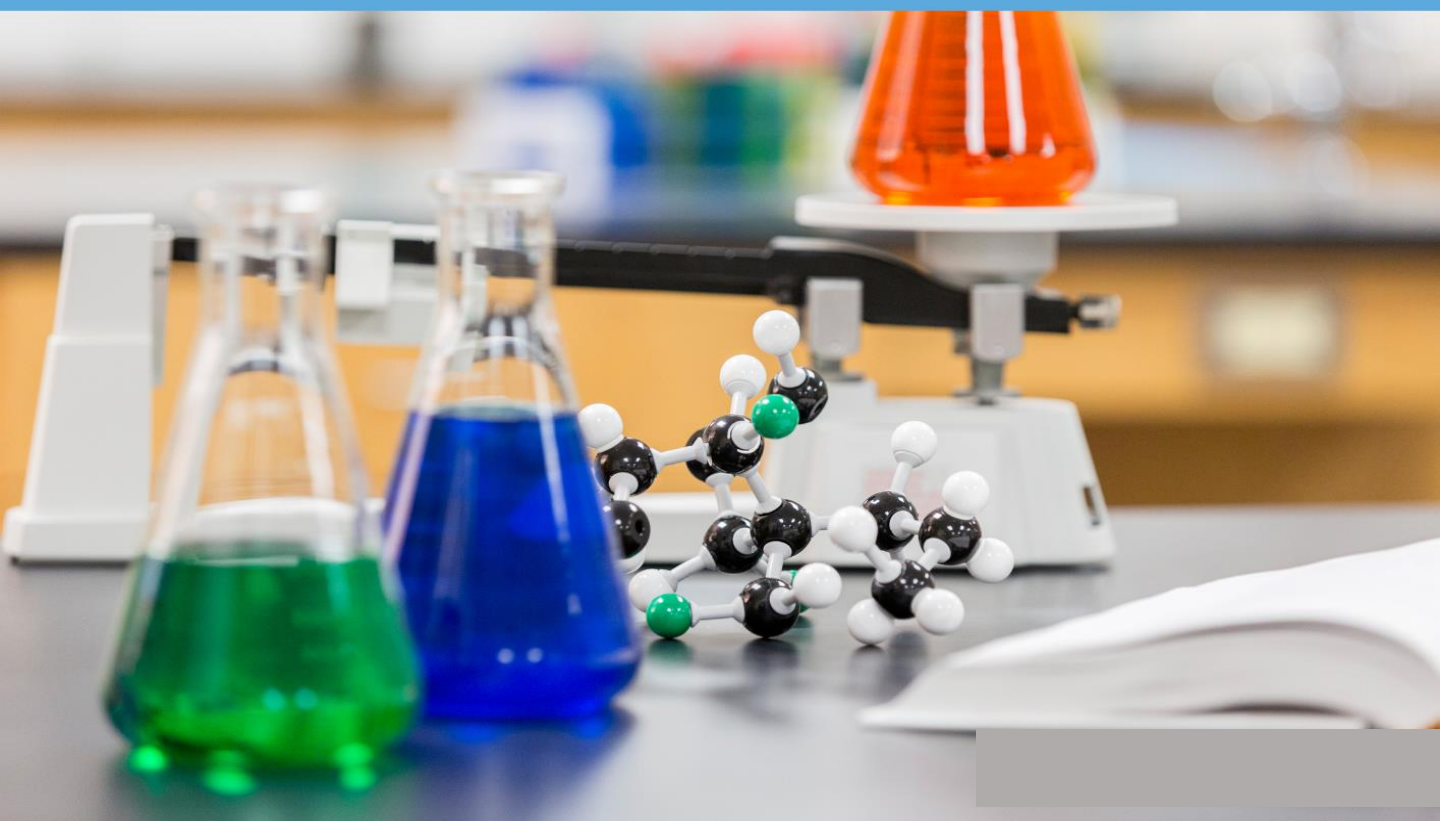


REVISION BOOKLET

Grade 11 • Chemistry

QUANTITATIVE ASPECTS OF CHEMICAL CHANGE

ENERGY & CHEMICAL CHANGE



Western Cape
Government

CTSC

CapeTownScienceCentre



Subject: Chemistry

Grade: 11

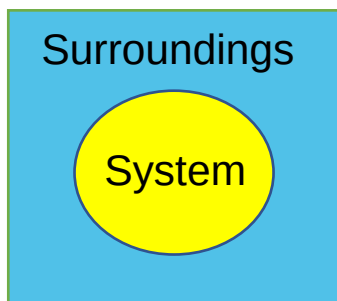
Content area: Chemical Change

Topic: Energy and Chemical Change

In this unit we will focus on the following concepts and skills:

- Exothermic & Endothermic reactions
- Enthalpy
- Classification of reaction

ENERGY AND CHEMICAL CHANGE

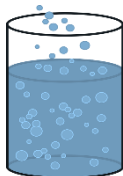


System: Any object you are interested in studying, Example, water in a pot. Phase, temperature, energy flow.

Surroundings: Everything **outside** for your system, and is where the observations and measurements of the particular system are taken.

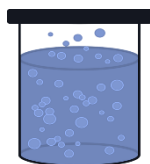
There are 2 types of systems

Open System



Matter and Energy **can leave** the system

Closed System / Isolated System



Matter **cannot leave** but **Energy can leave** the system (Heat)

Enthalpy (H), is the sum of the internal energy (E) of a system and the pressure (P) times volume (V). Pressure times volume refers to the energy available to do **work** on the environment/surroundings.

