g}}{1 \text{ mol}} = \mathbf{0.504 \text{ g}}$

(e) mass = $0.0125 \text{ mol} \times \frac{207.3 \text{ g}}{1 \text{ mol}} = \mathbf{2.59 \text{ g}}$

(f) mass = $2.60 \text{ mol} \times \frac{30.0 \text{ g}}{1 \text{ mol}} = \mathbf{78.0 \text{ g}}$

(g) mass = $3.25 \times 10^{2} \text{ mol} \times \frac{17.0 \text{ g}}{1 \text{ mol}} = \mathbf{5.53 \times 10^{3} \text{ g}}$

(h) mass = $7.90 \times 10^{-4} \text{ mol} \times \frac{82.1 \text{ g}}{1 \text{ mol}} = \mathbf{0.0649 \text{ g}}$

(i) mass = $1.00 \times 10^{-3} \text{ mol} \times \frac{40.0 \text{ g}}{1 \text{ mol}} = \mathbf{0.0400 \text{ g}}$

(j) mass = $1.75 \times 10^{-4} \text{ mol} \times \frac{55.8 \text{ g}}{1 \text{ mol}} = \mathbf{9.77 \times 10^{-3} \text{ g}}$

9. (a) # of moles = $17.0 \text{ g} \times \frac{1 \text{ mol}}{98.1 \text{ g}} = \mathbf{0.173 \text{ mol}}$

(b) # of moles = $91.5 \text{ g} \times \frac{1 \text{ mol}}{18.0 \text{ g}} = \mathbf{5.08 \text{ mol}}$

(c) # of moles = $53.0 \text{ g} \times \frac{1 \text{ mol}}{12.0 \text{ g}} = \mathbf{4.42 \text{ mol}}$

(d) # of moles = $1.25 \times 10^{-4} \text{ g} \times \frac{1 \text{ mol}}{95.6 \text{ g}} = \mathbf{1.31 \times 10^{-6} \text{ mol}}$

(e) # of moles = $4.50 \text{ kg} \times \frac{10^{3} \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol}}{16.0 \text{ g}} = \mathbf{281 \text{ mol}}$

(f) # of moles = $225 \text{ g} \times \frac{1 \text{ mol}}{132.1 \text{ g}} = \mathbf{1.70 \text{ mol}}$

(g) # of moles = $55.2 \text{ mg} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ mol}}{71.0 \text{ g}} = \mathbf{7.77 \times 10^{-4} \text{ mol}}$

(h) # of moles = $128.2 \text{ g} \times \frac{1 \text{ mol}}{64.1 \text{ g}} = \mathbf{2.00 \text{ mol}}$

(i) # of moles = $2955 \text{ kg} \times \frac{10^{3} \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol}}{107.9 \text{ g}} = \mathbf{2.739 \times 10^{4} \text{ mol}}$

(j) # of moles = $0.0845 \text{ g} \times \frac{1 \text{ mol}}{158.0 \text{ g}} = \mathbf{5.35 \times 10^{-4} \text{ mol}}$

(a) molar mass = $\frac{4.00\ g}{0.250\ mol}$ = **16.0 g/mol** (c) molar mass = $\frac{7.76 \times 10^{-3}\ g}{6.47 \times 10^{-4}\ mol}$ = **12.0 g/mol**

(b) molar mass = $\frac{0.947\ g}{0.00248\ mol}$ = **382 g/mol** (d) molar mass = $\frac{74.8\ g}{3.44 \times 10^{-5}\ mol}$ = **2.17 x $10^{6}$ g/mol**

(a) volume = 12.5 mol x $\frac{24.8\ L}{1\ mol}$ = **3.10 x $10^{2}$ L** (c) volume = 4.25 mol x $\frac{24.8\ L}{1\ mol}$ = **105 L**

(b) volume = 0.350 mol x 24.8 L / 1mol = **8.68 L**

(a) # of moles = 85.9 L x 1 mol / 22.7 L = **3.78 mol**

(b) # of moles = 375 mL x $\frac{10^{-3}\ L}{1\ mL}$ x $\frac{1\ mol}{22.7\ L}$ = **0.0165 mol**

(c) # of moles = 5.00 mL x $\frac{10^{-3}\ L}{1\ mL}$ x $\frac{1\ mol}{22.7\ L}$ = **2.20 x $10^{-4}$ mol**

13. # of seconds in 1 year = 365 x 24 x 60 x 60 = 3.15 x $10^{7}$ s

amount spent in 1 yr = 3.15 x $10^{7}$ s x $\frac{\$10^{3}}{1\ s}$ = \$3.15 x $10^{10}$

amount given to each person = $\frac{\$6.02 \times 10^{23}}{4.5 \times 10^{9}}$ = \$1.34 x $10^{14}$

percentage spent = $\frac{\$3.15 \times 10^{10}}{\$1.34 \times 10^{14}}$ x 100 % = **0.024 %**

14. # of pennies/layer = $\frac{1\ penny}{3.61\ cm^{2}}$ x $\frac{10^{10}\ cm^{2}}{1\ km^{2}}$ x 1.49 x $10^{8}$ $km^{2}$ = 4.13 x $10^{17}$

thickness = 6.02 x $10^{23}$ pennies x $\frac{1\ layer}{4.13 \times 10^{17}\ pennies}$ x $\frac{1.50\ mm}{1\ layer}$ x $\frac{10^{-3}\ m}{1\ mm}$ x $\frac{1\ km}{10^{3}\ m}$ = **2.19 km**

15. (a) # of moles = 10.6 L x $\frac{1\ mol}{22.7\ L}$ = **0.467 mol**

(b) # of moles = 7.50 x $10^{21}$ molecules x $\frac{1\ mol\ molecules}{6.02 \times 10^{23}\ molecules}$ = **0.0125 mol**

(c) # of moles = 425 mg x $\frac{10^{-3}\ g}{1\ mg}$ x $\frac{1\ mol}{74.1\ g}$ = **5.74 x $10^{-3}$ mol**

(d) # of moles = 4.25 x $10^{12}$ molecule x $\frac{1\ mol\ molecules}{6.02 \times 10^{23}\ molecules}$ = **7.06 x $10^{-12}$ mol**

(e) # of moles = 0.950 kg x $\frac{10^{3}\ g}{1\ kg}$ x $\frac{1\ mol}{40.0\ g}$ = **23.8 mol**

(f) # of moles = 25.0 mL x $\frac{10^{-3}\ L}{1\ mL}$ x $\frac{1\ mol}{24.8\ L}$ = **1.01 x $10^{-3}$ mol**

(g) # of moles = 5.50 x $10^{25}$ molecules x $\frac{1\ mol\ molecules}{6.02 \times 10^{23}\ molecules}$ = **91.4 mol**

(h) # of moles = 0.120 L x $\frac{1\ mol}{22.7\ L}$ = **5.29 x $10^{-3}$ mol**

16. (a) volume = 0.235 mol x $\frac{22.7\ L}{1\ mol}$ = **5.33 L** (c) volume = $2.55 \times 10^3$ mol x $\frac{22.7\ L}{1\ mol}$ = **$5.79 \times 10^4$ L**

(b) volume = 9.36 mol x $\frac{22.7\ L}{1\ mol}$ = **$2.12 \times 10^2$ L**

17. (a) mass = 0.125 mol x $\frac{44.0\ g}{1\ mol}$ = **5.50 g** (c) mass = $6.54 \times 10^{-4}$ mol x $\frac{27.0\ g}{1\ mol}$ = **0.0177 g**

(b) mass = 5.48 mol x $\frac{162.3\ g}{1\ mol}$ = **889 g** (d) mass = 15.4 mol x $\frac{92.7\ g}{1\ mol}$ = **$1.43 \times 10^3$ g**

18. (a)
$2\ Na = 2 \times 23.0 = 46.0\ g$
$4\ B = 4 \times 10.8 = 43.2\ g$
$17\ O = 17 \times 16.0 = 272.0\ g$
$20\ H = 20 \times 1.0 = 20.0\ g$
molar mass = **381.2 g**

(b) mass of 1 mol of grannies = $6.02 \times 10^{23} \times 52\ kg = 3.1 \times 10^{25}$ **kg**

(c) mass of 1 mol = $3.52 \times 10^{-22}\ g \times 6.02 \times 10^{23} =$ **212 g**

(d) mass of 1 mol of electrons = $6.02 \times 10^{23} \times 9.1 \times 10^{-28}\ g = 5.5 \times 10^{-4}$ **g**

(e)
$3\ Cu = 3 \times 63.5 = 190.5\ g$
$8\ O = 8 \times 16.0 = 128.0\ g$
$2\ H = 2 \times 1.0 = 2.0\ g$
$2\ C = 2 \times 12.0 = 24.0\ g$
molar mass = **344.5 g**

