Standard Heats of Reaction and Hess' Law

Determine the heat of reaction for the following using Hess' Law of Summation of Heat and ΔH_f^0 values Thermochemical Data Sheet .

Enthalpy change for a reaction = D H^0_{rxn} = S [D H^0_f (products)] - S [D H^0_f (reactants)]

1. $C_6H_{6\,(l)} + 15/2\ O_{2(g)} \longrightarrow 6\ CO_{2(g)} + 3\ H_2O_{(l)}$

2. $2\ NaOH_{(s)} + SO_{3\,(g)} \longrightarrow Na_2SO_{4\,(s)} + H_2O_{(l)}$

3. $4\ NH_{3(g)} + 7\ O_{2(g)} \longrightarrow 6\ H_2O_{(g)} + 4\ NO_{2(g)}$

4. $3\ Cu_{(s)} + Al_2O_{3(s)} \longrightarrow 2\ Al_{(s)} + 3\ CuO_{(s)}$

5. $2\ CO_{(g)} + O_{2\,(g)} \longrightarrow 2\ CO_{2\,(g)}$

6. When ammonia is oxidised according to the following equation:
$4\ NH_{3(g)} + 7\ O_{2(g)} \longrightarrow 6\ H_2O_{(g)} + 4\ NO_{2(g)}$
1132 .0 kJ are evolved, determine the heat of formation of ammonia, $NH_{3(g)}$.

7. The molar heat of combustion of palmitic acid, $C_{16}H_{32}O_{2\,(s)}$ is - 9948.4 kJ mol^{-1} .

$C_{16}H_{32}O_{2\,(s)} + 23\ O_{2\,(g)} \longrightarrow 16\ CO_{2\,(g)} + 16\ H_2O_{(g)}$

Determine the molar enthalpy of formation of palmitic acid.

8. One of the "building blocks" for proteins such as those in muscles and sinews is amino acid called glycine, $C_2H_5NO_2$. The equation for its combustion is:

$4\ C_2H_5\ NO_{2\,(s)} + 9\ O_{2\,(g)} \longrightarrow 8\ CO_{2\,(g)} + 10\ H_2O_{(l)} + 2\ N_{2\,(g)}$

The value of its heat of combustion is - 973.49 kJ mol^{-1}. Calculate the heat of formation for glycine.

9. Glucose undergoes combustion according to the following equation:

$C_6\ H_{12}O_{6\,(s)} + 6\ O_{2\,(g)} \longrightarrow 6\ CO_{2\,(g)} + 6\ H_2O_{(g)} \quad \Delta H_f^0 = -2.82 \times 10^3$ kJ mol^{-1}

Determine the enthalpy of formation for glucose.

10. The reaction that occurs when a typical fat, glyceral trioleate, is metabolized in the body is:

$C_{57}\ H_{104}O_{6\,(s)} + 80\ O_{2(g)} \longrightarrow 57\ CO_{2(g)} + 52\ H_2O_{(l)}$

a) 37.8 kJ is evolved when 1.00 g of this fat (Molar Mass = 884) is metabolized. Calculate the molar enthalpy of formation of fat in kJ mol^{-1}.
b) How many kilojoules of energy must be in the form of heat if you want t get rid of 1.00 pound (454 g) of this fat by combustion?

Answers

1. –3 267.4 kJ 2. 3. – 1397.6 kJ 4. +1203.8 kJ 5. –566 kJ
6. – 612.5 kJ 7. –216.4 kJ 8. – 1258.1 kJ 9. –991.8 kJ 10. –71654.7 kJ