$$H = E + PV$$

Enthalpy change (ΔH), is the transfer of energy, to or from a system. This usually occurs with a heat transfer. Therefore enthalpy change is also known as **heat of reaction**.

This then leads to the formula:

Enthalpy change = Enthalpy of products – Enthalpy of reactants

$$\Delta H = H_{\text{products}} - H_{\text{reactants}}$$

Subject: Chemistry

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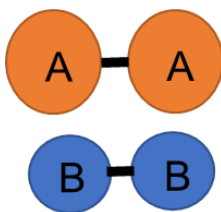
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ENERGY AND CHEMICAL CHANGE

Atoms or ions, found in chemical compounds, has an **internal energy**, due to how they have bonded with one another.

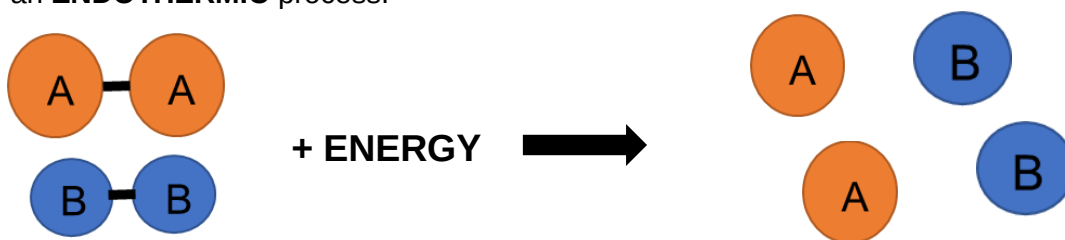


Reactants

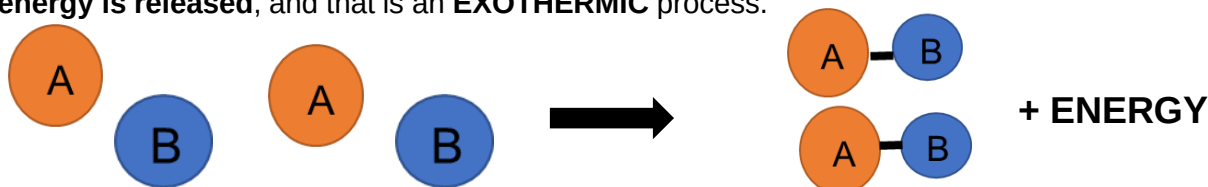
In a chemical reaction, reactants, reactant with one another in order to form products.



In order for this to happen, the bonds that exists between the reactants atoms or ions needs to be broken. **Energy is needed** in order to break these bonds. The breakage of bonds is an **ENDOTHERMIC** process.