(f) mass of 1 mol of books = $6.02 \times 10^{23} \times 1.24\ kg = 8.67 \times 10^{23}$ **kg**

19. mass of 1 mol of unknown = $6.02 \times 10^{23} \times 1.18 \times 10^{-22}\ g = 71.0\ g$
molar masses of known gases:
$SO_2 = 80.1\ g$
$CH_4 = 16.0\ g$
$NF_3 = 71.0\ g$ (this is the unknown)
$C_2H_2 = 26.0\ g$

20. (a) # of drumsticks = 2 mol x $\frac{6.02 \times 10^{23}\ chickens}{1\ mol\ chickens} \times \frac{2\ drumsticks}{1\ chicken}$ = **$2.41 \times 10^{24}$ drumsticks**

(b) each chicken has 2 drumsticks + 2 wings + 2 thighs = 6 "parts"

# of parts = 2 mol x $\frac{6.02 \times 10^{23}\ chickens}{1\ mol\ chickens} \times \frac{6\ parts}{1\ chicken}$ = **$7.22 \times 10^{24}$ parts**

21. (a) 8 (b) 6 (c) 10 (d) 15 (e) 46 (f) 23

22. (a) mass = $2 \times 10^6$ molecules x $\frac{1\ mol}{6.02 \times 10^{23}\ molecules} \times \frac{28.0\ g}{1\ mol}$ = **$9 \times 10^{-17}$ g**

(b) mass = 1.25 L x $\frac{1\ mol}{22.7\ L} \times \frac{17.0\ g}{1\ mol}$ = **0.936 g**

(c) mass = $5 \times 10^{14}$ molecules x $\frac{1\ mol}{6.02 \times 10^{23}\ molecules} \times \frac{28.0\ g}{1\ mol}$ = **$2 \times 10^{-8}$ g**

(d) mass = 1 molecule x $\frac{1\ mol}{6.02 \times 10^{23}\ molecules} \times \frac{56.1\ g}{1\ mol}$ = **$9.32 \times 10^{-23}$ g**

(e) mass = 125 atoms $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{4.0 \text{ g}}{1 \text{ mol}} = \mathbf{8.3 \times 10^{-22} \text{ g}}$

(f) mass = 1 atom $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{107.9 \text{ g}}{1 \text{ mol}} = \mathbf{1.79 \times 10^{-22} \text{ g}}$

(g) mass = $4.15 \times 10^{15}$ molec $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{16.0 \text{ g}}{1 \text{ mol}} = \mathbf{1.10 \times 10^{-7} \text{ g}}$

(h) mass = 175 atoms $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{14.0 \text{ g}}{1 \text{ mol}} = \mathbf{4.07 \times 10^{-21} \text{ g}}$

(i) mass = 3.45 mL $\times \frac{10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{1 \text{ mol}}{24.8 \text{ L}} \times \frac{32.0 \text{ g}}{1 \text{ mol}} = \mathbf{4.45 \times 10^{-3} \text{ g}}$

(j) mass = $1.00 \times 10^{8}$ L $\times \frac{1 \text{ mol}}{22.7 \text{ L}} \times \frac{2.0 \text{ g}}{1 \text{ mol}} = \mathbf{8.8 \times 10^{6} \text{ g}}$

23. (a) # of atoms = 1.00 mol $\times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{6 \text{ atoms}}{1 \text{ molecule}} = \mathbf{3.61 \times 10^{24} \text{ atoms}}$

(b) # of atoms = 2.5 mol $\times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{3 \text{ atoms}}{1 \text{ molecule}} = \mathbf{4.5 \times 10^{24} \text{ atoms}}$

(c) # of atoms = 8.00 g $\times \frac{1 \text{ mol}}{55.8 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = \mathbf{8.63 \times 10^{22} \text{ atoms}}$

(d) # of atoms = 15.0 L $\times \frac{1 \text{ mol}}{24.8 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = \mathbf{3.64 \times 10^{23} \text{ atoms}}$

(e) # of atoms = 12 g $\times \frac{1 \text{ mol}}{34.0 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{4 \text{ atoms}}{1 \text{ molecule}} = \mathbf{8.5 \times 10^{23} \text{ atoms}}$

(f) # of atoms = 55.0 mL $\times \frac{10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{1 \text{ mol}}{22.7 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{3 \text{ atoms}}{1 \text{ molecule}}$

$= \mathbf{4.38 \times 10^{21} \text{ atoms}}$

(g) # of atoms = 40.0 g $\times \frac{1 \text{ mol}}{39.1 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = \mathbf{6.16 \times 10^{23} \text{ atoms}}$

(h) # of atoms = 5.0 g $\times \frac{1 \text{ mol}}{58.5 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{2 \text{ atoms}}{1 \text{ molecule}} = \mathbf{1.0 \times 10^{23} \text{ atoms}}$

(i) # of atoms = 125 g $\times \frac{1 \text{ mol}}{50.5 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{5 \text{ atoms}}{1 \text{ molecule}} = \mathbf{7.45 \times 10^{24} \text{ atoms}}$

(j) # of atoms = $8.30 \times 10^{-4}$ mL $\times \frac{10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{1 \text{ mol}}{24.8 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{4 \text{ atoms}}{1 \text{ molecule}}$

$= \mathbf{8.06 \times 10^{16} \text{ atoms}}$

(k) # of atoms = $6.5 \times 10^{-6}$ g $\times \frac{1 \text{ mol}}{83.8 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = \mathbf{4.7 \times 10^{16} \text{ atoms}}$

(l) # of atoms = $9.5 \times 10^{-3}$ g $\times \frac{1 \text{ mol}}{17.0 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{4 \text{ atoms}}{1 \text{ molecule}} = \mathbf{1.3 \times 10^{21} \text{ atoms}}$

24. (a) volume = 16.5 g $\times \frac{1 \text{ mol}}{77.9 \text{ g}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{4.81 L}$

(b) volume = $5.65 \times 10^{22}$ molecules $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{2.13\ L}$

(c) volume = $0.750 \text{ g} \times \frac{1 \text{ mol}}{48.0 \text{ g}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{0.355\ L}$

(d) volume = $9.04 \times 10^{24}$ atoms $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{341\ L}$

(e) volume = $8.65 \times 10^{21}$ molecules $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{0.326\ L}$

(f) volume = $6.98 \times 10^{15}$ atoms $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{2.63 \times 10^{-7}\ L}$

(g) volume = $28.4 \text{ mg} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ mol}}{129.6 \text{ g}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{4.97 \times 10^{-3}\ L}$

(h) volume = $3.25 \text{ kg} \times \frac{10^{3} \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol}}{30.0 \text{ g}} \times \frac{22.7 \text{ L}}{1 \text{ mol}} = \mathbf{2.46 \times 10^{3}\ L}$

25. density of $CO_2(g)$ = 44.0 g / 24.8 L = **1.77 g/L**

26. # of N atoms = $30.0 \text{ g} \times \frac{1 \text{ mol}}{80.0 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{2 \text{ N-atoms}}{1 \text{ molecule}} = \mathbf{4.52 \times 10^{23}\ atoms}$

27. # of molecules = $2.50 \text{ L} \times \frac{1.59 \text{ g}}{10^{-3} \text{ L}} \times \frac{1 \text{ mol}}{154.0 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = \mathbf{1.55 \times 10^{25}\ molecules}$

28. density = $\frac{1.64 \text{ g}}{1.35 \text{ L}} = 1.215 \text{ g/L}$ , and mass of 1 mol = $1.215 \frac{\text{g}}{\text{L}} \times 22.7 \text{ L} = \mathbf{27.6\ g}$

29. density = 30.0 g / 22.7 L = **1.32 g/L**

30. volume = $8.50 \times 10^{24}$ C–atoms $\times \frac{1 \text{ molecule}}{6 \text{ C-atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{78.0 \text{ g}}{1 \text{ mol}} \times \frac{1 \text{ mL}}{0.877 \text{ g}} = \mathbf{209\ mL}$

31. density = $\frac{0.324 \text{ g}}{0.2500 \text{ L}} = 1.296 \text{ g/L}$ , and mass of 1 mol = $1.296 \frac{\text{g}}{\text{L}} \times 24.8 \text{ L} = \mathbf{32.1\ g}$

Silane molecules have at least one Si and one H atom. The molar mass of Si is 28.1 g and of H is 1.0 g. Silane has a molar mass of 32.1 g, which is not big enough to allow 2 atoms of Si per molecule. Hence there is exactly 1 Si per molecule and 32.1 – 28.1 = 4.0 H atoms. The formula must be $\mathbf{SiH_4}$.

