Mole and Stoichiometry Worksheet

1. What is the volume of a 1.5 mol/L KOH solution that contains 2.24 g of solute?

$n = \frac{m}{mm}$ $\frac{2.24}{56.11} = 0.039921583$ $\frac{1.5\,mol}{L} = \frac{.039...}{x}$ = 0.027L

2. What mass of solute is required to prepare 350 mL of NaOH at a concentration of 0.75 mol/L?

$\frac{.75\,mol}{L} = \frac{x}{.35L} = .2625\,mol$ $m = n \times mm$ $.2625 \times 40.00 =$ 11g

3. What is the volume of a 0.25 M solution of Na_2SO_4 that contains 35.5 g of sodium sulfate?

$n = \frac{m}{mm}$ $\frac{35.5}{142.05} = .249912003$ $\frac{.2499...\,mol}{x} = \frac{.25\,mol}{L}$ = 1.0L

4. What is the molar concentration of the water in an aquarium that contains 100.0 L of salt water prepared with 2.8 kg of sodium chloride (NaCl)?

$n = \frac{m}{mm}$ $\frac{2800}{58.44} = 47.91238877$ $\frac{47.912...}{100.0} =$ .48 mol/L

5. Explain the procedure involved in preparing 250 mL of a 3.0 mol/L solution of $CaCO_3$.

$\frac{3.0\,mol}{L} = \frac{x}{.25L} = .75\,mol$ $m = n \times mm$ $.75 \times 100.09 = 75g$

① Weigh 75g of solute ② Put solute in VF ③ add water & swirl ④ add water to line ⑤ CH

6. What is the molarity of a 10.0 L solution of HCl that contains 0.36 g of solute?

$n = \frac{m}{mm}$ $\frac{.36}{36.46} = .009873834$ $\frac{.0098...}{10.0} =$ .00099 mol/L

7. If 4.6 g of sodium (Na) combines with fluorine (F) to produce 8.4 g of sodium fluoride (NaF). How much fluorine reacts?

Na + F = NaF

4.6 + ? = 8.4 8.4 − 4.6 = 3.8g

8. 75mL of $BaCl_2$ is used to produce $BaCrO_4$. If 4.81g of $BaCrO_4$ is made, what is the concentration of the $BaCl_2$ used? The following equation represents the reaction:

$K_2CrO_{4\,(aq)} + BaCl_{2(aq)} \rightarrow BaCrO_{4(s)} + 2KCl_{(aq)}$

Given mm Ratio

$4.81g \times \frac{1\,mol}{253.33} \times \frac{1\,mol}{1\,mol} = \frac{0.018987092}{.075\,L} =$ $\frac{.25\,mol}{L}$

9. Iron rusts according to the following equation:

$$4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$$

If 10.0 g of iron rust in the presence of oxygen, what mass of Fe_2O_3 will be produced?

Given: $10.0\ g\ Fe \times \frac{1\ mol\ Fe}{55.85\ g\ Fe}$ (mm) $\times \frac{2\ mol\ Fe_2O_3}{4\ mol\ Fe}$ (R) $\times \frac{159.7\ g\ Fe_2O_3}{1\ mol\ Fe_2O_3} = 143\ g\ Fe_2O_3$

10. Consider the following unbalanced equation:

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

How many moles of carbon dioxide will be produced when 5.0 moles of oxygen react?

Given: $5.0\ mol\ O_2 \times \frac{2\ mol\ CO_2}{3\ mol\ O_2}$ (R) $= 3.3\ mol\ CO_2$

11. Aspirin ($C_9H_8O_4$) is produced from salicylic acid ($C_7H_6O_3$) according to the equation below:

$$2\ C_7H_6O_3 + C_4H_6O_3 \rightarrow 2\ C_9H_8O_4 + H_2O$$

What mass of water is produced when 540 g of aspirin are produced?

Given: $540\ g\ C_9H_8O_4 \times \frac{1\ mol\ C_9H_8O_4}{180.17\ g\ C_9H_8O_4}$ (MM) $\times \frac{1\ mol\ H_2O}{2\ mol\ C_9H_8O_4}$ (R) $\times \frac{18.02\ g\ H_2O}{1\ mol\ H_2O}$ (MM) $= 27\ g\ H_2O$

12. When iron (Fe) reacts with chlorine (Cl_2), iron chloride ($FeCl_2$) forms. How much chlorine is required to produce 6.0 moles of iron chloride?

$Fe + Cl_2 \rightarrow FeCl_2$

Given: $6.0\ mol\ FeCl_2 \times \frac{1\ mol\ Cl_2}{1\ mol\ FeCl_2}$ (R) $\times \frac{70.90\ Cl_2}{1\ mol\ Cl_2} = 430\ g\ Cl_2$

13. When 200mL of HCl is mixed with $NaHCO_3$, 22.01g of CO_2 is produced. What was the concentration of the HCl solution used to produce this much gas?

$$HCl_{(aq)} + NaHCO_{3(s)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$$

Given: $22.01\ g\ CO_2 \times \frac{1\ mol\ CO_2}{44.01\ g\ CO_2}$ (mm) $\times \frac{1\ mol\ HCl}{1\ mol\ CO_2}$ (R) $= \frac{.500113611\ mol}{.2\ L} = \frac{x}{1L}$ $\frac{3\ mol}{L}$

14. A student prepared 1 250 mL of solution by using 17.1 g of aluminum sulfate, $Al_2(SO_4)_3$. What is the molar concentration of the solution?

