

Enthalpy and standard states

1. What is an enthalpy change?
2. If an enthalpy change is measured under standard conditions what does this mean?
3. Define:
 - a. Standard enthalpy of combustion.
 - b. Standard enthalpy of formation.
4. What does the phrase standard state mean?
5. What are the standard states of the following substances?
 - a. H_2O
 - b. carbon
 - c. oxygen
 - d. chlorine
 - e. potassium
6. Write an equation to show the standard enthalpy of formation of:
 - a. water - $\text{H}_2\text{O}_{(l)}$
 - b. ethanol - $\text{C}_2\text{H}_5\text{OH}_{(l)}$
 - c. calcium carbonate - $\text{CaCO}_{3(s)}$
 - d. aluminium oxide - $\text{Al}_2\text{O}_{3(s)}$
 - e. sodium bromide - $\text{NaBr}_{(s)}$

7. Write an equation to show the standard enthalpy of combustion of:
- carbon
 - hydrogen
 - sodium to form sodium oxide (Na_2O)
 - magnesium
 - butane C_4H_{10}
 - octane C_8H_{18}
8. Benzene has the formula C_6H_6 . A student burned 7.8g of benzene and calculated that it released 326kJ of heat energy. Calculate the standard enthalpy of combustion of benzene.
9. Write an equation to show:
- The standard enthalpy of formation of water.
 - The standard enthalpy of combustion of hydrogen.
 - What do the 2 equations have in common?

Answers

1. What is an enthalpy change?

Amount of heat energy released or taken in at constant pressure.

2. If an enthalpy change is measured under standard conditions what does this mean?

Standard conditions are 298K, 100kPa and if using solutions concentrations are

1 mol dm^{-3}

3. Define:

a. Standard enthalpy of combustion.

Enthalpy change when 1 mole of a substance is completely burned in oxygen under standard conditions with all reactants and products in their standard states.

b. Standard enthalpy of formation.

Enthalpy change under standard conditions when 1 mol of a compound is formed from its elements with all reactants and products in their standard states.

4. What does the phrase standard state mean?

Most stable form of the substance at standard conditions.

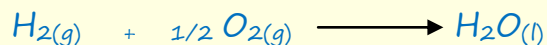
5. What are the standard states of the following substances?

a. H_2O liquid b. carbon solid c. oxygen gas d. chlorine gas

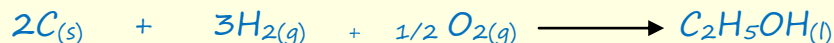
e. potassium solid

6. Write an equation to show the standard enthalpy of formation of:

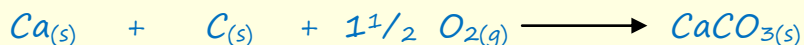
a. water - $\text{H}_2\text{O}_{(l)}$



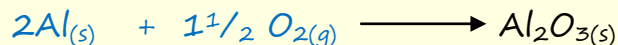
b. ethanol - $\text{C}_2\text{H}_5\text{OH}_{(l)}$



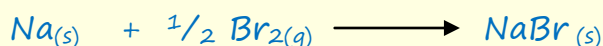
c. calcium carbonate - $\text{CaCO}_{3(s)}$



d. aluminium oxide - $\text{Al}_2\text{O}_{3(s)}$

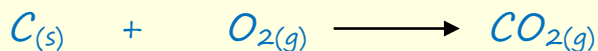


e. sodium bromide - $\text{NaBr}_{(s)}$

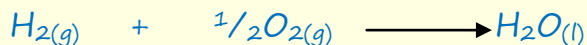


7. Write an equation to show the standard enthalpy of combustion of:

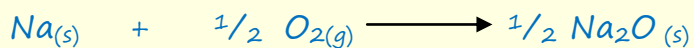
a. carbon



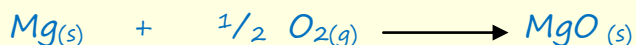
b. hydrogen



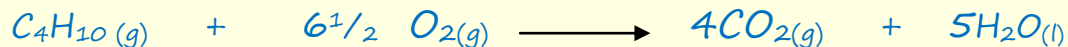
c. sodium to form sodium oxide (Na_2O)



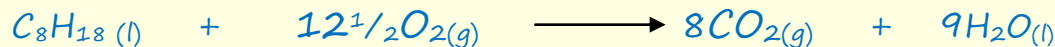
d. magnesium



e. butane C_4H_{10}



f. octane C_8H_{18}



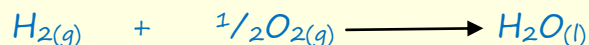
8. Benzene has the formula C_6H_6 . A student burned 7.8g of benzene and calculated that it released 326kJ of heat energy. Calculate the standard enthalpy of combustion of benzene.

$$1 \text{ mole of benzene} = (12 \times 6) + (1 \times 6) = 78g$$

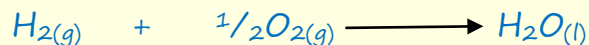
7.8g releases 326kJ so 78g will release 3260kJ

9. Write an equation to show:

a. The standard enthalpy of formation of water.



b. The standard enthalpy of combustion of hydrogen.



c. What do the 2 equations have in common? *They are identical!*