32. volume = $4.50 \times 10^{22}$ molecules $\times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{76.2 \text{ g}}{1 \text{ mol}} \times \frac{1 \text{ mL}}{1.26 \text{ g}} = \mathbf{4.52\ mL}$

33. molar mass = 60.1 g; volume of 1 mol = $60.1 \text{ g} \times \frac{1 \text{ mL}}{2.64 \text{ g}} = \mathbf{22.8\ mL}$

34. density = $\frac{0.02780 \text{ mol}}{0.2836 \times 10^{-3} \text{ L}} \times \frac{197.0 \text{ g}}{1 \text{ mol}} = \mathbf{1.931 \times 10^{4}\ g/L}$

35. (a) 60 (b) 290

36. (a) # of molecules = $0.0500 \text{ L} \times \frac{1 \text{ mol}}{22.7 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = \mathbf{1.33 \times 10^{21}\ molecules}$

(b) # of molecules = $25.0\ \text{L} \times \frac{1\ \text{mol}}{24.8\ \text{L}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = \mathbf{6.07 \times 10^{23}\ molecules}$

(c) # of molecules = $75.0\ \text{g} \times \frac{1\ \text{mol}}{342.0\ \text{g}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = \mathbf{1.32 \times 10^{23}\ molecules}$

(d) # of molecules = $0.125\ \text{g} \times \frac{1\ \text{mol}}{124.0\ \text{g}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = \mathbf{6.07 \times 10^{20}\ molecules}$

37. (a) volume = $10.0\ \text{g} \times \frac{1\ \text{mol}}{34.1\ \text{g}} \times \frac{22.7\ \text{L}}{1\ \text{mol}} = \mathbf{6.66\ L}$

(b) volume = $0.0150\ \text{g} \times \frac{1\ \text{mol}}{124.0\ \text{g}} \times \frac{22.7\ \text{L}}{1\ \text{mol}} = \mathbf{0.00275\ L}$

(c) volume = $5.0 \times 10^{20}\ \text{molecules} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{22.7\ \text{L}}{1\ \text{mol}} = \mathbf{0.019\ L}$

(d) volume = $8.5 \times 10^{25}\ \text{molecules} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{22.7\ \text{L}}{1\ \text{mol}} = \mathbf{3.2 \times 10^{3}\ L}$

38. (a) mass = $1\ \text{atom} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{atoms}} \times \frac{197.0\ \text{g}}{1\ \text{mol}} = \mathbf{3.27 \times 10^{-22}\ g}$

(b) mass = $1.5 \times 10^{15}\ \text{molecules} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{143.4\ \text{g}}{1\ \text{mol}} = \mathbf{3.6 \times 10^{-7}\ g}$

(c) mass = $0.2500\ \text{L} \times \frac{1\ \text{mol}}{24.8\ \text{L}} \times \frac{42.0\ \text{g}}{1\ \text{mol}} = \mathbf{0.423\ g}$

(d) mass = $2.00\ \text{L} \times \frac{1\ \text{mol}}{22.7\ \text{L}} \times \frac{146.1\ \text{g}}{1\ \text{mol}} = \mathbf{12.9\ g}$

39. (a) # of moles = $5.00\ \text{g} \times \frac{1\ \text{mol}}{128.0\ \text{g}} = \mathbf{0.0391\ mol}$

(b) # of moles = $0.525\ \text{g} \times \frac{1\ \text{mol}}{212.3\ \text{g}} = \mathbf{0.00247\ mol}$

(c) # of moles = $6.00\ \text{L} \times \frac{1\ \text{mol}}{22.7\ \text{L}} = \mathbf{0.264\ mol}$

(d) # of moles = $1.00 \times 10^{-3}\ \text{L} \times \frac{1\ \text{mol}}{24.8\ \text{L}} = \mathbf{4.03 \times 10^{-5}\ mol}$

(e) # of moles = $4.55 \times 10^{12}\ \text{atoms} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{atoms}} = \mathbf{7.56 \times 10^{-12}\ mol}$

(f) # of moles = $6.02 \times 10^{16}\ \text{molecules} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}} = \mathbf{1.00 \times 10^{-7}\ mol}$

40. (a) molar mass = $6.02 \times 10^{23}\ \text{molecules} \times \frac{1.25 \times 10^{-17}\ \text{g}}{\text{molecule}} = \mathbf{7.53 \times 10^{6}\ g}$

(b) molar mass = $\frac{74.0\ \text{g}}{0.179\ \text{mol}} = \mathbf{413\ g/mol}$

(c) molar mass = $6.02 \times 10^{23}$ molecules $\times \frac{2.66 \times 10^{-22}\ g}{\text{molecule}} = 160\ g$

(d) molar mass = 249.2 g

(e) molar mass = $\frac{2.13\ g}{0.0229\ mol} = 93.0\ g/mol$

(f) molar mass = 220.8 g

41. (a) density = $\frac{34.0\ g}{22.7\ L} = 1.50\ g/L$

(b) volume of 1 mol = 197.0 g $\times \frac{1\ mL}{19.31\ g} = 10.2\ mL$

(c) # of moles = 1.25 mL $\times \frac{1.26\ g}{mL} \times \frac{1\ mol}{78.2\ g} = 0.0207\ mol$

(d) density = $\frac{0.100\ mol}{16.2\ mL} \times \frac{114.0\ g}{1\ mol} = 0.704\ g/mL$

(e) density = $\frac{65.6\ g}{24.8\ L} = 2.64\ g/L$

(f) volume = 0.0875 mol $\times \frac{107.9\ g}{1\ mol} \times \frac{1\ mL}{10.5\ g} = 0.899\ mL$

(g) density = $\frac{0.0275\ mol}{3.01\ mL} \times \frac{249.8\ g}{1\ mol} = 2.28\ g/mL$

(h) # of moles = 7.50 L $\times \frac{1\ mL}{10^{-3}\ L} \times \frac{0.789\ g}{1\ mL} \times \frac{1\ mol}{46.0\ g} = 129\ mol$

(i) density = $\frac{1.12\ g}{0.7500\ L} = 1.49\ g/L$ and mass of 1 mol = $1.49\ \frac{g}{L} \times 22.7\ L = 33.9\ g$

(j) volume = 0.0156 mol $\times \frac{58.5\ g}{1\ mol} \times \frac{1\ mL}{2.17\ g} = 0.418\ mL$

(k) density = $\frac{3.14\ g}{1.25\ L} = 2.512\ g/L$ and mass of 1 mol = $2.512\ \frac{g}{L} \times 24.8\ L = 62.3\ g$

(l) volume of 1 mol = 6.9 g $\times \frac{1\ L}{534\ g} = 0.013\ L$

42. (a) # of atoms = 2 molecules $\times \frac{9\ atoms}{1\ molecule} = 18\ atoms$

(b) volume = $1.45 \times 10^{20}$ molecules $\times \frac{1\ mol}{6.02 \times 10^{23}\ molecules} \times \frac{22.7\ L}{1\ mol} = 5.47 \times 10^{-7}\ L$

(c) # of molecules = 54.0 g $\times \frac{1\ mol}{87.9\ g} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol} = 4.36 \times 10^{23}\ molecules$

(d) # of moles = 0.0250 L $\times \frac{1\ mol}{24.8\ L} = 1.01 \times 10^{-3}\ mol$

(e) volume = 43.5 g $\times \frac{1\ mol}{92.5\ g} \times \frac{22.7\ L}{1\ mol} = 10.7\ L$

(f) # of moles = $2.75 \times 10^{23}$ atoms $\times \frac{1\ mol}{6.02 \times 10^{23}\ atoms} = 0.457\ mol$

(g) # of molecules = $0.125\ \text{L} \times \frac{1\ \text{mol}}{24.8\ \text{L}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = \mathbf{3.03 \times 10^{21}\ molecules}$

(h) mass = $3.01 \times 10^{22}\ \text{atoms} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{atoms}} \times \frac{195.1\ \text{g}}{1\ \text{mol}} = \mathbf{9.76\ g}$

(i) molar mass = 136.5 g

(j) density = 52.0 g / 24.8 L = **2.10 g/L**

(k) mass = $0.0250\ \text{L} \times \frac{1\ \text{mol}}{22.7\ \text{L}} \times \frac{83.8\ \text{g}}{1\ \text{mol}} = \mathbf{0.0923\ g}$

(l) volume of 1 mol = $192.2\ \text{g} \times \frac{1\ \text{mL}}{22.42\ \text{g}} = \mathbf{8.573\ mL}$

(m) molar mass = $\frac{0.888\ \text{g}}{0.0139\ \text{mol}} = \mathbf{63.9\ g/mol}$

(n) density = $\frac{0.250\ \text{mol}}{14.3\ \text{mL}} \times \frac{60.0\ \text{g}}{1\ \text{mol}} = \mathbf{1.05\ g/mL}$