When the free atoms or ions are rearranged, to form new bonds, in order to make products, **energy is released**, and that is an **EXOTHERMIC** process.



The total (net) energy change during these types of reactions could either then be, and endothermic reaction or an exothermic reaction.

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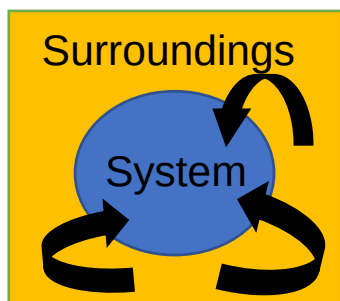
Endothermic reaction



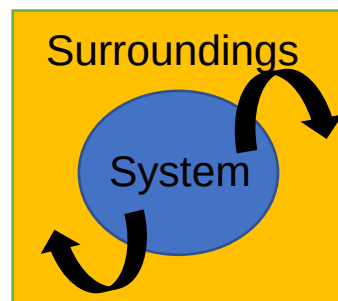
Exothermic reaction



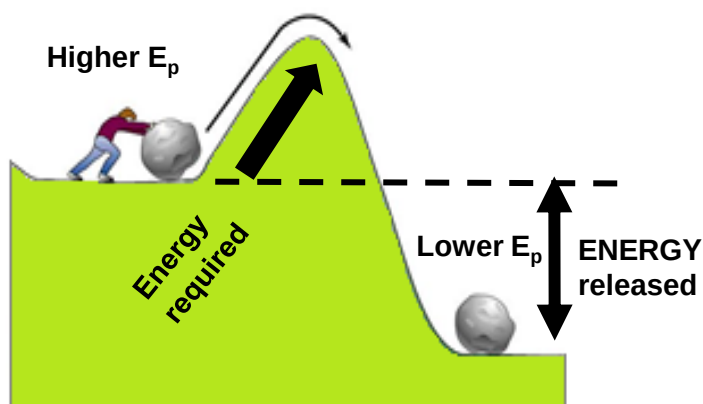
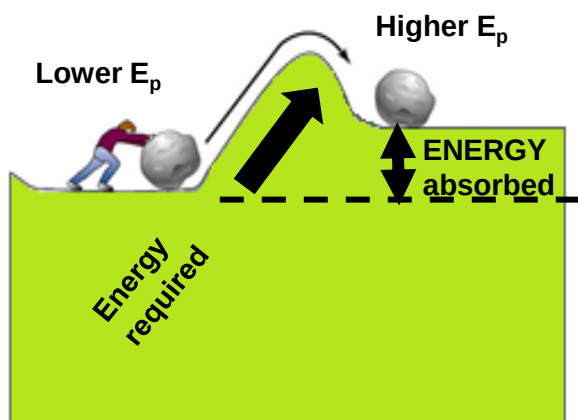
Think in terms of
system



