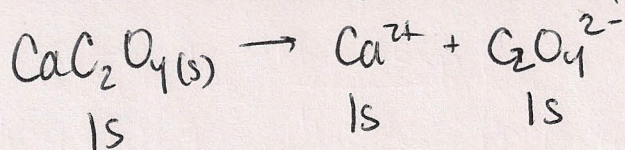


ANSWERS & EXPLANATIONS

11. Calculate the molar solubility of calcium oxalate (CaC_2O_4). Show all of your steps clearly.

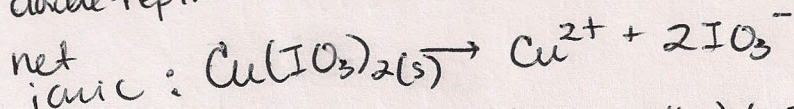
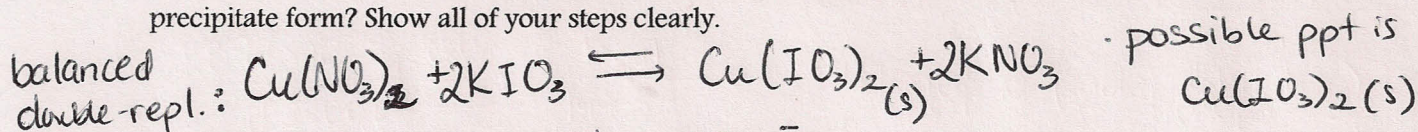


$$K_{sp} = [\text{Ca}^{2+}][\text{C}_2\text{O}_4^{2-}] = 2.3 \times 10^{-9} \quad \leftarrow \text{lookup in solubility table}$$

$$2.3 \times 10^{-9} = (s)(s) = s^2$$

$$s = \sqrt{2.3 \times 10^{-9}} = \boxed{4.8 \times 10^{-5} \text{ M}}$$

(3 s.f.) 12. If 250.0 mL of 0.000340 M $\text{Cu}(\text{NO}_3)_2$ is mixed with 350.0 mL of $3.12 \times 10^{-4} \text{ M}$ KIO_3 , will a precipitate form? Show all of your steps clearly.



$$[\text{Cu}^{2+}]_{\text{dil}} = \frac{C_1 V_1}{V_2} = \frac{(3.4 \times 10^{-4} \text{ M})(250.0 \text{ mL})}{600.0 \text{ mL}} = 1.417 \times 10^{-4} \text{ M}$$

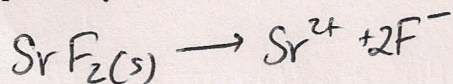
$$[\text{IO}_3^-]_{\text{dil}} = \frac{C_1 V_1}{V_2} = \frac{(3.12 \times 10^{-4})(350.0 \text{ mL})}{600.0 \text{ mL}} = 1.82 \times 10^{-4} \text{ M}$$

$$\text{TIP} = [\text{Cu}^{2+}]_{\text{dil}} [\text{IO}_3^-]_{\text{dil}} = (1.417 \times 10^{-4})(1.82 \times 10^{-4})^2 = \boxed{4.69 \times 10^{-12} < 6.9 \times 10^{-8}}$$

(2 s.f.) 13. Calculate the maximum $[\text{F}^-]$ that can exist in a solution in which $[\text{Sr}^{2+}] = 0.00050 \text{ M}$. Show all of your steps clearly.

$$5.0 \times 10^{-4} \text{ M}$$

∴ no ppt



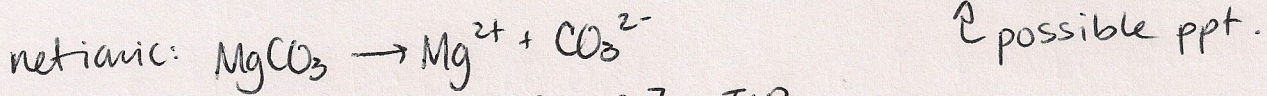
$$K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2 = 4.3 \times 10^{-9}$$

$$[\text{F}^-]^2 = \frac{K_{sp}}{[\text{Sr}^{2+}]}$$

$$[\text{F}^-] = \sqrt{\frac{K_{sp}}{[\text{Sr}^{2+}]}} = \sqrt{\frac{4.3 \times 10^{-9}}{5.0 \times 10^{-4}}} = \boxed{2.9 \times 10^{-3} \text{ M}}$$

ANSWERS & EXPLANATIONS

(25.6) 14. Calculate the mass of Na_2CO_3 that must be added to 2.50 L of 0.00085 M MgCl_2 in order to just start precipitation. Show all of your steps clearly. -look up K_{sp} in solubility table.



