STOICHIOMETRY 5 - ANSWER KEY

Solution stoichiometry – Calculations using molarity and a balanced chemical equation.

Example 1: You add 500 ml of 0.100 M $AgNO_3$ solution to a solution containing an excess of Cl^- ion. How much AgCl precipitate will you form?

Molar masses:	169.88 g	58.44 g		143.32	85.00

$AgNO_3$ (aq) + NaCl (aq) → AgCl (s) + $NaNO_3$(aq)

(given) (given) (wanted)

given:
500 mL $AgNO_3$
0.500 L $AgNO_3$
0.100 M $AgNO_3$

wanted:
g AgCl

$0.500\ \cancel{L}\ AgNO_3 \times \frac{0.100\ mol}{1\ \cancel{L}} AgNO_3 = 0.0500\ mol\ AgNO_3$

$0.0500\ \cancel{mol}\ AgNO_3 \times \frac{1\ mol\ AgCl}{1\ \cancel{mol}\ AgNO_3} = 0.0500\ mol\ AgCl$

$0.0500\ mol\ AgCl \times \frac{143.32\ g}{1\ mol} AgCl = 7.17\ g\ AgCl$

rounded 7 g AgCl

Example 2: If you mix 200 ml of 0.100 M $Pb(NO_3)_2$ and 300 ml of 0.200 M $MgCl_2$, how much $PbCl_2$ precipitate will you form?

Molar masses:	331.22g	95.21 g		278.10 g	148.33 g

$Pb(NO_3)_2$ (aq) + $MgCl_2$(aq) → $PbCl_2$(aq) + $Mg(NO_3)_2$(aq)

(given) (given) (wanted)

given:
200 mL $Pb(NO_3)_2$
0.2 L $Pb(NO_3)_2$
0.100 M $Pb(NO_3)_2$

300 mL $MgCl_2$
0.300 L $MgCl_2$
0.200 M $MgCl_2$

wanted:
g $PbCl_2$

limiting reactant → smallest mol $PbCl_2$

① $0.2\ L\ Pb(NO_3) \times \frac{0.100\ mol}{1\ L} Pb(NO_3) \times \frac{1\ mol\ PbCl_2}{1\ mol\ Pb(NO_3)_2}$

$= 0.02\ mol\ PbCl_2$ smallest

② $0.3\ L\ MgCl_2 \times \frac{0.200\ mol}{1\ L} MgCl_2 \times \frac{1\ mol\ PbCl_2}{1\ mol\ MgCl_2} =$

$= 0.06\ mol\ PbCl_2$

$Pb(NO_3)_2$ = limiting reactant.

$0.02\ mol\ PbCl_2 \times \frac{278.10\ g}{1\ mol} PbCl_2 =$ 6 g $PbCl_2$

* calculate excess mL $MgCl_2$ → 200 mL $MgCl_2$ XS

Titration problems

Example 3: How many moles of water form when 25.0 mls of 0.100 M HNO_3 (nitric acid) solution is completely neutralized by NaOH (a base)?

Molar masses:	63.02 g	40.00 g		85.00 g	18.02 g
	HNO_3 (aq) +	NaOH(aq)	→	$NaNO_3$(aq) +	H_2O(l)

given:
25.0 mL HNO_3
0.0250 L HNO_3
0.100 M HNO_3
wanted
mol H_2O

$0.0250\ mL\ HNO_3 \times \frac{0.100\ mol\ HNO_3}{L} = 0.00250\ mol\ HNO_3$

$0.00250\ mol\ HNO_3 \times \frac{1\ mol\ H_2O}{1\ mol\ HNO_3} = 0.00250\ mol\ H_2O$

Example 4: What is the concentration (M) of a sulfuric acid solution, 125.0 mL of which required 37.5 mL of a 0.0125 M NaOH solution for neutralization

Molar masses:	98.08 g	40.00 g		142.04 g	18.02 g
	H_2SO_4(aq) +	2NaOH(aq)	→	Na_2SO_4(aq) +	$2H_2O$(l)

given:
125 mL H_2SO_4
0.125 L H_2SO_4
37.5 mL NaOH
0.0375 L NaOH
0.0125 M NaOH
wanted:
M H_2SO_4
$\frac{mol}{L}$ H_2SO_4

$0.0375\ L\ NaOH \times \frac{0.0125\ mol\ NaOH}{L} = 0.000469\ mol\ NaOH$

$0.000469\ mol\ NaOH \times \frac{1\ mol\ H_2SO_4}{2\ mol\ NaOH} = 0.000234\ mol\ H_2SO_4$

$M = \frac{0.000234\ mol\ H_2SO_4}{0.125\ L\ H_2SO_4} = 0.00188\ M\ H_2SO_4$