(o) # of moles = $0.0650\ \text{g} \times \frac{1\ \text{mol}}{121.6\ \text{g}} = \mathbf{6.99 \times 10^{-4}\ mol}$

(p) volume = $0.145\ \text{mol} \times \frac{102.0\ \text{g}}{1\ \text{mol}} \times \frac{1\ \text{mL}}{3.97\ \text{g}} = \mathbf{3.73\ mL}$

(q) molar mass = $6.02 \times 10^{23}\ \text{particles} \times \frac{9.11 \times 10^{-28}\ \text{g}}{\text{particle}} = \mathbf{5.48 \times 10^{-4}\ g}$

(r) density = $\frac{309\ \text{g}}{135\ \text{L}} = 2.289\ \text{g/L}$ and mass of 1 mol = $2.289\ \frac{\text{g}}{\text{L}} \times 22.7\ \text{L} = \mathbf{52.0\ g}$

(s) # of moles = $50.0\ \text{mL} \times \frac{8.10\ \text{g}}{1\ \text{mL}} \times \frac{1\ \text{mol}}{232.7\ \text{g}} = \mathbf{1.74\ mol}$

46. (a) volume = $5.75 \times 10^{10}\ \text{molecules} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{24.8\ \text{L}}{1\ \text{mol}} = \mathbf{2.37 \times 10^{-12}\ L}$

(b) # of molecules = $75.0\ \text{L} \times \frac{1\ \text{mol}}{22.7\ \text{L}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = \mathbf{1.99 \times 10^{24}\ molecules}$

(c) mass = $2.50\ \text{L} \times \frac{1\ \text{mol}}{22.7\ \text{L}} \times \frac{126.0\ \text{g}}{1\ \text{mol}} = \mathbf{13.9\ g}$

(d) molar mass = 390.0 g

(e) # of moles = $15.0\ \text{L} \times \frac{1\ \text{mol}}{24.8\ \text{L}} = \mathbf{0.605\ mol}$

(f) mass = $1\ \text{molecule} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{132.1\ \text{g}}{1\ \text{mol}} = \mathbf{2.19 \times 10^{-22}\ g}$

(g) density = 56.0 g / 22.7 L = **2.47 g/L**

(h) molar mass = $6.02 \times 10^{23}\ \text{molecules} \times \frac{6.23 \times 10^{-22}\ \text{g}}{\text{molecule}} = \mathbf{375\ g}$

(i) # of atoms = $3\ \text{molecules} \times \frac{14\ \text{atoms}}{1\ \text{molecule}} = \mathbf{42}$

(j) density = $\frac{0.0134\ g}{0.00554\ L}$ = 2.419 g/L and mass of 1 mol = 2.419 $\frac{g}{L}$ x 24.8 L = **60.0 g**

(k) # of moles = 125 g x $\frac{1\ mol}{295.2\ g}$ = **0.423 mol**

(l) molar mass = $\frac{73.1\ g}{0.546\ mol}$ = **134 g/mol**

(m) # of moles = $1.85 \times 10^{24}$ molecules x $\frac{1\ mol}{6.02 \times 10^{23}\ molecules}$ = **3.07 mol**

(n) volume = 0.0694 mol x $\frac{160.1\ g}{1\ mol}$ x $\frac{1\ mL}{4.80\ g}$ = **2.31 mL**

(o) # of molecules = 5.00 g x $\frac{1\ mol}{54.0\ g}$ x $\frac{6.02 \times 10^{23}\ molecules}{1\ mol}$ = **$5.57 \times 10^{22}$ molecules**

(p) density = $\frac{0.0316\ mol}{1.167\ mL}$ x $\frac{100.1\ g}{1\ mol}$ = **2.71 g/mL**

(q) # of moles = 100.0 mL x $\frac{1.58\ g}{1\ mL}$ x $\frac{1\ mol}{342.0\ g}$ = **0.462 mol**

(r) volume = 0.275 g x $\frac{1\ mol}{76.6\ g}$ x $\frac{22.7\ L}{1\ mol}$ = **0.0815 L**