$$K_{sp} = [\text{Mg}^{2+}][\text{CO}_3^{2-}] = \text{TIP}$$

$$[\text{CO}_3^{2-}] = \frac{K_{sp}}{[\text{Mg}^{2+}]} = \frac{6.8 \times 10^{-6}}{8.5 \times 10^{-4}} = 8.0 \times 10^{-3} \text{ M}$$

$$[\text{CO}_3^{2-}] = [\text{Na}_2\text{CO}_3] = \frac{8.0 \times 10^{-3} \text{ mol}}{1 \text{ L}} \times \frac{106.0 \text{ g}}{1 \text{ mol}} \times 2.50 \text{ L} = \boxed{2.1 \text{ g}}$$

15. A sample of a saturated solution of MgF_2 was evaporated and the following data table was constructed. Use this data to calculate the value of K_{sp} for MgF_2 at 25 °C.

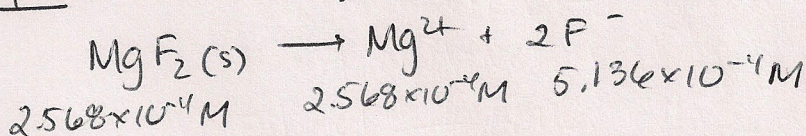
Mass of empty evaporating dish	78.5418 g
Mass of evaporating dish and MgF_2 residue after evaporation	78.5434 g
Volume of saturated MgF_2	100.00 mL
Temperature	25.0 °C

Step 1: Mass of $\text{MgF}_2 = 78.5434 \text{ g} - 78.5418 \text{ g} = 0.0016 \text{ g}$

Step 2: Moles of $\text{MgF}_2 = 0.0016 \text{ g} \times \frac{1 \text{ mol}}{62.3 \text{ g}} = 2.568 \times 10^{-5} \text{ mol}$

Step 3: Concentration of $\text{MgF}_2 = \frac{2.568 \times 10^{-5} \text{ mol}}{0.10000 \text{ L}} = 2.568 \times 10^{-4} \text{ M}$

Step 4: Net ionic equation (to determine molar ratios)



Step 5: K_{sp} expression + calculate

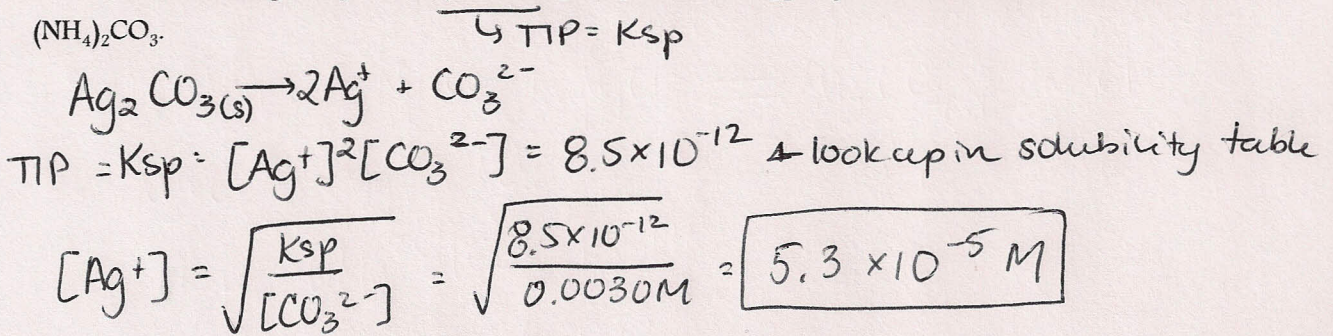
$$K_{sp} = [\text{Mg}^{2+}][\text{F}^-]^2$$

$$= (2.568 \times 10^{-4} \text{ M})(5.136 \times 10^{-4} \text{ M})^2$$

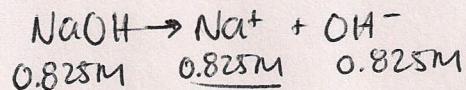
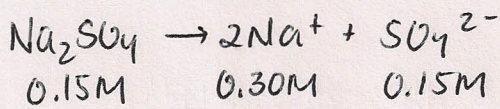
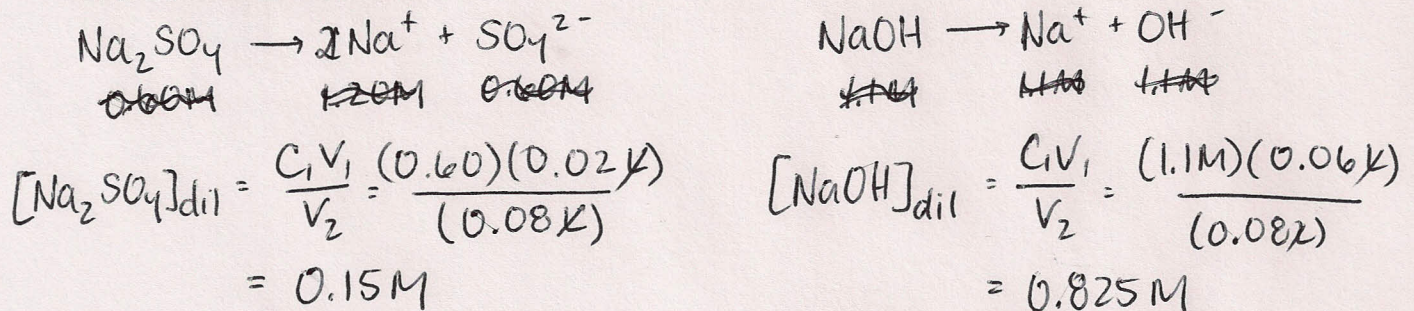
$$K_{sp} = \boxed{6.8 \times 10^{-11}}$$

