Hello students, we are going to learn the

topic from Course title physical chemistry,

and organic chemistry of semester II.

Title of the unit is chemical energetics.

Module name is concept of standard

state and standard enthalpies of

formation and this is module #3.

Outline of this presentation has

concept of standard state, Enthalpy,

Standard enthalpies of formation and problems

based on standard enthalpies of formation.

let's see what

are the learning outcomes.

From this module you will

understand what is standard state.

How do we define standard state

standard enthalpies of formation?

How do we define standard enthalpies

of formation and how to solve problems

based on standard enthalpies of formation?

Let's first understand

what is standard state.

The standard state of a substance is

taken as its natural state at 25 ^{o}C

and at one atmospheric pressure.

So when we talk about a standard

state of any liquid or a solid

at any particular temperature,

we define the standard state of

any liquid or solid substance to

be the most stable form of that

substance at a pressure of 1 bar.

For gases at any particular

temperature we define the standard

state of a gas to be the ideal gas

standard state at that temperature.

Now what do we mean by ideal

gas standard state?

By the ideal gas standard state we

mean at finite low pressure at which

the real gas behaves as an ideal gas.

OK,

so we understand how do we

define the standard state of any

liquid, solid or gases.

Now let's see what is enthalpy.

No enthalpy is defined as the sum of

the system's internal energy and the

product of its pressure and volume.

Enthalpy is given by symbol H,

so we write H is equal to E plus PV,

where E is the internal energy,

P is pressure and V is volume.

Now let's see what do you mean by

standard enthalpies of formation.

The standard enthalpy of formation of a

compound is defined as the enthalpy change

accompanying the formation of 1 mole of a

compound from its constituent elements.

When all the substances are

taken in their standard state.

It is represented by ΔH_f^o

Where? The superscript degree sign

indicates that the reactants as

well as the product are all in the

standard states and the subscript f

indicates that the enthalpy change

is for the formation of indicated

compound from its elements.

Standard enthalpies can be

assigned to substances.

Let's see one example.

For standard enthalpies of formation.

This reaction is hydrogenation of ethene.

That is CH_2CH_2 plus H_2 forming

CH_3CH_3 that is ethane.

OK, so the enthalpy change

for this particular reaction,

which is denoted as ΔH^o

is given by enthalpy of the

products minus that of the reactant.

Now we can write this equation.

Like this that is ΔH^o

can be written as enthalpy

of formation of the product.

That is Enthalpy of formation for ethane minus the total enthalpy

of the reactant as sum of the

enthalpy for formation of H_2 and

enthalpy of formation of ethene

So we write the overall reaction as

$\Delta H^o = \Delta H_f^o(CH_3CH_3) - [\Delta H_f^o(H_2) + \Delta H_f^o(CH_2CH_2)]$

Let's solve one problem based on this.

The problem says calculate the

standard enthalpy of formation of

methanol at 25 ^oC from the

value of minus 128.12 KJ

that will be obtained for enthalpy

change for the reaction.

In which 1 mole of the substance was

formed from hydrogen and carbon monoxide.

Standard enthalpy of formation of

carbon monoxide is given as

-110.52 kilo joules in solution.

Let's first write the complete stoichiometric

equation for this particular reaction.

That is $2H_{2\,(g)} + CO_{(g)} \longrightarrow CH_3OH_{(l)}$

Now from the given problem we

have been given ΔH^o,

that is enthalpy change for the reaction.

Which is equal to -128.14 KJ.

We are being also given enthalpy of

formation of carbon monoxide which

is equal to -110.52 KJ.

We know enthalpy of formation

of hydrogen is 0.

So what we need to find is

enthalpy of formation of methanol.

Now first let's write the complete equation.

That is 2 moles of hydrogen plus

one mole of carbon monoxide gives

one mole of methanol.

Now, using this reaction,

let's write the equation.

Enthalpy of the reaction that is ΔH^o.

We can write it as enthalpy of

formation of product minus enthalpy

of formation of reactant.

Now in this case the product is methanol.

So we write ΔH^o_f for methanol

minus enthalpy of formation of reactant.

Now using this stoichiometric

equation we see that we

need 2 moles of hydrogen.

So we have to multiply enthalpy of

formation of hydrogen by two

plus the enthalpy of formation of carbon.

so accordingly we

substitute all the values.

OK, so the values for ΔH^o,

that is enthalpy of the reaction is

-128.14 enthalpy of formation

of hydrogen is zero and enthalpy of

formation of carbon monoxide is -110.52.

Now once we substitute all the values

we get -128.14 is equal to

ΔH^o_f for methanol plus 110.52.

How do we get the plus sign?

Is just when you say two in to zero,

is zero and when you just

multiply minus into minus,

that is minus of 110.52 we get

plus sign there.

So by rearranging, ΔH^o_f for methanol

will be equal to -128.

-128.14 – 110.52

So adding this values up we

get $\Delta H_f^o (CH_3OH)$ = -238.66 KJ

So this is how we have to solve the

problems based on enthalpies of formation.

So where do we use this standard

enthalpies of formation values?

So standard enthalpies can be used

for calculation of ΔH,

that is to find out change in enthalpy

values at 25 ^oC for any

reaction that is involving these substances.

These are some of the references.

Thank you.