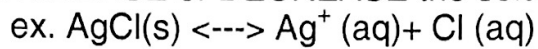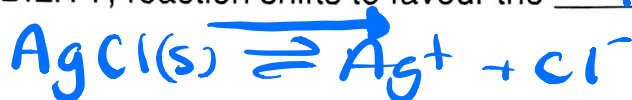Chemistry 12
Solubility Lesson #10
THE COMMON ION EFFECT and other ways to alter the solubility of a salt

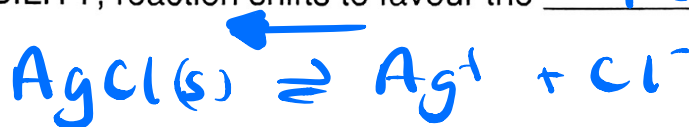What does it mean to INCREASE or DECREASE the solubility of a salt?
ex. $AgCl(s) \longleftrightarrow Ag^+ (aq) + Cl^- (aq)$

INCREASE SOLUBILITY, reaction shifts to favour the ___**PRODUCTS**___ .

$$AgCl(s) \rightleftharpoons Ag^+ + Cl^-$$

DECREASE SOLUBILITY, reaction shifts to favour the ___**REACTANTS**___.

$$AgCl(s) \rightleftharpoons Ag^+ + Cl^-$$

Recall LE CHATELIER'S PRINCIPLE; **changing the concentration of dissolved ions in the equilibrium will shift the equilibrium:**

A. DECREASING the solubility of a salt   (Reactants)

If we ___increase___ the concentration of (one) of the ions in solution, according to Le Chatelier the reaction will shift to the ___reactant___.

ex i. increase $[Ag^+]$ by adding (AgNO₃)
$$AgCl(s) \rightleftharpoons \uparrow Ag^+ + Cl^- \downarrow$$

ex ii. increase $[Cl^-]$ by adding (NaCl)
$$AgCl(s) \rightleftharpoons \downarrow Ag^+ + \uparrow Cl^-$$
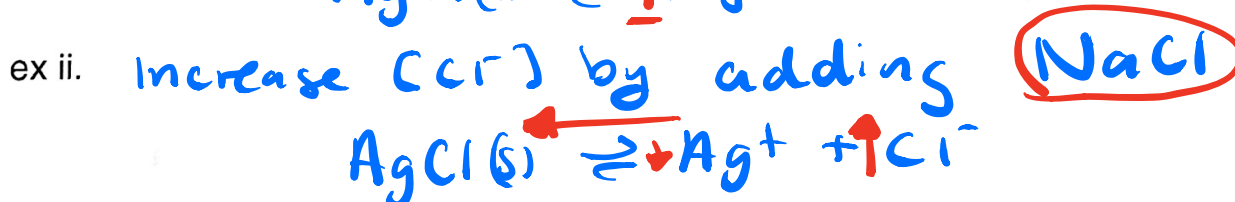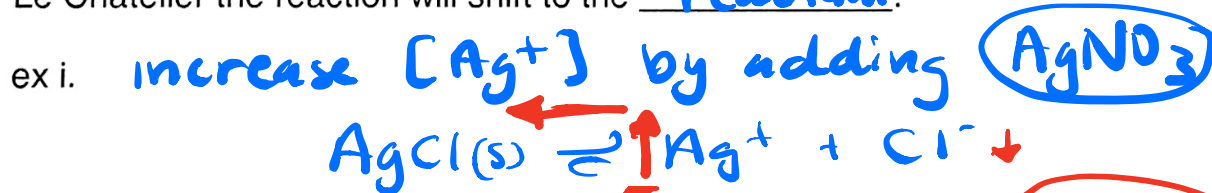
THIS PROCEDURE IS CALLED THE COMMON ION EFFECT!
The *common ion effect* is often used in chemistry to deliberately prevent a particular salt form dissolving to any great extent or to force a particular dissolved ion to leave a solution.

Example1: The solubility of $Mg(OH)_2$ is about 0.5 M at 25 ºC.
State two ways to **DECREASE** the solubility of $Mg(OH)_2$ in water.

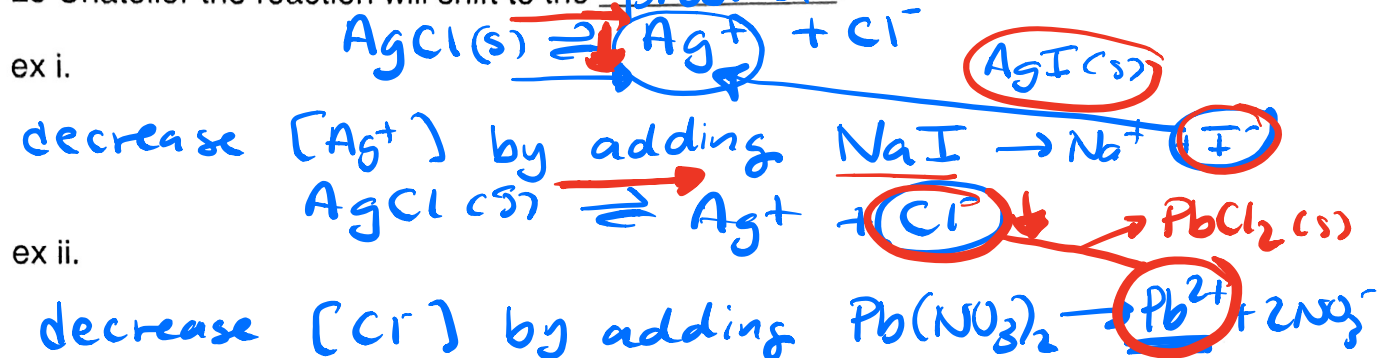heat + $Mg(OH)_2(s) \rightleftharpoons Mg^{2+} + 2OH^-$
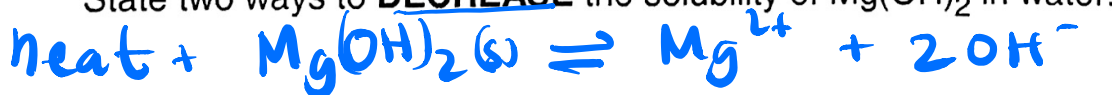
1. adding $Mg(NO_3)_2$ ∴ ↑ $[Mg^{2+}]$