(s) volume of 1 mol = 200.6 g x $\frac{1\ mL}{13.55\ g}$ = **14.80 mL**

44. (a) molar mass = 30.0 g

% C = $\frac{24.0\ g}{30.0\ g}$ x 100 % = 80.0 %

% H = $\frac{6.0\ g}{30.0\ g}$ x 100 % = 20.0 %

(b) molar mass = 126.8 g

% Fe = $\frac{55.8\ g}{126.8\ g}$ x 100 % = 44.0 %

% Cl = $\frac{71.0\ g}{126.8\ g}$ x 100 % = 56.0 %

(c) molar mass = 162.3 g

% Fe = $\frac{55.8\ g}{162.3\ g}$ x 100 % = 34.4 %

% Cl = $\frac{106.5\ g}{162.3\ g}$ x 100 % = 65.6 %

(d) molar mass = 60.0 g

% C = $\frac{24.0\ g}{60.0\ g}$ x 100 % = 40.0 %

% H = $\frac{4.0\ g}{60.0\ g}$ x 100 % = 6.7 %

% O = $\frac{32.0\ g}{60.0\ g}$ x 100 % = 53.3 %

(e) molar mass = 100.1 g

% Ca = $\frac{40.1\ g}{100.1\ g}$ x 100 % = 40.0 %

% C = $\frac{12.0\ g}{100.1\ g}$ x 100 % = 12.0 %

% O = $\frac{48.0\ g}{100.1\ g}$ x 100 % = 48.0 %

(f) molar mass = 40.0 g

% Na = $\frac{23.0\ g}{40.0\ g}$ x 100 % = 57.5 %

% O = $\frac{16.0\ g}{40.0\ g}$ x 100 % = 40.0 %

% H = $\frac{1.0\ g}{40.0\ g}$ x 100 % = 2.5 %

(g) molar mass = 147.1 g

$$\%\,Ca = \frac{40.1\ g}{147.1\ g} \times 100\,\% = 27.3\,\%$$

$$\%\,Cl = \frac{71.0\ g}{147.1\ g} \times 100\,\% = 48.3\,\%$$

$$\%\,H = \frac{4.0\ g}{147.1\ g} \times 100\,\% = 2.7\,\%$$

$$\%\,O = \frac{32.0\ g}{147.1\ g} \times 100\,\% = 21.8\,\%$$

(h) molar mass = 149.0 g

$$\%\,N = \frac{42.0\ g}{149.0\ g} \times 100\,\% = 28.2\,\%$$

$$\%\,H = \frac{12.0\ g}{149.0\ g} \times 100\,\% = 8.1\,\%$$

$$\%\,P = \frac{31.0\ g}{149.0\ g} \times 100\,\% = 20.8\,\%$$

$$\%\,O = \frac{64.0\ g}{149.0\ g} \times 100\,\% = 43.0\,\%$$

(i) molar mass = 177.4 g

$$\%\,Ag = \frac{107.9\ g}{177.4\ g} \times 100\,\% = 60.8\,\%$$

$$\%\,N = \frac{28.0\ g}{177.4\ g} \times 100\,\% = 15.8\,\%$$

$$\%\,H = \frac{6.0\ g}{177.4\ g} \times 100\,\% = 3.4\,\%$$

$$\%\,Cl = \frac{35.5\ g}{177.4\ g} \times 100\,\% = 20.0\,\%$$

(j) molar mass = 328.5 g

$$\%\,C = \frac{204.0\ g}{328.5\ g} \times 100\,\% = 62.1\,\%$$

$$\%\,H = \frac{15.0\ g}{328.5\ g} \times 100\,\% = 4.6\,\%$$

$$\%\,N = \frac{42.0\ g}{328.5\ g} \times 100\,\% = 12.8\,\%$$

$$\%\,O = \frac{32.0\ g}{328.5\ g} \times 100\,\% = 9.7\,\%$$

$$\%\,Cl = \frac{35.5\ g}{328.5\ g} \times 100\,\% = 10.8\,\%$$

(k) molar mass = 346.9 g

$$\%\,Sn = \frac{118.7\ g}{346.9\ g} \times 100\,\% = 34.2\,\%$$

$$\%\,S = \frac{64.2\ g}{346.9\ g} \times 100\,\% = 18.5\,\%$$

$$\%\,O = \frac{160.0\ g}{346.9\ g} \times 100\,\% = 46.1\,\%$$

$$\%\,H = \frac{4.0\ g}{346.9\ g} \times 100\,\% = 1.2\,\%$$

(l) molar mass = 256.7 g

$$\%\,N = \frac{28.0\ g}{256.7\ g} \times 100\,\% = 10.9\,\%$$

$$\%\,H = \frac{14.0\ g}{256.7\ g} \times 100\,\% = 5.4\,\%$$

$$\%\,Sn = \frac{118.7\ g}{256.7\ g} \times 100\,\% = 46.2\,\%$$

$$\%\,O = \frac{96.0\ g}{256.7\ g} \times 100\,\% = 37.4\,\%$$

(m) molar mass = 120.0 g

$$\%\,C = \frac{24.0\ g}{120.0\ g} \times 100\,\% = 20.0\,\%$$

$$\%\,H = \frac{4.0\ g}{120.0\ g} \times 100\,\% = 3.3\,\%$$

$$\%\,N = \frac{28.0\ g}{120.0\ g} \times 100\,\% = 23.3\,\%$$

$$\%\,O = \frac{64.0\ g}{120.0\ g} \times 100\,\% = 53.3\,\%$$

(n) molar mass = 329.1 g

$$\%\,K = \frac{117.3\ g}{329.1\ g} \times 100\,\% = 35.6\,\%$$

$$\%\,Fe = \frac{55.8\ g}{329.1\ g} \times 100\,\% = 17.0\,\%$$

$$\%\,C = \frac{72.0\ g}{329.1\ g} \times 100\,\% = 21.9\,\%$$

$$\%\,N = \frac{84.0\ g}{329.1\ g} \times 100\,\% = 25.5\,\%$$

45. (a) $\%\,H_2O = \frac{36.0\ g}{147.1\ g} \times 100\,\% = 24.5\,\%$

(b) $\%\,H_2O = \frac{126.0\ g}{280.8\ g} \times 100\,\% = 44.9\,\%$

(c) $\%\,H_2O = \frac{162.0\ g}{708.2\ g} \times 100\,\% = 22.9\,\%$

(d) $\%\,H_2O = \frac{324.0\ g}{666.3\ g} \times 100\,\% = 48.6\,\%$

(e) $\%\,NH_3 = \frac{102.0\ g}{278.0\ g} \times 100\% = 36.7\%$ (f) $\%\,H_2O = \frac{18.0\ g}{278.0\ g} \times 100\% = 6.48\%$

(g) $\%\,C_6H_8O_6 = \frac{176.0\ g}{278.0\ g} \times 100\% = 54.0\%$ (h) $\%\,SO_4 = \frac{288.0\ g}{367.0\ g} \times 100\% = 31.0\%$

46. (a) $\text{moles S} = 15.8\ g \times \frac{1\ mol}{32.0\ g} = 1.47\ mol$ | 1

$\text{moles F} = 84.1\ g \times \frac{1\ mol}{19.0\ g} = 4.42\ mol$ | 3

and empirical formula = $SF_3$

(b) $\text{moles S} = 67.5\ g \times \frac{1\ mol}{32.1\ g} = 2.11\ mol$ | 1

$\text{moles H} = 12.5\ g \times \frac{1\ mol}{1.0\ g} = 12.5\ mol$ | 4

and empirical formula = $SH_6$

(c) $\text{moles P} = 43.7\ g \times \frac{1\ mol}{31.0\ g} = 1.41\ mol$ | 1 | 2

$\text{moles O} = 90.3\ g \times \frac{1\ mol}{16.0\ g} = 5.62\ mol$ | 2.50 | 5

and empirical formula = $P_2O_5$

(d) $\text{moles I} = 77.3\ g \times \frac{1\ mol}{126.9\ g} = 0.614\ mol$ | 1 | 4

$\text{moles O} = 22.1\ g \times \frac{1\ mol}{16.0\ g} = 1.38\ mol$ | 2.25 | 9

and empirical formula = $IO_9$

(e) $\text{moles Fe} = 77.7\ g \times \frac{1\ mol}{55.8\ g} = 1.39\ mol$ | 1

$\text{moles O} = 22.3\ g \times \frac{1\ mol}{16.0\ g} = 1.39\ mol$ | 1

and empirical formula = FeO

(f) $\text{moles Fe} = 70.0\ g \times \frac{1\ mol}{55.8\ g} = 1.25\ mol$ | 1 | 2

$\text{moles O} = 30.0\ g \times \frac{1\ mol}{16.0\ g} = 1.875\ mol$ | 1.5 | 3

and empirical formula = $Fe_2O_3$

(g) $\text{moles Fe} = 72.4\ g \times \frac{1\ mol}{55.8\ g} = 1.30\ mol$ | 1 | 3

$\text{moles O} = 27.6\ g \times \frac{1\ mol}{16.0\ g} = 1.725\ mol$ | 1.33 | 4

and empirical formula = $Fe_3O_4$

(h) $\text{moles Li} = 46.3\ g \times \frac{1\ mol}{6.9\ g} = 6.71\ mol$ | 2

$\text{moles O} = 53.7\ g \times \frac{1\ mol}{16.0\ g} = 3.36\ mol$ | 1

and empirical formula = $Li_2O$

moles C = 24.4 g × $\frac{1\ \text{mol}}{12.0\ \text{g}}$ = 2.03 mol | 1 | 3

moles H = 3.39 g × $\frac{1\ \text{mol}}{1.0\ \text{g}}$ = 3.39 mol | 1.67 | 5 and empirical formula = $C_3H_5Cl_3$

moles Cl = 72.2 g × $\frac{1\ \text{mol}}{35.5\ \text{g}}$ = 2.03 mol | 1 | 3

(k) moles K = 26.6 g × $\frac{1\ \text{mol}}{39.1\ \text{g}}$ = 0.680 mol | 1 | 2

moles Cr = 35.4 g × $\frac{1\ \text{mol}}{52.0\ \text{g}}$ = 0.681 mol | 1 | 2 and empirical formula = $K_2Cr_2O_7$

moles O = 38.0 g × $\frac{1\ \text{mol}}{16.0\ \text{g}}$ = 2.375 mol | 3.49 | 7

(l) moles Mg = 21.8 g × $\frac{1\ \text{mol}}{24.3\ \text{g}}$ = 0.897 mol | 1 | 2

moles P = 27.9 g × $\frac{1\ \text{mol}}{31.0\ \text{g}}$ = 0.900 mol | 1 | 2 and empirical formula = $Mg_2P_2O_7$

moles O = 50.3 g × $\frac{1\ \text{mol}}{16.0\ \text{g}}$ = 3.14 mol | 3.5 | 7

(m) moles H = 3.66 g × $\frac{1\ \text{mol}}{1.0\ \text{g}}$ = 3.66 mol | 3

moles P = 37.8 g × $\frac{1\ \text{mol}}{31.0\ \text{g}}$ = 1.22 mol | 1 and empirical formula = $H_3PO_3$

moles O = 58.4 g × $\frac{1\ \text{mol}}{16.0\ \text{g}}$ = 3.65 mol | 3

(n) moles C = 46.2 g × $\frac{1\ \text{mol}}{12.0\ \text{g}}$ = 3.85 mol | 1.33 | 4

moles H = 7.69 g × $\frac{1\ \text{mol}}{1.0\ \text{g}}$ = 7.69 mol | 2.66 | 8 and empirical formula = $C_4H_8O_3$

moles O = 46.2 g × $\frac{1\ \text{mol}}{16.0\ \text{g}}$ = 2.89 mol | 1 | 3

(o) moles C = 50.5 g × $\frac{1\ \text{mol}}{12.0\ \text{g}}$ = 4.21 mol | 1.33 | 4

moles H = 5.26 g × $\frac{1\ \text{mol}}{1.0\ \text{g}}$ = 5.26 mol | 1.66 | 5 and empirical formula = $C_4H_5N_3$

moles N = 44.2 g × $\frac{1\ \text{mol}}{14.0\ \text{g}}$ = 3.16 mol | 1 | 3

47. density = 1.57 g / 0.850 L = 1.847 g/L, and mass of 1 mol = 1.847 $\frac{\text{g}}{\text{L}}$ × 22.7 L = 41.9 g

empirical mass of $CH_2$ = 12.0 + 2 × 1.0 = 14.0 g

N = $\frac{41.9\ \text{g}}{14.0\ \text{g}}$ = 2.99 . Therefore the molecular formula = 3 × $(CH_2)$ = $C_3H_6$ .

48. moles N = 30.4 g x $\frac{1 \text{ mol}}{14.0 \text{ g}}$ = 2.17 mol | 1

moles O = 69.6 g x $\frac{1 \text{ mol}}{16.0 \text{ g}}$ = 4.35 mol | 2

and empirical formula = $NO_2$ , empirical mass = 14.0 + 2 x 16.0 = 46.0 g

molar mass = 3.71 g/L x 24.8 L = 92.0 g

N = $\frac{92.1 \text{ g}}{46.0 \text{ g}}$ = 2.0 . Therefore the molecular formula = 2 x ($NO_2$) = $N_2O_4$.

