LE CHATELIER'S PRINCIPLE:

When a "stress" is applied to a closed system at equilibrium, the system readjusts so as to relieve or offset the stress.

IMPOSED FACTORS WHICH CAN APPLY STRESS TO AN EQUILIBRIUM ARE:

1) Change in concentration
2) Change in temperature
3) Change in total pressure
4) Change in volume (of a gaseous system)

**RECALL from the beginning of this unit - in the introductory notes, we stated that adding a catalyst is NOT a stress on the equilibrium, it just allows equilibrium to be achieved in a shorter period of time!

A system not at equilibrium will tend to move toward a position of equilibrium.
Although an unbalanced equilibrium system will attempt to return to its original equilibrium concentration it CANNOT be 100% successful!

DRIVE TOWARDS MINIMUM ENTHALPY AND MAXIMUM ENTROPY AND THE EFFECT ON EQUILIBRIUM:

Recall in the notes at the beginning of the unit - some reactions are reversible and some are not. How to tell which reactions favours products (the forward reaction), which reactions favour reactants (the reverse reaction), and which are at a ***dynamic equilibrium***.

?⇔? ***refers fo the question*** – which direction (forward or reverse) does this reaction prefer…***or*** is it a dynamic equilibrium (reversible reaction)

1) Consider the following reaction:

$$C_2H_2\,(g) + 2\,Cl_2\,(g) \quad ?\Leftrightarrow? \quad C_2\,H_2Cl_4\,(l) + 386\ kJ$$

The tendency to go to the side with MAXIMUM ENTROPY favours the formation of the reactants (g vs. l, more moles)

The tendency to go to the side with MINIMUM ENTHALPY favours the formation of the products (exo)

Overall, then, the two tendencies oppose each other and **this reaction** forms an equilibrium.

- A SPONTANEOUS EQUILIBRIUM REACTION IN WHICH ENTHALPY AND ENTROPY OPPOSE EACH OTHER.

2) Consider the following reaction:

$$CH_4\,(g) + 3/2\,O_2\,(g) \quad ?\Leftrightarrow? \quad CO_2\,(g) + 2H_2O\,(g) + 394\ kJ$$

The tendency to go to the side with MAXIMUM ENTROPY favours the formation of the products (more moles)

The tendency to go to the side with MINIMUM ENTHALPY favours the formation of the products (exo)

Overall, then, the two tendencies BOTH FAVOUR THE PRODUCTS and the reaction will go 100% in the forward direction.
- A SPONTANEOUS REACTION THAT GOES 100% TO COMPLETION.

***IMPORTANT NOTE:*
In our S vs. H sheet (first worksheet of Unit 2) – we were TOLD that is WAS equilibrium. We just had to justify the reasons for H and S opposing each other. We NOW know that we might also be asked IF a given reaction is a dynamic equilibrium…In other words we have to determine if S and H oppose, or BOTH favour products or BOTH favour reactants.

3) Consider the following reaction:

$$4Au\,(s) + 3\,O_2\,(g) + 162\ kJ \quad ?\Leftrightarrow? \quad 2Au_2\,O_3\,(s)$$

The tendency to go to the side with MAXIMUM ENTROPY favours the formation of the reactants (g vs. s, more moles)

The tendency to go to the side with MINIMUM ENTHALPY favours the formation of the reactants (endo)

Overall, then, the two tendencies BOTH FAVOUR THE REACTANTS and the reaction will go 0% in the forward direction, or in otherwords, this reaction only occurs in the reverse direction.
- A NON - SPONTANEOUS REACTION IN WHICH NO PRODUCTS ARE FORMED - won't occur as written!

IMPORTANT LEARNING OUTCOME FOR UNIT 2:
You must be able to apply the concept of equilibrium to a commercial or industrial process textbook pages 320 - 321 (including inserts), 324 - 329.
(Remember that you were required to know industrial applications for Unit 1 too - text reading and handouts)