

## Predicting Enthalpy Changes-Hess's Law

Not every reaction of interest can be studied by means of calorimetry.

Why? *- reactions are slow.*

Example: The rusting of iron

*- products may vary.*

Example: The formation of carbon monoxide



In the event we want to determine an enthalpy change for a reaction, we can use predetermined reaction values.

This principle is known as Hess's Law of summation

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$$\Delta H_{\text{NET}} = \Delta H_1 + \Delta H_2 + \Delta H_3 + \dots$$

$$\Delta H_{\text{NET}} = \sum \Delta H_{\text{RXN}}$$

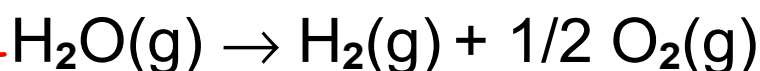
## Characteristics of Enthalpy Changes

1. If a reaction is reversed, the sign of  $\Delta H$  is also reversed.

- If  $\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g})$

$$\Delta H = -285.5 \text{ kJ}$$

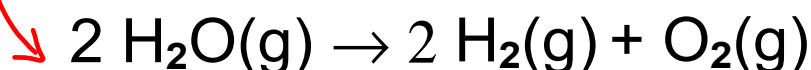
then the reverse is:



$$\Delta H = +285.5 \text{ kJ}$$

2. The magnitude of  $\Delta H$  is directly proportional to the quantities of reactants and products in a reaction.

- If you multiply the equation by a number, you multiply the heat by that number:

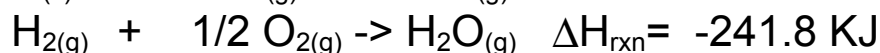
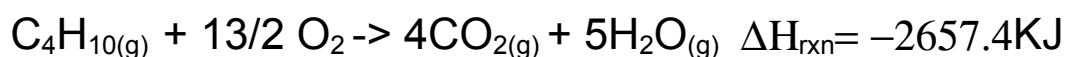


$$\Delta H = +571.0 \text{ kJ}$$

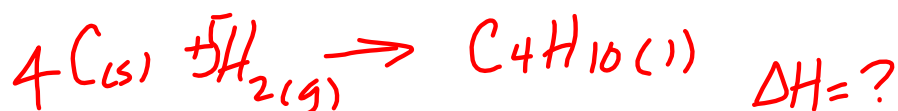
EX

a) Find the enthalpy change for the formation of butane.  $\Delta H = ?$

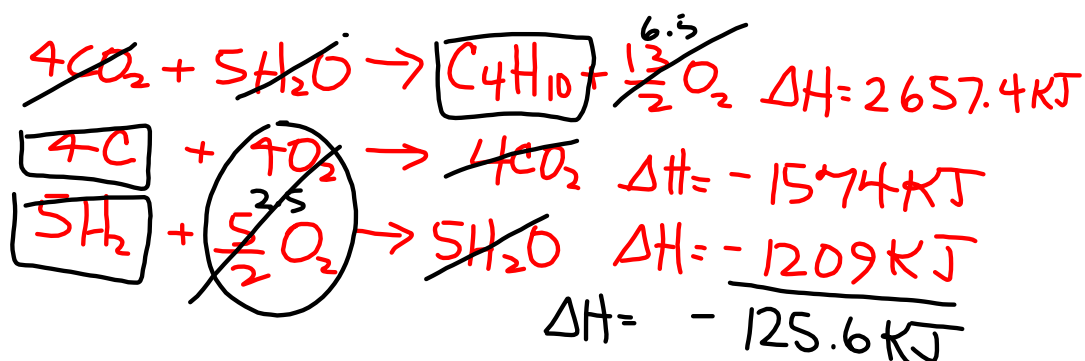
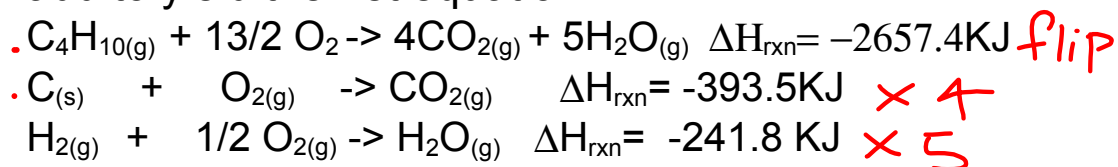
Given:



Step 1: Write the net reaction if it is not given:



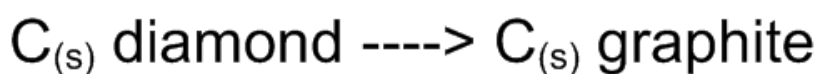
Step 2: Manipulate the given equations so they will add to yield the net equation.



Step 3: Cancel and add the remaining reactants and products

Step 4: Add the component enthalpy changes to obtain the net enthalpy change

Step 5: Determine molar enthalpy, if required

 $\Delta H = ?$ 

reactions to use....