3.
↓ temp
Ksp value

2. adding $NaOH$ ∴ ↑ $[OH^-]$

B. INCREASING the solubility of a salt → force one ion to form a precipitate
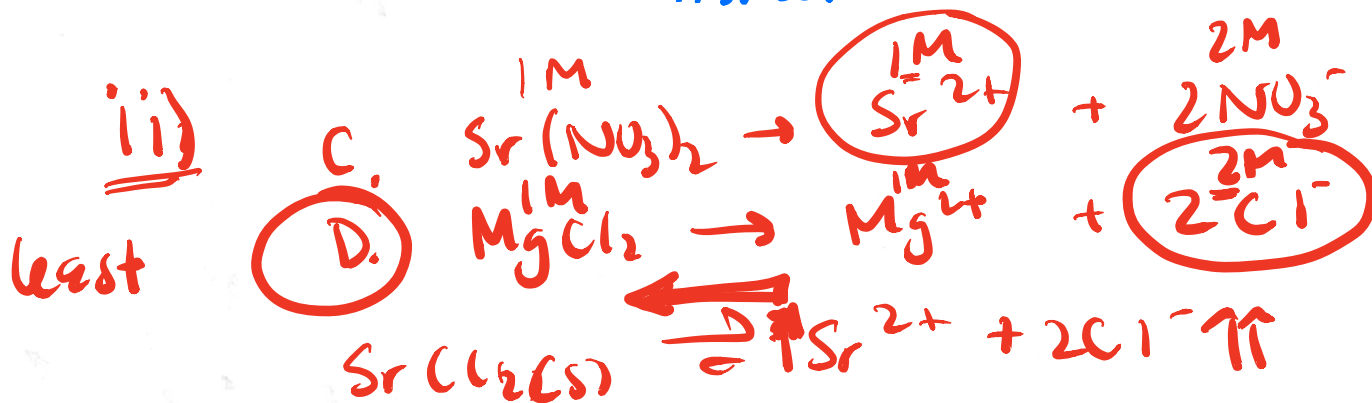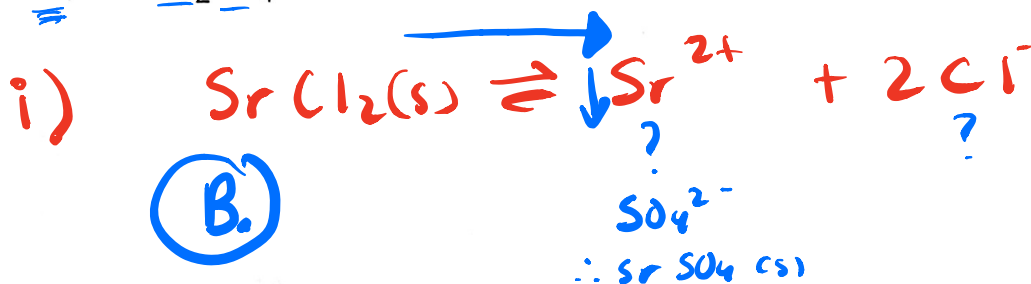
If we __decrease__ the concentration of one of the ions in solution, according to Le Chatelier the reaction will shift to the __product__.

ex i.

$$AgCl(s) \rightleftharpoons Ag^+ + Cl^-$$

$AgI(s)$

decrease $[Ag^+]$ by adding $NaI \rightarrow Na^+ + I^-$

ex ii.

$$AgCl(s) \rightleftharpoons Ag^+ + Cl^- \rightarrow PbCl_2(s)$$

Pb^{2+}

decrease $[Cl^-]$ by adding $Pb(NO_3)_2 \rightarrow Pb^{2+} + 2NO_3^-$

Example 2: In which solution would $SrCl_2$ be most soluble? In which solution would $SrCl_2$ be least soluble? Explain your answers

A) 1 M $NaNO_3$ C) 1 M $Sr(NO_3)_2$
B) 1 M Na_2SO_4 D) 1 M $MgCl_2$

i) $$SrCl_2(s) \rightleftharpoons Sr^{2+} + 2Cl^-$$
        ?   ?

B.

SO_4^{2-}

∴ $SrSO_4(s)$

ii)

least

C. 1M $Sr(NO_3)_2 \rightarrow$ 1M Sr^{2+} + 2M $2NO_3^-$

D. 1M $MgCl_2 \rightarrow$ Mg^{2+} + 2M $2Cl^-$

$$SrCl_2(s) \rightleftharpoons Sr^{2+} + 2Cl^- \Uparrow$$

temp = ~~∝~~