KEY

Common Ion Effect

1.) A new kettle was used to make tea using "temporarily hard" water. After a few weeks there was a thin layer of white scale on the inside of the kettle. Suggest the chemical formula for the kettle scale.

Answer - $Ca^{+2} + 2\,HCO_3^- + \text{energy} \rightarrow CaCO_{3\,(s)} + CO_2 + H_2O$ $(CaCO_3)$

(temporary differs from permanent only in the fact that HCO_3^- is also dissolved in the water with the Ca^{+2}).

2.) Is it possible to distinguish between temporarily hard and permanently hard water by adding washing soda and seeing if a precipitate forms?

Answer – No. adding Na_2CO_3 (washing soda) will precipitate the Mg^{+2} and the Ca^{+2} whether there is HCO_3^- or not. If HCO_3^- is present (as in the question above) then only heat is required to precipitate the Ca^{+2} and Mg^{+2}.

3.) Cities whose water supply has temporarily hard water often have problems with the hot water pipes in homes becoming clogged and having decreased water flow. Why might this be?

Answer – as some of the water evaporates or is heated the Ca^{+2} (and to a lesser extent Mg^{+2}) are precipitating out and clogging the pipes up over time.

4.) The solubility of $Sr(OH)_2$ is about $0.5\ M$ at $25°C$. What are two ways you could increase the solubility and decreasing the solubility in water.

Answer -

	Increase	Decrease
1.)	- increase temperature	- decrease temperature
2.)	- add CaS. The S^{-2} will precipitate out Sr^{+2} and shift equilibrium right. (Common ion effect)	- add NaOH. The increased OH^- will drive the equilibrium to the reactants. (Common ion effect)

5.) A metal plate had an unwanted coating of $CaCO_{3\,(s)}$. How might you dissolve this coating?

Answer – increase solubility of $CaCO_3$. Add a chemical like Na_3PO_4 to dissolve the Ca^{+2}.

6.) In which solution would $SrCl_{2\,(s)}$ be the most soluble? In which would it be least soluble? Explain.

a. $1\ M\ NaNO_3$ b. $1\ M\ Na_2SO_4$ c. $1\ M\ Sr(NO_3)_2$ d. $1\ MgCl_2$

Answer – Most soluble in Na_2SO_4 as the sulphate will precipitate with the strontium, driving the reaction to the products (more soluble).

- Least soluble in $MgCl_2$ as the chloride is a common ion and so drives the reaction back to the reactant (solid $SrCl_2$). The $Sr(NO_3)_2$ is also a common ion like the Cl^- BUT the Cl^- is trice as concentrated from the $MgCl_2$ driving the reaction to the reactants more!