Energy INTO system =
ENDOthemic reaction

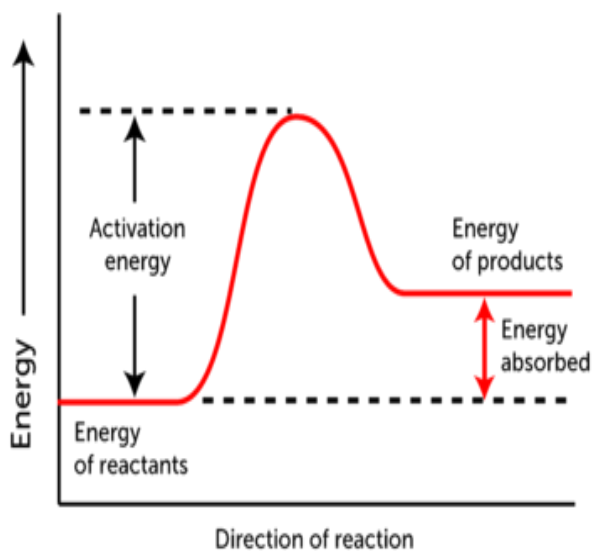


Energy EXITING
system = EXOthemic
reaction



Potential Energy Graphs

Endothermic reaction



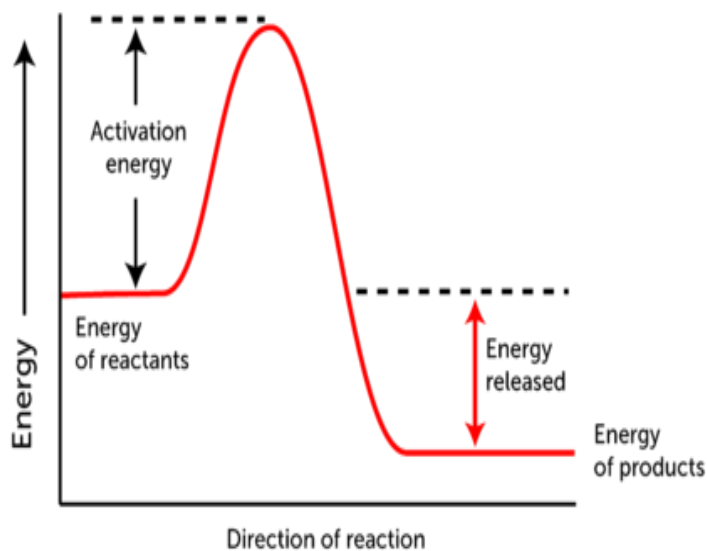
Absorbs heat from it's surroundings, decreasing their temperature.

The products have more potential energy than the reactants.

$$\therefore H_{\text{products}} > H_{\text{reactants}}$$

$$\therefore H > 0$$

Exothermic reaction



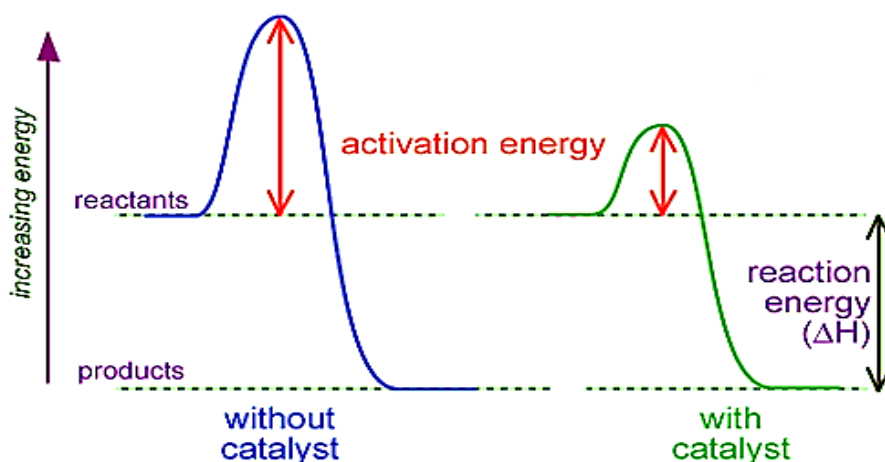
Gives off heat to it's surroundings, increasing their temperature.

The products have less potential energy than the reactants.

$$\therefore H_{\text{products}} < H_{\text{reactants}}$$

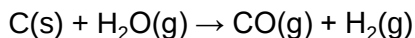
$$\therefore H < 0$$

A CATALYST LOWERS the ACTIVATION ENERGY

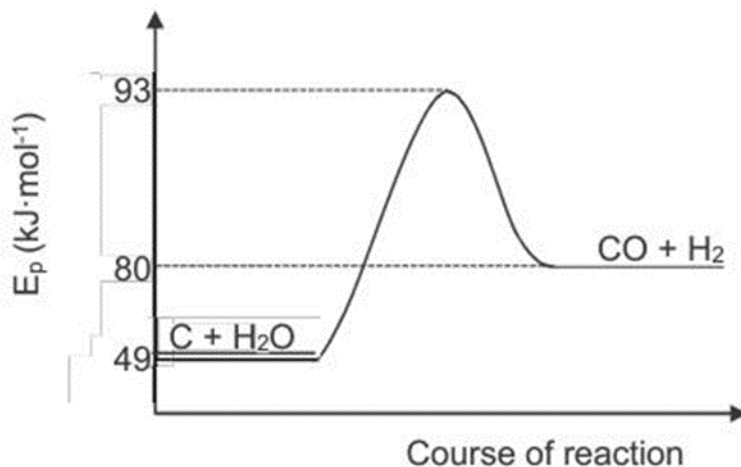


A catalyst only increase its rate without changing its products(outcome).

