

Exercise 12.3e(H)

Solution Stoichiometry – Answers

Name: _____

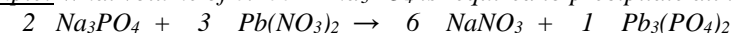
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Stoichiometry calculations rely on the conversion of chemical measurements into moles. The volume and molarity (mol/L) of a solution may be used to determine the number of moles of a reactant or product in a stoichiometric calculation. Multiplying the volume of the solution in liters by the molarity results in the number of moles of solute.

| <small>(given volume of solution expressed in liters)</small> | <small>(given molarity written as a ratio over 1 mole)</small> | <small>(mole ratio step)</small> | <small>(final conversion to desired units)</small> |
|---|--|----------------------------------|--|
| volume of solution (L) | moles of solute | moles unknown | desired unit of known (or 1 liter) |
| | 1 Liter | moles known | 1 mole known (or moles solute) |

If finding a volume of a particular concentration of solution, the final conversion factor may be written as concentration ratio (L/mol). This provides a final answer in liters of solution.

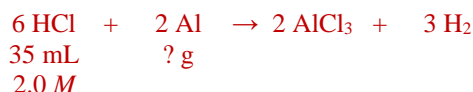
Example: What volume of 0.100 M Na_3PO_4 is required to precipitate all the lead(II) ions from 150.0 mL of 0.250 M $\text{Pb}(\text{NO}_3)_2$?



$$\frac{0.150 \text{ L Pb}(\text{NO}_3)_2}{1 \text{ liter solution}} \times \frac{0.250 \text{ mol Pb}(\text{NO}_3)_2}{1 \text{ liter solution}} \times \frac{2 \text{ mol Na}_3\text{PO}_4}{3 \text{ mol Pb}(\text{NO}_3)_2} \times \frac{1 \text{ liter Na}_3\text{PO}_4 \text{ sol'n}}{0.100 \text{ mol Na}_3\text{PO}_4} = \boxed{0.250 \text{ L}}$$

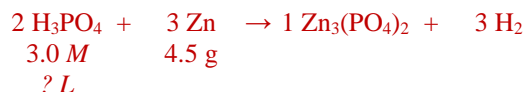
DIRECTIONS: Answer the following in the space provided.

1. How many grams of aluminum are required to react with 35 mL of 2.0 M hydrochloric acid, HCl?



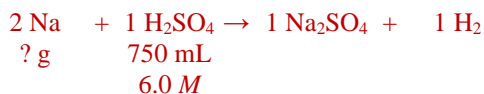
$$\frac{0.035 \text{ L HCl}}{1 \text{ liter sol'n}} \times \frac{2.0 \text{ mol HCl}}{1 \text{ liter sol'n}} \times \frac{2 \text{ mol Al}}{6 \text{ mol HCl}} \times \frac{26.982 \text{ g Al}}{1 \text{ mol Al}} = 0.62958 \text{ g Al} = \boxed{0.63 \text{ g Al}}$$

2. How many liters of a 3.0 M H_3PO_4 solution are required to react with 4.5 g of zinc?



$$\frac{4.5 \text{ g Zn}}{65.409 \text{ g Zn}} \times \frac{1 \text{ mol Zn}}{65.409 \text{ g Zn}} \times \frac{2 \text{ mol H}_3\text{PO}_4}{3 \text{ mol Zn}} \times \frac{1 \text{ L sol'n}}{3.0 \text{ mol H}_3\text{PO}_4} = 0.01528 \text{ L sol'n} = \boxed{0.015 \text{ L sol'n}}$$

3. How many grams of sodium can be reacted with 750 mL of a 6.0 M solution of sulfuric acid, H_2SO_4 ?



$$\frac{0.750 \text{ L H}_2\text{SO}_4}{1 \text{ liter sol'n}} \times \frac{6.0 \text{ mol H}_2\text{SO}_4}{1 \text{ liter sol'n}} \times \frac{2 \text{ mol Na}}{1 \text{ mol H}_2\text{SO}_4} \times \frac{22.990 \text{ g Na}}{1 \text{ mol Na}} = 206.91 \text{ g Na} = \boxed{210 \text{ g Na}}$$

4. How many milliliters of 0.10 M $\text{Pb}(\text{NO}_3)_2$ are required to react with 75 mL of 0.20 M NaI?



$$\frac{0.075 \text{ L NaI}}{1 \text{ liter sol'n}} \times \frac{0.20 \text{ mol NaI}}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol Pb}(\text{NO}_3)_2}{2 \text{ mol NaI}} \times \frac{1 \text{ liter sol'n}}{0.10 \text{ mol Pb}(\text{NO}_3)_2} \times \frac{1000 \text{ mL sol'n}}{1 \text{ liter sol'n}} = 75 \text{ mL sol'n} = \boxed{75 \text{ mL sol'n}}$$

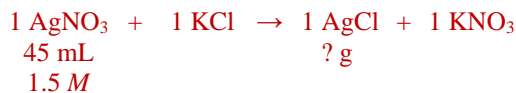
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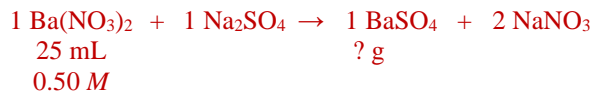
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5. If 45 mL of a 1.5 M AgNO₃ is added to KCl how many grams of AgCl can be formed?