ANSWERS & EXPLANATIONS

16. Calculate the $[Ag^+]$ required to just start precipitation of Ag_2CO_3 in a 0.0030 M solution of $(NH_4)_2CO_3$.

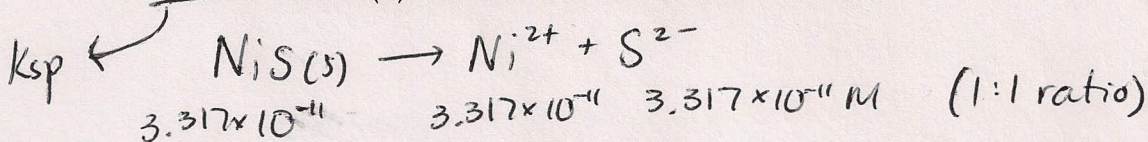


(2 s.f.) 17. A solution is prepared by mixing 20.0 mL of 0.60 M Na_2SO_4 with 60.0 mL of 1.1 M NaOH. Calculate the $[Na^+]$ in the final mixture.



Final $[Na^+] = 0.30M + 0.825M = \boxed{1.1 M}$

(4 s.f.) 18. The molar solubility of nickel (II) sulphide is 3.317×10^{-11} M. Calculate the value of the solubility product for nickel (II) sulphide. Show all of your work clearly.



$$K_{sp} = [Ni^{2+}][S^{2-}]$$

$$= (3.317 \times 10^{-11})(3.317 \times 10^{-11} M)$$

$$K_{sp} = \boxed{1.100 \times 10^{-21}}$$

ANSWERS & EXPLANATIONS

- (3 s.f) 19. A solution of potassium chloride is titrated with 0.200 M silver nitrate solution. The following data table was obtained.

	Trial 1	Trial 2	Trial 3
Initial AgNO ₃ burette reading (mL)	0.00	5.26	14.63
Final AgNO ₃ burette reading (mL)	5.26	12.19	19.87
Volume of KCl titrated	25.0	25.0	25.0

Use the information in the data table to calculate the [Cl⁻] in the KCl solution. Show all of your work clearly.

KCl - sample ("unknown") solution → Purpose: to determine [Cl⁻] ions in KCl
 AgNO₃ - titrant or standard ("known") solution

Step 1: Determine ~~the~~ volume AgNO₃ used for each trial (Final AgNO₃ - Initial AgNO₃)

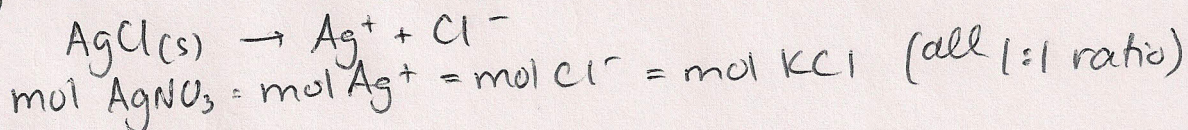
	TRIAL 1	TRIAL 2	TRIAL 3
Vol AgNO ₃ (mL)	5.26	6.93	5.24

Step 2: Average volume: $\frac{5.26 + 6.93 + 5.24}{3} = 5.81 \text{ mL AgNO}_3$ or 0.00581 L

Step 3: Calculate moles of AgNO₃

$$\text{moles AgNO}_3 = (C)(V) = (0.200 \text{ M})(0.00581 \text{ L}) = 0.001162 \text{ mol AgNO}_3$$

Step 4: Determine moles of KCl / [Cl⁻] using molar ratios



$$\text{mol Cl}^- = 0.001162 \text{ mol}$$

Step 5: determine concentration: $[\text{Cl}^-] = \frac{\text{mol}}{\text{L}} = \frac{0.001162 \text{ mol}}{0.0250 \text{ L}} = 0.4648 = \boxed{0.465 \text{ M}}$
 ↑ from 25.0 mL of sample solution