$n = \frac{m}{mm}$ $\frac{17.1}{342.17} = .049975159$ $\frac{.0499\ldots}{1.250L} = \frac{.0400\ mol}{L}$

15. The label of a juice drink indicates the concentration of fructose, $C_6H_{12}O_6$ to be 18.0 g/200 mL. What is the molar concentration of the sugar in the juice?

$\frac{18.0\,g}{.2\,L} = \frac{x}{L} = \frac{90\,g}{L}$ $\quad n = \frac{m}{mm}$ $\quad \frac{90}{180.18} = \frac{.5\,mol}{L}$

16. Which of the following solutions has the highest concentration?
Solution 1- 3.5 moles of NaOH in 3.0 litres of solution
Solution 2- 2.5 moles of HCl in 2.0 litres of solution

$m = n \times mm$
$3.5 \times 40.00 = 140\,g$
$\frac{140}{3.0} = \frac{x}{1L} = 47\,g/L$

$m = n \times mm$
$2.5 \times 36.46 = 91.15$
$\frac{91.15}{2.0} = \frac{x}{1L} = 46\,g/L$

17. What mass of $CaCl_2$ is needed to prepare 200.0 mL of a solution with a concentration of 2.0 mol/L?

$\frac{2.0\,mol}{L} = \frac{x}{.200L} = .40\,mol$ $\quad m = n \times mm$
$.40 \times 110.98 = 44\,g$

18. What is the molar concentration of solution containing 17.6 g of $ZnSO_4$ dissolved in 750.0 mL?

$n = \frac{m}{mm}$ $\quad \frac{17.6}{161.46} = .109005326$ $\quad \frac{.109\ldots}{.7500} = .145\,mol/L$

19. Sandy neutralizes 200mL of HCL at a concentration of 1.5mol/L using $Ca(OH)_2$ according to the following equation:

$$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$$

$\frac{1.5\,mol}{L} = \frac{x}{.2} = .3\,mol$

After the neutralization, she allows the water from the beaker to evaporate. What is the mass of the $CaCl_2$ that will be left in the beaker?

Given R mm
$.3\,mol \times \frac{1\,mol}{2\,mol} \times \frac{110.97}{1\,mol} = 20\,g$

20. How many grams of solute are there in 350.0 mL of a solution of NH_4OH with a concentration of 0.65 mol/L

$\frac{.65\,mol}{L} = \frac{x}{.350} = .2275$ $\quad m = n \times mm$
$.2275 \times 35.06$
$8.0\,g$

21. You are to prepare 30.00 mL of an aqueous solution of sodium hydroxide, NaOH that will have a concentration of 0.80 M. What mass of NaOH do you need?

$\frac{.80\,mol}{L} = \frac{x}{.80L} = .024\,mol$ $\quad m = n \times mm$
$.024 \times 4000 = .96\,g$

22. Sodium nitrate, $NaNO_3$, is a salt that can be used to fertilize plants. You are to prepare 500.0 mL of a 0.20 mol/L sodium nitrate solution. What mass of sodium nitrate must be used?

$\frac{.20\ mol}{L} = \frac{x}{.50L} = .10 mol$ $\quad m = n \times mm$ $\quad .10 \times 85.00 = 8.5g$

23. A student dissolves 25.0 g of calcium carbonate, $CaCO_3$, in water to obtain a 550 mL solution. What is the molar concentration of this solution?

$n = \frac{m}{mm}$ $\quad \frac{25.0}{100.09} = .249775202$ $\quad \frac{.249\ldots}{.55L} = \frac{.45 mol}{L}$

24. You must prepare 50.0 mL of an aqueous solution of sodium nitrate ($NaNO_3$) that will have a concentration of 0.40 mol/L. What mass of $NaNO_3$ is required?

$\frac{.40\ mol}{L} = \frac{x}{.050L} = .020$ $\quad m = n \times mm$ $\quad .020 \times 85.03$ $\quad 1.7g$

25. A 3.0 L aqueous solution contains 120 g of sodium hydroxide, NaOH. What is the molar concentration of this solution?

$n = \frac{m}{mm}$ $\quad \frac{120}{40.00} = 3 mol$ $\quad \frac{3}{3.0L} = \frac{1.0 mol}{L}$

26. Iron oxide, Fe_2O_3, reacts with carbon, C, to produce iron, Fe, according to the following balanced equation: $\quad Fe_2O_3 + 3\,C \rightarrow 2\,Fe + 3\,CO$
What mass of carbon is required for every 6.0 moles of Fe_2O_3 reacted?

Given (R) (MM)

$6.0 mol\ Fe_2O_3 \times \frac{3 mol\ C}{1 mol\ Fe_2O_3} \times \frac{12.01 C}{1 mol\ C} = 220g\ C$

27. How many mL of a 6.0M solution of HCl are needed to react with 4.85g of $NaHCO_3$? The equation that represents the reaction follows.

$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

Given (mm) (R)

$4.85g\ NaHCO_3 \times \frac{1 mol\ NaHCO_3}{84.01 g/mol\ NaHCO_3} \times \frac{1 mol\ HCl}{1 mol\ NaHCO_3} = \frac{.057781222 mol}{x} = \frac{6.0 mol}{L}$

$= 9.6 ml$