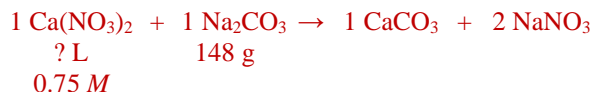
$$\frac{0.045 \text{ L AgNO}_3}{1 \text{ liter sol'n}} \times \frac{1.5 \text{ mol AgNO}_3}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol AgCl}}{1 \text{ mol AgNO}_3} \times \frac{143.323 \text{ g AgCl}}{1 \text{ mol AgCl}} = 9.674 \text{ g AgCl} = 9.7 \text{ g AgCl}$$

6. How many grams of solid BaSO₄ will form when Na₂SO₄ reacts with 25 mL of 0.50 M Ba(NO₃)₂?



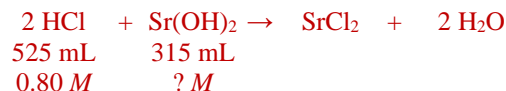
$$\frac{0.025 \text{ L Ba(NO}_3)_2}{1 \text{ liter sol'n}} \times \frac{0.50 \text{ mol Ba(NO}_3)_2}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol BaSO}_4}{1 \text{ mol Ba(NO}_3)_2} \times \frac{233.391 \text{ g BaSO}_4}{1 \text{ mol BaSO}_4} = 2.917 \text{ g BaSO}_4 = 2.9 \text{ g BaSO}_4$$

7. How many liters of a 0.75 M solution of Ca(NO₃)₂ will be required to react with 148 g of Na₂CO₃?



$$\frac{148 \text{ g Na}_2\text{CO}_3}{105.988 \text{ g Na}_2\text{CO}_3} \times \frac{1 \text{ mol Na}_2\text{CO}_3}{1 \text{ mol Na}_2\text{CO}_3} \times \frac{1 \text{ mol Ca(NO}_3)_2}{1 \text{ mol Na}_2\text{CO}_3} \times \frac{1 \text{ liter sol'n}}{0.75 \text{ mol Ca(NO}_3)_2} = 1.86 \text{ L sol'n} = 1.9 \text{ mL sol'n}$$

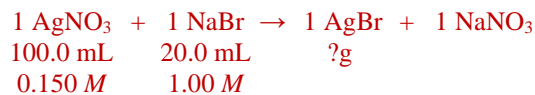
8. If 525 mL of 0.80 M HCl solution is neutralized with 315 mL of Sr(OH)₂ solution what is the molarity of the Sr(OH)₂?



$$\frac{0.525 \text{ L HCl}}{1 \text{ liter sol'n}} \times \frac{0.80 \text{ mol HCl}}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol Sr(OH)}_2}{2 \text{ mol HCl}} \times \frac{1 \text{ liter sol'n}}{0.315 \text{ L Sr(OH)}_2} = 0.6666 \text{ M Sr(OH)}_2 = 0.67 \text{ M Sr(OH)}_2$$

9. What mass of solid AgBr is produced when 100.0 mL of a 0.150 M AgNO₃ is added to 20.0 mL of 1.00 M NaBr?

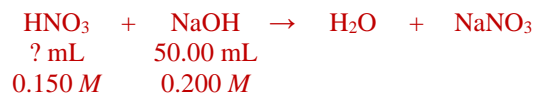
Limiting
Reactant
Problem



$$\frac{0.1000 \text{ L AgNO}_3}{1 \text{ liter sol'n}} \times \frac{0.150 \text{ mol AgNO}_3}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol AgBr}}{1 \text{ mol AgNO}_3} \times \frac{187.774 \text{ g AgBr}}{1 \text{ mol AgBr}} = 2.8166 \text{ g AgBr} = 2.82 \text{ g AgBr}$$

$$\frac{0.0200 \text{ L NaBr}}{1 \text{ liter sol'n}} \times \frac{1.00 \text{ mol NaBr}}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol AgBr}}{1 \text{ mol NaBr}} \times \frac{187.774 \text{ g AgBr}}{1 \text{ mol AgBr}} = 3.7554 \text{ g AgBr}$$

10. What volume of 0.150 M HNO₃ will react completely with 50.00 mL of 0.200 M NaOH?



$$\frac{0.05000 \text{ L NaOH}}{1 \text{ liter sol'n}} \times \frac{0.200 \text{ mol NaOH}}{1 \text{ liter sol'n}} \times \frac{1 \text{ mol HNO}_3}{1 \text{ mol NaOH}} \times \frac{1 \text{ liter sol'n}}{0.150 \text{ mol HNO}_3} = 0.06666 \text{ L sol'n} = 0.667 \text{ L sol'n}$$