

Name: Key
Blk: _____ Date: 0

Chemistry 12
EQUILIBRIUM Lesson #3
PREDICTING WHETHER A REACTION IS SPONTANEOUS OR NOT

A SPONTANEOUS change is one that occurs BY ITSELF without any outside assistance.

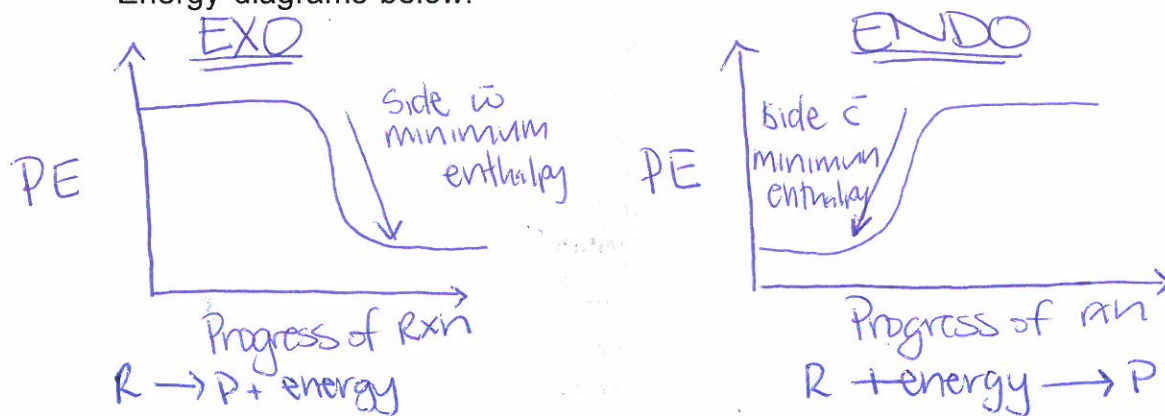
THERE ARE TWO FACTORS THAT DETERMINES WHETHER A REACTION WILL BE SPONTANEOUS OR NOT:

1. ENTHALPY (HEAT)
2. ENTROPY (RANDOMNESS)

ENTHALPY (H): the total kinetic and potential energies that exist in a system which is at constant pressure.

All chemical reactions can be categorized as either an endothermic or exothermic reaction. EXOTHERMIC GIVE OFF HEAT to the environment whereas ENDOTHERMIC ABSORB HEAT from the environment.

EXOTHERMIC and **ENDOTHERMIC REACTIONS** are illustrated in the Potential Energy diagrams below:



CHEMICAL REACTIONS TEND TO FAVOUR THE SIDE WITH

MINIMUM ENTHALPY !!!! (HEAT TERM)

The tendency to MINIMUM ENTHALPY favours the side of the reaction containing the HEAT term (as the heat is on the "DOWNHILL" side of the PE diagram)

Recall : endo
Reactants + heat \rightleftharpoons Products ; $\Delta H = H_P - H_R = +ve$
exo
Reactants \rightleftharpoons Products + heat ; $\Delta H = H_P - H_R = -ve$
from Chem
11

ENTROPY : the amount of *randomness* in a system

Randomness is the opposite to orderliness. When considering the **chemical phases** the most *orderly* is A SOLID whereas the most *random* is A GAS.

The randomness of the phases in order of **most random to least** is:

GASES >> AQUEOUS >> LIQUIDS >> SOLIDS

CHEMICAL REACTIONS TEND TO FAVOUR THE SIDE WITH
MAXIMUM ENTROPY !!!!

If there is only a **SINGLE PHASE** in the entire chemical reaction, the side having the **most molecules** is favoured.

eg. $A(s) + B(s) \rightleftharpoons C(s)$ The reactant side is favoured
2(s) vs 1(s)

If a chemical reaction contains a **VARIETY OF PHASES** the side with the **most molecules** of the **most random** phase is favoured.

eg. $A(g) + B(s) \rightleftharpoons 2C(g) + D(s)$
1(s) + 1(s) vs 2(g) + 1(s)
The product side is favoured b/c of the 2 molecules of gas vs 1 on the reactant side

IF **MINIMUM ENTHALPY** and **MAXIMUM ENTROPY** both favour the PRODUCTS the reaction will go to completion.

eg. $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g) + 394\text{ KJ}$
2 vs 3 + heat

The product side is favoured & rxn will go to completion

IF **MINIMUM ENTHALPY** favours the PRODUCTS and **MAXIMUM ENTROPY** favours the REACTANTS the reaction will reach equilibrium.

eg. $C_2H_2(g) + 2Cl_2(g) \rightarrow C_2H_2Cl_4(l) + 386\text{ KJ}$
3(g) vs 1(l) + heat

NOTE : Vice versa is also true for equilibrium!

IF **MINIMUM ENTHALPY** and **MAXIMUM ENTROPY** both favour the REACTANTS the reaction will not be spontaneous (not occur)

eg. $4Au(s) + 3O_2(g) + 162\text{ KJ} \rightarrow 2Au_2O_3(s)$
4(s) + 3(g) + heat vs 2(s)

SEAT WORK/HOMEWORK: EXERCISES 14-16 pgs 48 + 49
PLO's D7-D9