49. Empirical mass of $C_5H_{11}$ = 71.0 g

molar mass = $\frac{3.91 \text{ g}}{0.0275 \text{ mol}}$ = 142 g/mol

N = $\frac{142 \text{ g}}{71.0 \text{ g}}$ = 2.0. Therefore the molecular formula = 2 x ($C_5H_{11}$) = $C_{10}H_{22}$.

50. density = $\frac{0.515 \text{ g}}{0.460 \text{ L}}$ = 1.14 g/L , and mass of 1 mol = 1.14 $\frac{\text{g}}{\text{L}}$ x 22.7 L = 26.0 g

empirical mass = 1 x 12.0 + 1 x 1.0 = 13.0 g

N = $\frac{26.0 \text{ g}}{13.0 \text{ g}}$ = 2.0 . Therefore the molecular formula = 2 x (CH) = $C_2H_2$.

51. Percentage O = 100% – 42.9% = 57.1%

moles C = 42.9 g x $\frac{1 \text{ mol}}{12.0 \text{ g}}$ = 3.58 mol | 1

moles O = 57.1 g x $\frac{1 \text{ mol}}{16.0 \text{ g}}$ = 3.57 mol | 1

empirical formula = CO and empirical mass = 28.0 g

molar mass = $\frac{1.68 \text{ g}}{0.0600 \text{ mol}}$ = 28.0 g/mol

N = $\frac{28.0 \text{ g}}{28.0 \text{ g}}$ = 1 and the molecular formula is **CO**

52. moles Si = 33.0 g x $\frac{1 \text{ mol}}{28.1 \text{ g}}$ = 1.17 mol | 1

moles F = 67.0 g x $\frac{1 \text{ mol}}{19.0 \text{ g}}$ = 3.53 mol | 3

empirical formula = $SiF_3$ and empirical mass = 85.1 g

molar mass = 7.50 $\frac{\text{g}}{\text{L}}$ x 22.7 L = 1.70 x $10^2$ g

N = $\frac{1.70 \times 10^2 \text{ g}}{85.1 \text{ g}}$ = 2.0 and the molecular formula = 2 x ($SiF_3$) = $Si_2F_6$

53. moles B = 78.3 g x $\frac{1 \text{ mol}}{10.8 \text{ g}}$ = 7.25 mol | 1

moles H = 21.7 g x $\frac{1 \text{ mol}}{1.0 \text{ g}}$ = 21.7 mol | 3

empirical formula = $BH_3$ and empirical mass = 13.8 g

molar mass = 0.986 x 28.0 g = 27.6 g

N = $\frac{27.6 \text{ g}}{13.8 \text{ g}}$ = 2.0 and the molecular formula = 2 x ($BH_3$) = $B_2H_6$

59. (a) $[HCl] = \frac{\text{mol}}{1.0\ \text{L}} = \mathbf{0.26\ M}$

(b) $[HNO_3] = \frac{2.8\ \text{mol}}{4.0\ \text{L}} = \mathbf{0.70\ M}$

(c) $[NH_4Cl] = \frac{0.0700\ \text{mol}}{0.0500\ \text{L}} = \mathbf{1.40\ M}$

(d) $[NaCl] = \frac{25.0\ \text{g}}{0.2500\ \text{L}} \times \frac{1\ \text{mol}}{58.5\ \text{g}} = \mathbf{1.71\ M}$

(e) $[CoBr_2 \cdot 6H_2O] = \frac{1.50\ \text{g}}{0.6000\ \text{L}} \times \frac{1\ \text{mol}}{326.7\ \text{g}} = \mathbf{0.00765\ M}$

(f) $[Cr(NO_3)_3 \cdot 9H_2O] = \frac{10.0\ \text{g}}{0.325\ \text{L}} \times \frac{1\ \text{mol}}{400.0\ \text{g}} = \mathbf{0.0769\ M}$

60. (a) moles $NH_4Cl = 3.00\ \frac{\text{mol}}{\text{L}} \times 1.00\ \text{L} = 3.00\ \text{mol}$

mass $NH_4Cl = 3.00\ \text{mol} \times \frac{53.5\ \text{g}}{1\ \text{mol}} = 161\ \text{g}$

Dissolve 161 g of $NH_4Cl$ in less than 1.00 L of water and dilute to 1.00 L.

(b) moles $Hg(NO_3)_2 = 0.250\ \frac{\text{mol}}{\text{L}} \times 0.5000\ \text{L} = 0.125\ \text{mol}$

mass $Hg(NO_3)_2 = 0.125\ \text{mol} \times \frac{324.6\ \text{g}}{1\ \text{mol}} = 40.6\ \text{g}$

Dissolve 40.6 g of $Hg(NO_3)_2$ in less than 500 mL of water and dilute to 500.0 mL.

(c) moles $Ba(NO_3)_2 = 0.500\ \frac{\text{mol}}{\text{L}} \times 0.125\ \text{L} = 0.0625\ \text{mol}$

mass $Ba(NO_3)_2 = 0.0625\ \text{mol} \times \frac{261.3\ \text{g}}{1\ \text{mol}} = 16.3\ \text{g}$

Dissolve 16.3 g of $Ba(NO_3)_2$ in less than 125 mL of water and dilute to 125 mL.

(d) moles $SbCl_3 = 0.100 \frac{mol}{L} \times 0.2500\ L = 0.0250\ mol$

mass $SbCl_3 = 0.0250\ mol \times \frac{228.3\ g}{1\ mol} = 5.71\ g$

Dissolve 5.71 g of $SbCl_3$ in less than 250 mL of water and then dilute to 250 mL.

(e) moles $NaOH = 0.0125 \frac{mol}{L} \times 2.75\ L = 0.0230\ mol$

mass $NaOH = 0.0230\ mol \times \frac{40.0\ g}{1\ mol} = 1.22\ g$

Dissolve 1.22 g of NaOH in less than 2.75 L of water and then dilute to 2.75 L.

(f) moles $CuSO_4 \cdot 5H_2O$ = moles $CuSO_4 = 0.0300 \frac{mol}{L} \times 2.00\ L = 0.0600\ mol$

mass $CuSO_4 \cdot 5H_2O = 0.0600\ mol \times \frac{249.6\ g}{1\ mol} = 15.0\ g$

Dissolve 15.0 g of $CuSO_4 \cdot 5H_2O$ in less than 2.00 L of water and then dilute to 2.00 L.

(g) moles $SnI_2 \cdot 2H_2O$ = moles $SnI_2 = 0.225 \frac{mol}{L} \times 0.0500\ L = 0.01125\ mol$

mass $SnI_2 \cdot 2H_2O = 0.01125\ mol \times \frac{427.1\ g}{1\ mol} = 4.80\ g$

Dissolve 4.80 g of $SnI_2 \cdot 2H_2O$ in less than 90.0 mL of water and then dilute to 50.0 mL.

61. moles $AlCl_3 = 0.250 \frac{mol}{L} \times 0.3500\ L = \mathbf{0.0875\ M}$

62. moles $HCl = 100.0\ g \times \frac{1\ mol}{36.5\ g} = 2.74\ mol$

$c = \frac{n}{V}$, so $V = \frac{n}{c} = \frac{2.74\ mol}{2.40\ mol/L} = \mathbf{1.14\ L}$

63. moles $Sr(NO_3)_2 = 1.30 \times 10^{-3} \frac{mol}{L} \times 0.0550\ L = \mathbf{7.15 \times 10^{-5}\ mol}$

64. moles $NaF = 0.15\ g \times \frac{1\ mol}{42.0\ g} = 3.57 \times 10^{-3}\ mol$

$c = \frac{n}{V}$, so $V = \frac{n}{c} = \frac{3.57 \times 10^{-3}\ mol}{2.8 \times 10^{-2}\ mol/L} = \mathbf{0.13\ L}$

65. $[H_2O] = 1000 \frac{g}{L} \times \frac{1\ mol}{18.0\ g} = \mathbf{55.6\ M}$

66. $[CH_3COOH] = 1049 \frac{g}{L} \times \frac{1\ mol}{60.0\ g} = \mathbf{17.5\ M}$

67. $d = 17.8 \frac{mol}{L} \times \frac{100.5\ g}{1\ mol} = \mathbf{1.77 \times 10^3 \frac{g}{L}}$

68. $d = 16.8 \frac{mol}{L} \times \frac{76.2\ g}{1\ mol} = \mathbf{1.28 \times 10^3 \frac{g}{L}}$

moles $CaCl_2 = 0.0350 \frac{mol}{L} \times 0.225\ L = 7.88 \times 10^{-3}$ mol

mass $= 7.88 \times 10^{-3}$ mol $\times \frac{111.1\ g}{1\ mol} = \mathbf{0.875\ g}$

moles $Na_3PO_4$ = moles $Na_3PO_4 \cdot 12H_2O = 0.175 \frac{mol}{L} \times 3.45\ L = 0.604$ mol

mass $Na_3PO_4 = 0.604$ mol $\times \frac{164.0\ g}{1\ mol} = \mathbf{99.0\ g}$

moles $C_6H_5COOH = 0.0100 \frac{mol}{L} \times 0.3500\ L = 3.50 \times 10^{-3}$ mol

mass $C_6H_5COOH = 3.50 \times 10^{-3}$ mol $\times \frac{122.0\ g}{1\ mol} = \mathbf{0.427\ g}$

Now to find the mass of the acetone. Since $d = \frac{m}{V}$, then $m = d \cdot V$

and mass acetone $= 0.790 \frac{g}{mL} \times 350.0\ mL = \mathbf{277\ g}$.

