

# Reactivity 1.2

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IB CHEMISTRY SL

25 <b>Mn</b> Manganese 54.938045	16 <b>S</b> Sulfur 32.065	<b>J</b>	6 <b>C</b> Carbon 12.0107	2 <b>He</b> Helium 4.002602	25 <b>Mn</b> Manganese 54.938045
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## Reactivity 1.2.1

### Understandings:

- Bond-breaking absorbs energy and bond-forming releases energy.

### Learning outcomes:

- Calculate the enthalpy change of a reaction from given average bond enthalpy data.

### Additional notes:

- Include explanation of why bond enthalpy data are average values and may differ from those measured experimentally.
- Average bond enthalpy values are given in the data booklet.

### Linking questions:

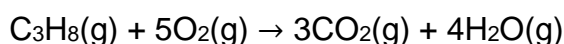
- Structure 2.2 How would you expect bond enthalpy data to relate to bond length and polarity?
- Reactivity 3.4 How does the strength of a carbon– halogen bond affect the rate of a nucleophilic substitution reaction?

### Bond enthalpy and average bond enthalpies

- Average bond enthalpy is the energy needed to break one mole of bonds in a gaseous molecule averaged over similar compounds.
- Bond breaking is endothermic (requires energy).
- Bond making is exothermic (releases energy).

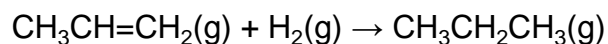
$$\Delta H = \sum (\text{bonds broken}) - \sum (\text{bonds formed})$$

**Example:** Calculate the enthalpy change for the following reaction.



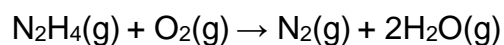
**Exercises:**

1. Propane can be formed by the hydrogenation of propene.



Determine a value for the hydrogenation of propene using information from Table 11 of the Data Booklet. State and explain if the reaction is exothermic or endothermic.

2. Use the information from Table 11 of the Data Booklet to calculate the enthalpy change for the following reaction.



3. State three reasons why enthalpy changes calculated using average bond enthalpies can be inaccurate.

## Reactivity 1.2.2

### Understandings:

- Hess's law states that the enthalpy change for a reaction is independent of the pathway between the initial and final states.

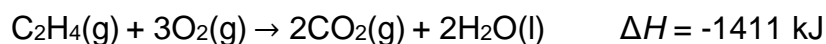
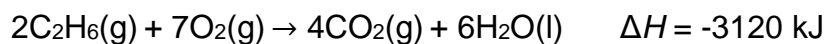
### Learning outcomes:

- Apply Hess's law to calculate enthalpy changes in multistep reactions.

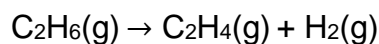
### Calculating the enthalpy change of a reaction that is the sum of multiple reactions with known enthalpy changes

- Applying Hess's law, the enthalpy change for a reaction can be calculated using multiple reactions with known enthalpy changes.

#### Example:

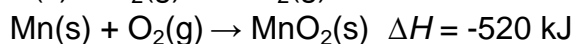
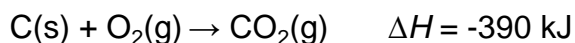


Calculate the enthalpy change for the following reaction:

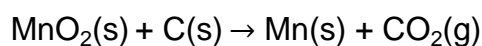


## Exercises:

1. Using the equations below:



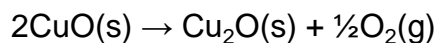
Determine the  $\Delta H$  (in kJ) for the following reaction.



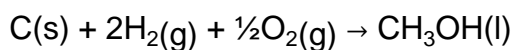
2. Using the equations below:



Determine the  $\Delta H$  (in kJ) for the following reaction.



3. Calculate the enthalpy change,  $\Delta H$ , for the reaction:



using Hess's Law and the following information.