The balanced equation for the reaction of carbon with steam is as follows:



The graph below, NOT drawn to scale, represents the change in potential energy of the substances during the reaction.



7.1 Define the term heat of reaction.

The energy absorbed or released per mole in a chemical reaction

(2)

7.2 Is the reaction ENDOTHERMIC or EXOTHERMIC? Give a reason for the answer.

(2)

It is Endothermic

More energy is absorbed than released or $\Delta H > 0$

7.3 Use the information on the graph and write down the value of the:

7.3.1 Activation energy

(2)

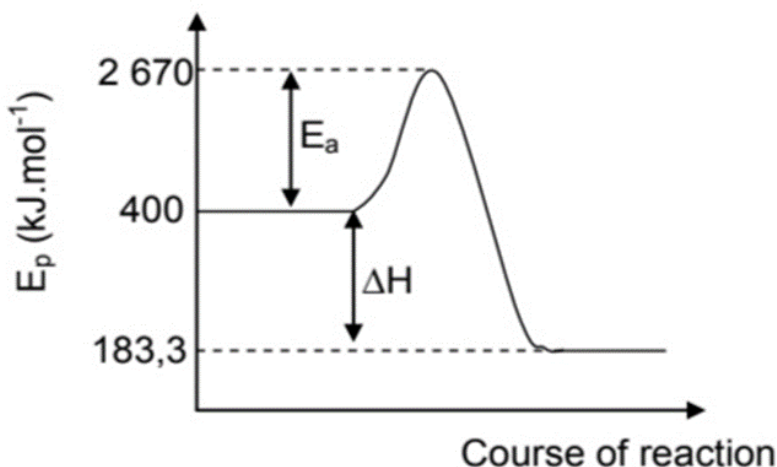
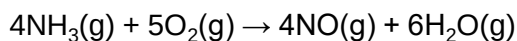
44 ($\text{kJ}/\text{kJ} \cdot \text{mol}^{-1}$)

7.3.2 Heat of reaction

31 ($\text{kJ}/\text{kJ} \cdot \text{mol}^{-1}$)

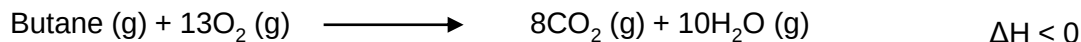
(2)

The following reaction between ammonia and oxygen takes place in a closed system at constant pressure and temperature:



- 7.1 Define the term **activation energy**. (2)
- 7.2 Give a reason why this reaction is exothermic. (1)
- 7.3 Calculate the heat of reaction. (3)
- 7.4 Redraw the graph and indicate with a dotted line the effect of a catalyst on the activation energy. (2)
- 7.5 State *Avogadro's law* in words. (2)
- 7.6 If 6 dm^3 of NH_3 and 9 dm^3 of O_2 are used, calculate the TOTAL VOLUME of the gases at the end of the reaction. (4)
- 7.7 The reaction above is the first step in the manufacturing of an acid. This acid contains 1,59% hydrogen, 22,2% nitrogen and 76,2% oxygen. Determine the empirical formula of the acid. (5)

The equation for the combustion of butane gas is given below.



7.1 Define the term *activation energy*. (2)

7.2 Is the combustion reaction of butane *exothermic* or *endothermic*?

Give a reason for the answer

(2)

7.3 Draw a sketch graph of potential energy versus course of reaction for the reaction above.

Clearly indicate the following on the graph:

- Activation energy
 - Heat of reaction (ΔH)
 - Reactants and products
- (3)

7.4 Determine the empirical formula of butane gas if it consists of 82,76% carbon and 17,24% hydrogen. (4)