Since the volume of solvent used was 350 mL (about a "pop-can-full"), the addition of less than half a gram of solid (about a "pinch") would not appreciably change the volume.

72. (a) $\frac{1}{3}$ OJ (b) $\frac{1}{4}$ OJ (c) $\frac{1}{10}$ OJ (d) $\frac{2}{4}$ OJ = $\frac{1}{2}$ OJ (e) $\frac{1}{5}$ OJ (f) $\frac{3}{8}$ OJ

73. diluted concentration = $\frac{\mathbf{C}}{\mathbf{C + W}}$ OJ

74. (a) The amount of orange juice is not changed and the total volume is unchanged from that produced when water is used instead of apple juice. Therefore the orange juice is diluted to the same extent, regardless of whether apple juice or water is added.

(b) diluted concentration of apple juice = $\frac{1}{2}$ AJ

(c) i) diluted orange = $\frac{1}{2}$ OJ ; diluted apple = $\frac{1}{2}$ AJ

ii) diluted orange = $\frac{1}{3}$ OJ ; diluted apple = $\frac{2}{3}$ AJ

iii) diluted orange = $\frac{1}{4}$ OJ ; diluted apple = $\frac{3}{4}$ AJ

iv) diluted orange = $\frac{2}{5}$ OJ ; diluted apple = $\frac{3}{5}$ AJ

v) diluted orange = $\frac{1}{2}$ OJ ; diluted apple = $\frac{1}{2}$ AJ

vi) diluted orange = $\frac{2}{5}$ OJ ; diluted apple = $\frac{3}{5}$ AJ

75. diluted orange = $\frac{\mathbf{O}}{\mathbf{O + A}}$ OJ ; diluted apple = $\frac{\mathbf{A}}{\mathbf{O + A}}$ AJ

76. diluted orange = $\frac{\mathbf{O}}{\mathbf{O + A}} \times 0.8$ OJ ; diluted apple = $\frac{\mathbf{A}}{\mathbf{O + A}} \times 0.7$ AJ

77. (a) diluted ① Cheaper $= \frac{2}{5} \times 0.5\ \text{C}\mu = 0.20\ \text{C}\mu$

(b) diluted Expensive $= \frac{3}{5} \times 1.0\ \text{C}\mu = 0.60\ \text{C}\mu$

(c) total concentration $= 0.20\ \text{C}\mu + 0.60\ \text{C}\mu = 0.80\ \text{C}\mu$

(d) total concentration $= \frac{5}{8} \times 1.0\ \text{C}\mu + \frac{3}{8} \times 0.50\ \text{C}\mu = 0.81\ \text{C}\mu$

(e) total concentration $= \frac{4}{11} \times 1.0\ \text{C}\mu + \frac{7}{11} \times 0.50\ \text{C}\mu = 0.68\ \text{C}\mu$

78. $[HBr] = 0.75\ \text{M} \times \frac{30.0\ \text{mL}}{90.0\ \text{mL}} = \mathbf{0.17\ M}$

79. $[KOH]_{DIL\ (\#1)} = 0.15\ \text{M} \times \frac{55\ \text{mL}}{130\ \text{mL}} = 0.063\ \text{M}$

$[KOH]_{DIL\ (\#2)} = 0.25\ \text{M} \times \frac{75\ \text{mL}}{130\ \text{mL}} = 0.14\ \text{M}$

$[KOH]\ (\text{total}) = 0.063 + 0.14 = \mathbf{0.21\ M}$

80. $[NaBr] = 0.201\ \text{M} \times \frac{0.050\ \text{mL}}{100.05\ \text{mL}} = \mathbf{1.0 \times 10^{-4}\ M}$

81. $[HNO_3]_{DIL\ (\#1)} = 3.5\ \text{M} \times \frac{5.0\ \text{mL}}{100\ \text{mL}} = 0.18\ \text{M}$

$[HNO_3]_{DIL\ (\#2)} = 0.20\ \text{M} \times \frac{95\ \text{mL}}{100\ \text{mL}} = 0.19\ \text{M}$

$[HNO_3]\ (\text{total}) = 0.18 + 0.19 = \mathbf{0.37\ M}$

82. $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.375\ \text{M} \times 2.50\ \text{L}}{15.4\ \text{M}} = 0.0609\ \text{L}$

Dilute 0.0609 L of concentrated $HNO_3$ to a total volume of 2.50 L.

83. $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.0600\ \text{M} \times 45.0\ \text{L}}{14.6\ \text{M}} = 0.185\ \text{L}$

Dilute 0.185 L of concentrated $H_3PO_4$ to a total volume of 45.0 L.

84. $[KCl] = \frac{\text{total moles}}{\text{total volume}}$, total mass $KCl = 25.0 + 60.0 = 85.0\ \text{g}$

$[KCl] = \frac{85.0\ \text{g}}{0.5500\ \text{L}} \times \frac{1\ \text{mol}}{74.6\ \text{g}} = \mathbf{2.07\ M}$

85. $[NaCl] = 0.750\ \text{M} \times \frac{500.0\ \text{mL}}{300.0\ \text{mL}} = \mathbf{1.25\ M}$

86. $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.350\text{M} \times 0.2500\ \text{L}}{6.00\ \text{M}} = 0.0146\ \text{L} = 14.6\ \text{mL}$

Dilute 14.6 mL of concentrated HCl to a total volume of 250.0 mL.

87. moles NaCl needed $= 0.400\ \frac{\text{mol}}{\text{L}} \times 0.5000\ \text{L} = 0.200\ \text{mol}$

mass NaCl $= 0.200\ \text{mol} \times \frac{58.5\ \text{g}}{1\ \text{mol}} = \mathbf{11.7\ g}$

88. $[NaOH]_{DIL}$ (#1) = 0.250 M x $\frac{125.0\ mL}{325.0\ mL}$ = 0.0962 M

$[NaOH]_{DIL}$ (#2) = 0.175 M x $\frac{200.0\ mL}{325.0\ mL}$ = 0.108 M

[NaOH] (total) = 0.0962 + 0.108 = **0.204 M**

89. $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.750\ M \times 3.00\ L}{12.0\ M}$ = **0.188 L**

90. $[CaCl_2]$ = 0.550 M x $\frac{80.0\ mL}{135.0\ mL}$ = **0.326 M**

91. $[MgCl_2]$ = 0.250 M x $\frac{350.0\ mL}{275.0\ mL}$ = **0.318 M**

92. $[NaCl]_{DIL}$ (#1) = 0.350 M x $\frac{20.0\ mL}{60.0\ mL}$ = 0.117 M

$[NaCl]_{DIL}$ (#2) = 0.875 M x $\frac{75.0\ mL}{60.0\ mL}$ = 1.09 M

[NaCl] (total) = 0.117 M + 1.09 M = **1.21 M**

93. [NaCl] = 0.400 M x $\frac{150.0\ mL}{250.0\ mL}$ = **0.240 M**

94. $[Na_3PO_4]$ = 0.200 M x $\frac{75.0\ mL}{100.0\ mL}$ = **0.150 M**

95. (a) $[NaHCO_3] = \frac{5.62\ g}{0.2500\ L} \times \frac{1\ mol}{84.0\ g}$ = **0.268 M**

(b) $[K_2CrO_4] = \frac{0.1846\ g}{0.5000\ L} \times \frac{1\ mol}{194.2\ g}$ = **$1.901 \times 10^{-3}$ M**

(c) $[H_2C_2O_4] = \frac{0.584\ g}{0.1000\ L} \times \frac{1\ mol}{90.0\ g}$ = **0.0649 M**

96. (a) moles NaCl = 0.100 $\frac{mol}{L}$ x 1.00 L = 0.100 mol

mass NaCl = 0.100 mol x $\frac{58.5\ g}{1\ mol}$ = 5.85 g

Dissolve 5.85 g of NaCl in less than 1 L and then dilute to 1.00 L.

(b) moles KBr = 0.09000 $\frac{mol}{L}$ x 0.2500 L = 0.02250 mol

mass KBr = 0.02250 mol x $\frac{119.0\ g}{1\ mol}$ = 2.678 g

Dissolve 2.678 g of KBr in less than 250 mL and then dilute to 250.0 mL.

