

Entropy and Enthalpy Guided Notes

1) Define

a) Entropy _____

b) Enthalpy _____

c) Spontaneous _____

d) Non-spontaneous _____

2) There is a natural tendency for reaction to move to the side with **minimum** enthalpy

Minimum enthalpy is the side **with** the heat term

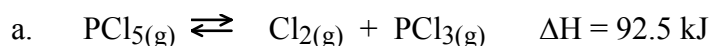
On a PE diagram, the tendency of minimum enthalpy favours the side that is **Higher or lower** on the graph.

In an endothermic reaction (forward), min. enthalpy favours the **reactants**.

In an exothermic reaction (forward), min. enthalpy favours the **products**.

Problems

Tell whether each of the following is *endothermic* or *exothermic* and state which has **minimum enthalpy**, the *reactants* or the *products*:



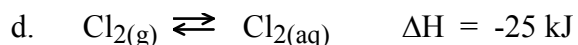
endo thermic and the **reactants** have *minimum enthalpy*.



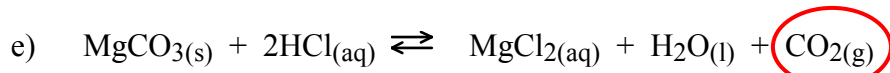
endo thermic and the **reactants** have *minimum enthalpy*.



exo thermic and the **products** have *minimum enthalpy*.



exo thermic and the **products** have *minimum enthalpy*.



The products have greater entropy.

4) In nature there is a natural tendency for a reaction to favour the side with

minimum enthalpy and maximum entropy.

5) Choose one of the following

does not occur-non-spontaneous or goes to completion- spontaneous or goes to equilibrium

a) If min. enthalpy and maximum entropy both favour the products

- the forward reaction will go to completion

-the reverse reaction will not occur

b) If min. enthalpy and maximum entropy both favour the reactants

- the forward reaction will not occur

-the reverse reaction will go to completion

c) If min. enthalpy and maximum entropy both favour the opposite directions

- the forward reaction will go to equilibrium

-the reverse reaction will go to equilibrium

Problems

For each of the following reactions decide which has *minimum enthalpy* (reactants or products), which has *maximum entropy* (reactants or products), and if the reactants are mixed, what will happen? (go to completion/ reach a state of equilibrium/not occur at all).

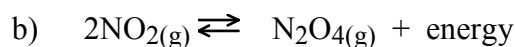


The products has/have minimum enthalpy.

The reactants has/have maximum entropy.

If PCl_3 and Cl_2 are put together, what should happen?(go to completion/ reach a state of equilibrium/not occur at all)

reach a state of equilibrium

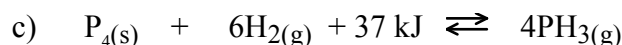


The products has/have minimum enthalpy.

The reactants has/have maximum entropy.

If NO_2 was put in a flask, what should happen?(go to completion/ reach a state of equilibrium/not occur at all)

reach a state of equilibrium

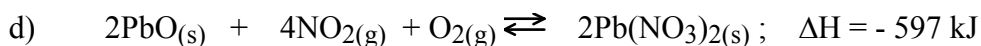


The reactants has/have minimum enthalpy.

The reactants has/have maximum entropy.

If $\text{P}_4(\text{s})$ and $6\text{H}_2(\text{g})$ was put in a flask, what should happen?(go to completion/ reach a state of equilibrium/not occur at all)

not occur at all



The products has/have minimum enthalpy.

The reactants has/have maximum entropy.

If $\text{PbO}(\text{s})$ and $\text{NO}_2(\text{g})$ were put in a flask, what should happen?(go to completion/ reach a state of equilibrium/not occur at all)

reach a state of equilibrium

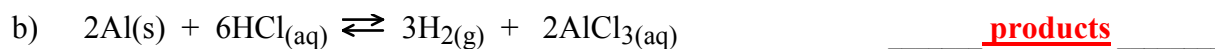
Self Test

1. What is meant by *enthalpy*? _____

2. What is meant by *entropy*? _____
3. In an *endothermic reaction*, the reactants have *minimum enthalpy*.
4. In an *exothermic reaction*, the products have *minimum enthalpy*.
5. Arrange the following in order from *least entropy* to *greatest entropy*:
a) liquids b) gases c) aqueous solutions d) solids

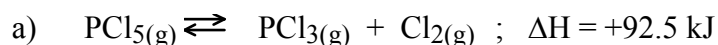
solids < liquids < aqueous solutions < gases
6. There is a natural tendency toward minimum *enthalpy*
and maximum *entropy*.
7. A process in which *entropy increases* and *enthalpy decreases* will
(go to completion/ reach a state of equilibrium/not occur at all) _____
8. A process in which *entropy increases* and *enthalpy increases* will
(go to completion/ reach a state of equilibrium/not occur at all) _____
9. A process in which *entropy decreases* and *enthalpy decreases* will
(go to completion/ reach a state of equilibrium/not occur at all) _____
10. A process in which *entropy decreases* and *enthalpy increases* will
(go to completion/ reach a state of equilibrium/not occur at all) _____
11. A process in which *both the enthalpy and entropy trends favour reactants* will
(go to completion/ reach a state of equilibrium/not occur at all) _____
12. A process in which *both the enthalpy and entropy trends favour products* will
(go to completion/ reach a state of equilibrium/not occur at all) _____
13. A process in which *the enthalpy and entropy trends oppose each other* will
(go to completion/ reach a state of equilibrium/not occur at all) _____

14. In each of the following, state which has the *maximum entropy*, (reactants or products)



15. For each of the following reactions decide which has *minimum enthalpy* (reactants or products), which has *maximum entropy* (reactants or products), and if the reactants are mixed, what will happen? (go to completion/ reach a state of equilibrium/not occur at all).

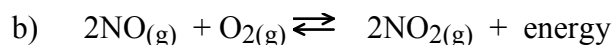
Assume there is sufficient activation energy to initiate any spontaneous reaction.



The reactants _____ has/have minimum enthalpy.

The products _____ has/have maximum entropy.

If PCl_5 is put in a flask what should happen? (go to completion/ reach a state of equilibrium/not occur at all)



The products _____ has/have minimum enthalpy.

The reactants _____ has/have maximum entropy.

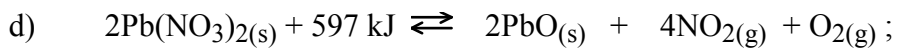
If NO and O_2 were put in a flask, what should happen? (go to completion/ reach a state of equilibrium/not occur at all)



The products _____ has/have minimum enthalpy.

The products _____ has/have maximum entropy.

If $Na_2CO_{3(s)} + 2HCl_{(aq)}$ were put in a flask, what should happen?
(go to completion/ reach a state of equilibrium/not occur at all)



The reactants has/have minimum enthalpy.

The products has/have maximum entropy.

If $\text{Pb}(\text{NO}_3)_2$ was put in a flask, what should happen? (go to completion/ reach a state of equilibrium/not occur at all)

16. Reactions which result in a/an decrease in enthalpy and a/an increase in entropy will *always* be **spontaneous**.

17. Reactions which result in a/an increase in enthalpy and a/an decrease in entropy will *always* be **non-spontaneous**.