PENANG SANGAM HIGH SCHOOL

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LESSON NOTES

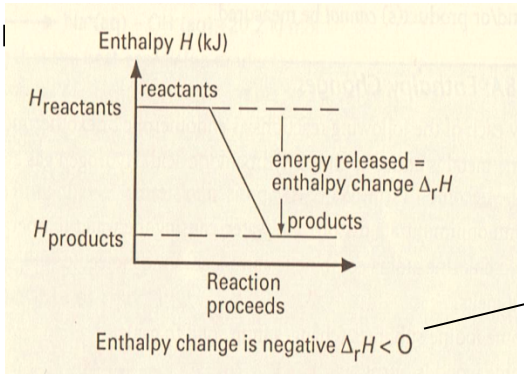
WEEK 13

Year/Level: 13A/B **Subject:** Chemistry

Strand 3	**Reactions**
Sub Strand 3.2	**Thermochemistry**
Content Learning Outcome	By the end of this lesson students should be able: • Define heat of reactions and describe the two types of reactions. • Define enthalpy change and perform calculations on enthalpy change related to it.

Exothermic Reactions

- Reaction in which energy is **released** into the surrounding.
- Heat of the product is **less than** the reactant and surrounding becomes warmer.



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Enthalpy

- The heat content of a substance.
- Enthalpy change in a reaction depends upon the making and the breaking of bonds:
  - i. Bond breaking is endothermic.
  - ii. Bond forming is exothermic.

Heat Capacity (C)

- Amount of heat that will change temperature of the object by 1°C.

$$C = \frac{\text{heat absorbed or released}}{\text{Change in temperature}} = \frac{H}{\Delta T}$$

Units: J/°C or J/K

Specific Heat Capacity(c)

- Amount of heat that will change the temperature of 1g of the substance by 1°C.

c = heat capacity = C
mass m
Units: J/°C.g or J/K.g

Therefore: heat capacity = specific heat capacity x mass

$$\frac{C}{\frac{H}{\Delta T}} = c \times m$$

$$H = mc\Delta T$$

Where:
H/q=heat energy i.e.* quantity of heat flowing into or out of the system *(J/kJ)
m= mass (g)
***c= specific heat capacity* (J/°C.g)**
***ΔT= change in temperature* (°C)**

Molar Heat Capacity

- Amount of heat that will change the temperature of one mole of the substance by 1°C.
- Heat capacity per mole of an element or compound.

Molar heat capacity = specific heat x Molar mass
$$MH_c = c.M$$
Units: J/°C.mol

Example:
78.2 J of heat raises temperature of 45.6g of lead by 13.3°C. Calculate specific heat and molar heat capacity of lead. (Molar mass of lead = 207.2 g/mol)
Solution

M(Pb)= 207.2 g/mol
H=78.2J
m= 45.6g
ΔT= 13.3°C
c= ??

$H = mc\Delta T$
$c = H/m\Delta T$
$= 78.2/(45.6).(13.3)$
$= 0.129 J/°C.g$

$MH_c = c.M$
$= 0.129\ (207.2)$
$= 26.72\ J/°C.mol$

Exercise

1. *When 2000J of energy is supplied to 100g of C_2H_5OH, the temperature increases from 13.5°C to 23.5°C. What is the specific heat capacity of C_2H_5OH in J/g/°C.*

ADDITIONAL QUESTIONS

1. *The following results were obtained for combustion of ethanol in the laboratory:*

   Volume of water in the calorimeter = 400ml
   Initial temperature of water = 23°C
   Final temperature of water = 33°C
   Mass of ethanol burnt = 0.95g
   Specific heat capacity of water = 4.2 J/g/K
   Mr of ethanol = 46 g/mol

   i. *Calculate the heat (Hc) required to raise the temperature of water from 23°C to 33°C.*

   ii. *Calculate the heat (Hc) energy produced when 1mol of ethanol is burnt.*

2. *89.3J of heat is required to raise the temperature of 10g of copper by 11.1°C. calculate :*
   i. *The heat of copper.*

   ii. *Molar heat capacity of copper.*

3. *How much heat is required to change the temperature of 114g water from 24°C to 37°C.? (specific heat capacity of water is 4.18J/g. K)*