(c) moles $Ca(NO_3)_2$ = 0.125 $\frac{mol}{L}$ x 0.5000 L = 0.0625 mol = moles $Ca(NO_3)_2 \cdot 3H_2O$

mass $Ca(NO_3)_2 \cdot 3H_2O$ = 0.0625 mol x $\frac{216.1\ g}{1\ mol}$ = 13.6 g

Dissolve 13.6 g of $Ca(NO_3)_2 \cdot 3H_2O$ in less than 500 mL and dilute to 500.0 mL.

97. (a) $[LiOH]_{DIL}$ (#1) = 3.55 M x $\frac{125\ mL}{600\ mL}$ = 0.740 M

$[LiOH]_{DIL}$ (#2) = 2.42 M x $\frac{475\ mL}{600\ mL}$ = 1.92 M

[LiOH] (total) = 0.740 M + 1.92 M = **2.66 M**

(b) [NaCl] = 0.250 M x $\frac{200.0\ mL}{350.0\ mL}$ = **0.143 M**

(c) $[KBr]_{DIL}$ (#1) = 12.0 M x $\frac{100.0\ mL}{1050.0\ mL}$ = 1.14 M

$[KBr]_{DIL}$ (#2) = 0.200 M x $\frac{950.0\ mL}{1050.0\ mL}$ = 0.181 M

[KBr] (total) = 1.14 M + 0.181 M = **1.32 M**

(d) [KBr] = 2.50 M x $\frac{5.0\ mL}{80\ mL}$ = **0.16 M**

(e) [HCl] = 0.1105 M x $\frac{850.0\ mL}{900.0\ mL}$ = **0.1044 M**

(f) $[HCl]_{DIL}$ (#1) = 0.125 M x $\frac{50.0\ mL}{125.0\ mL}$ = 0.0500 M

$[HCl]_{DIL}$ (#2) = 0.350 M x $\frac{75.0\ mL}{125.0\ mL}$ = 0.210 M

[HCl] (total) = 0.0500 M + 0.210 M = **0.260 M**

98. (a) [KBr] = 0.750 M x $\frac{250.0\ mL}{175.0\ mL}$ = **1.07 M**

(b) $[NaNO_3]$ = 0.125 M x $\frac{75.0\ mL}{325.0\ mL}$ = **0.0288 M**

(c) $[LiBr]_{DIL}$ (#1) = 0.325 M x $\frac{150.0\ mL}{275.0\ mL}$ = 0.177 M

$[LiBr]_{DIL}$ (#2) = 0.500 M x $\frac{225.0\ mL}{275.0\ mL}$ = 0.409 M

[LiBr] (total) = 0.177 M + 0.409 M = **0.586 M**

99. (a) moles KBr = 2.5 $\frac{mol}{L}$ x 5.0 L = 12.5 mol

mass KBr = 12.5 mol x $\frac{119.0\ g}{1\ mol}$ = **$1.5 \times 10^3$ g**

(b) moles $MgI_2$ = 0.135 $\frac{mol}{L}$ x 0.225 L = 0.0304 mol

mass $MgI_2$ = 0.0304 mol x $\frac{278.1\ g}{1\ mol}$ = **8.45 g**

(c) moles NaCl = 0.250 $\frac{mol}{L}$ x 0.3500 L = 0.0875 mol

mass NaCl = 0.0875 mol x $\frac{58.5\ g}{1\ mol}$ = **5.12 g**

(e) $[C_6H_{12}O_6] = 702.5 \frac{g}{L} \times \frac{1 \text{ mol}}{114.0 \text{ g}} = \mathbf{6.162\ M}$

(g) $[CH_3COCH_3] = 789.9 \frac{g}{L} \times \frac{1 \text{ mol}}{58.0 \text{ g}} = \mathbf{13.6\ M}$

(k) $[POCl_3] = 1675 \frac{g}{L} \times \frac{1 \text{ mol}}{153.5 \text{ g}} = \mathbf{10.91\ M}$

11. (a) $d = 13.8 \frac{\text{mol}}{L} \times \frac{216.8 \text{ g}}{1 \text{ mol}} = \mathbf{2.99 \times 10^3\ g/L}$ or **2.99 g/mL**

(b) $d = 12.73 \frac{\text{mol}}{L} \times \frac{135.2 \text{ g}}{1 \text{ mol}} = \mathbf{1721\ g/L}$ or **1.721 g/mL**

(c) $d = 9.825 \frac{\text{mol}}{L} \times \frac{106.0 \text{ g}}{1 \text{ mol}} = \mathbf{1041\ g/L}$ or **1.041 g/mL**

12. (a) $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.250 \text{ M} \times 5.00 \text{ L}}{3.00 \text{ M}} = \mathbf{0.417\ L}$

(b) $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.100 \text{ M} \times 0.5000 \text{ L}}{15.4 \text{ M}} = 0.00325 \text{ L} = \mathbf{3.25\ mL}$

(c) $V_{DIL} = \frac{c_{CONC} \times V_{CONC}}{c_{DIL}} = \frac{5.00 \text{ M} \times 0.2500 \text{ L}}{0.150 \text{ M}} = \mathbf{8.33\ L}$

(d) $c_{DIL} = \frac{c_{CONC} \times V_{CONC}}{V_{DIL}} = \frac{0.850 \text{ M} \times 3.00 \text{ L}}{12.5 \text{ L}} = \mathbf{0.204\ M}$

(e) $c_{CONC} = \frac{c_{DIL} \times V_{DIL}}{V_{CONC}} = \frac{0.100 \text{ M} \times 5.00 \text{ L}}{0.1000 \text{ L}} = \mathbf{5.00\ M}$

(f) moles KBr $= 0.235 \frac{\text{mol}}{L} \times 0.5000 \text{ L} = 0.118 \text{ mol}$

mass KBr $= 0.118 \text{ mol} \times \frac{119.0 \text{ g}}{1 \text{ mol}} = \mathbf{14.0\ g}$

(g) moles HCl $= 50.0 \text{ g} \times \frac{1 \text{ mol}}{36.5 \text{ g}} = 1.37 \text{ mol}$

volume $= \frac{1.37 \text{ mol}}{0.550 \text{ mol/L}} = \mathbf{2.49\ L}$

(h) moles LiCl $= 0.850 \frac{\text{mol}}{L} \times 5.50 \text{ L} = \mathbf{4.68\ mol}$

(i) $[CaCl_2] = \frac{75.0 \text{ g}}{0.9500 \text{ L}} \times \frac{1 \text{ mol}}{111.1 \text{ g}} = \mathbf{0.710\ M}$

(j) density $= 11.4 \frac{\text{mol}}{L} \times \frac{252.7 \text{ g}}{1 \text{ mol}} = \mathbf{2.88 \times 10^3\ g/L}$ or **2.88 g/mL**

(k) moles $Ba(NO_3)_2 = 2.55 \text{ g} \times \frac{1 \text{ mol}}{261.3 \text{ g}} = 9.76 \times 10^{-3} \text{ mol}$

volume $= \frac{9.76 \times 10^{-3} \text{ mol}}{0.0675 \text{ mol/L}} = \mathbf{0.144\ L}$

(l) moles $FeCl_3 = 0.368 \frac{mol}{L} \times 1.50\ L = \mathbf{0.552\ mol}$

(m) $[SnCl_2] = \frac{25.00\ g}{0.7500\ L} \times \frac{1\ mol}{225.7\ g} = \mathbf{0.1477\ M}$

(n) $V_{CONC} = \frac{c_{DIL} \times V_{DIL}}{c_{CONC}} = \frac{0.0450\ M \times 3.50\ L}{0.995\ M} = \mathbf{0.158\ M}$

(o) $[NaCl] = 0.543\ M \times \frac{55.0\ mL}{240.0\ mL} = \mathbf{0.124\ M}$

(p) moles $BaCl_2 \cdot 2H_2O$ = moles $BaCl_2 = 0.250 \frac{mol}{L} \times 1.35\ L = 0.338\ mol$

mass $BaCl_2 \cdot 2H_2O = 0.338\ mol \times \frac{244.3\ g}{1\ mol} = \mathbf{82.4\ g}$

(q) $[CaCl_2]_{DIL}$ (#1) $= 0.550\ M \times \frac{145\ mL}{200\ mL} = 0.399\ M$

$[CaCl_2]_{DIL}$ (#2) $= 0.135\ M \times \frac{55\ mL}{200\ mL} = 0.0371\ M$

$[CaCl_2]$ (total) $= 0.399\ M + 0.0371\ M = \mathbf{0.436\ M}$

(r) $[C_6H_6] = 878.7 \frac{g}{L} \times \frac{1\ mol}{78.0\ g} = \mathbf{11.3\ M}$