SCH4U1 Energy Quiz Review Name Answers

1. Use the thermochemical equations shown below to determine the enthalpy for the following reaction:

$CO_{2(g)} \Rightarrow C_{(s)} + O_{2(g)}$

$\frac{3}{2}\times$	$H_{2(g)} + ½ O_{2(g)} \Rightarrow H_2O_{(l)}$	ΔH = -214.3 kJ
$\div -2$	$2C_{(s)} + 3H_{2(g)} \Rightarrow C_2H_{6(g)}$	ΔH = -63.5 kJ
$\div 2$	$2CO_{2(g)} + 3H_2O_{(l)} \Rightarrow C_2H_{6(g)} + 7/2\ O_{2(g)}$	ΔH = 1170.4 kJ

(5) $\Delta H_{rxn} = 295.5$ kJ

2. Use the thermochemical equations shown below to determine the enthalpy for the reaction:

$Fe_3O_4 + CO(g) \Rightarrow 3FeO(s) + CO_2(g)$

$-\frac{1}{2}\times$	$2Fe(s) + 3CO_2(g) \Rightarrow Fe_2O_3(s) + 3CO(g)$	ΔH = 51.7KJ
$2\div$	$2Fe_3O_4(s) + CO_2(g) \Rightarrow 3Fe_2O_3(s) + CO(g)$	ΔH = 87.7KJ
$3\times$	$Fe(s) + CO_2(g) \Rightarrow FeO(s) + CO(g)$	ΔH = -2.3KJ

(5) $\Delta H_{rxn} = -40.6$ kJ

3. Given equations (1), (2), and (3), calculate the heat of reaction for equation.

x-1 (1) $\frac{1}{2}N_{2(g)} + \frac{3}{2}H_{2(g)} \rightarrow NH_{3(g)}$ $\Delta H°_f = -46.15$ kJ

(5) (2) $\frac{1}{2}N_{2(g)} + O_{2(g)} \rightarrow NO_{2(g)}$ $\Delta H°_f = 33.81$ kJ

x 3/2 (3) $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}$ $\Delta H°_f = -241.6$ kJ

$\boxed{(4)\ NH_{3(g)} + \frac{7}{4}O_{2(g)} \rightarrow NO_{2(g)} + \frac{3}{2}H_2O_{(g)}}$

$\Delta H_{rxn} = -282.44$ kJ

4. Calculate ΔH for the following reaction using the thermochemical equations given.

(5) $2\ C_{(s)} + H_{2\ (g)} \rightarrow C_2H_{2\ (g)}$ ΔH = ? ,

x2	1) $C_{(s)} + O_{2\ (g)} \rightarrow CO_{2\ (g)}$	ΔH = -393.5 kJ
	2) $H_{2\ (g)} + 1/2\ O_{2\ (g)} \rightarrow H_2O_{(l)}$	ΔH = -285.8 k J
$\div -2$	3) $2\ C_2H_{2\ (g)} + 5\ O_{2\ (g)} \rightarrow 4\ CO_{2\ (g)} + 2\ H_2O_{(l)}$	ΔH = -2598.8 kJ

ΔH = 226.6kJ

5. (4) A small piece of aluminium of mass 5 kg is used on a circuit that has a normal temperature of 20 °C. If the piece of aluminium absorbs 585 000 J, what is its final temperature? Specific heat capacity of Aluminium is 0.900 J/g°C.

585000 = 5000 (0.9) (Δt) $t_f = 150°C$

6. (5) A metal sample with a mass of 60 g at 100°C is placed into 0.4 kg of water at 20°C. If the final temperature is 22.1°C, what is the specific heat of the metal sample? (Calculate the heat gained by the water and then assume that the heat gained by the water is equal to the heat lost by the metal.) $c_w = 4.184$ J/g·°C [5]

Q = m·c·Δt = 400(4.184)(2.1) = 3514 3514 = 60(c)(60) $c_{metal} = 0.7519$ J/g·°C

7. $HNO_{3(aq)}$ $\Delta H°_f = -207$ kJ/mol $Mg(OH)_{2(s)}$ $\Delta H°_f = -925$ kJ/mol

$Mg(NO_3)_{2(aq)}$ $\Delta H°_f = -875$ kJ/mol $H_2O_{(l)}$ $\Delta H°_f = -285.8$ kJ/mol

(5) **(a)** Given the $\Delta H°_f$ values above, calculate $\Delta H°_{rxn}$ for the equation below, using the direct method:

$2HNO_{3(aq)} + Mg(OH)_{2(s)} \rightarrow Mg(NO_3)_{2(aq)} + 2H_2O_{(l)}$ + 107.6 ΔH = -107.6 kJ

(b) Is the reaction above exothermic or endothermic? How can you tell? negative

(c) Write the thermochemical equation with the heat value included.

8. Consider the following thermochemical equation.

$C_6H_{12}O_{6(s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)}$ $\Delta H°_{comb} = -2802$ kJ

(4) Calculate $\Delta H°_f$ for $C_6H_{12}O_{6(s)}$, given the following information:

$\Delta H°_f\ CO_{2(g)} = -393.5$ kJ/mol

$\Delta H°_f\ H_2O_{(l)} = -285.8$ kJ/mol

ΔH = -1273.8 kJ/mol

9. (5) 1.435 g of naphthalene ($C_{10}H_8$) is burned in a bomb calorimeter. There is exactly 2000.0 g of water surrounding the naphthalene. The temperature of the water rises from 20.17 °C to 25.85 °C. Write the thermochemical equation including the heat value.

$C_{10}H_8 + 12O_2 \rightarrow 10CO_2 + 4H_2O + 4245$ kJ

47530 J / .011196 mol

10. (5) Calculate the standard enthalpy (heat) of reaction for the reaction of ammonia gas with oxygen to produce nitrogen dioxide gas and water vapour using the direct method and table of enthalpies of formation. ($NO_{2(g)}$ $\Delta H_f° = +34$ kJ mol^{-1})

-565.6 kJ / 2 mol NH_3

11. (4) Use standard heats of formation (from the table) and the direct method to determine the heat of combustion for the following reaction. (4 marks)

$2C_2H_5OH_{(l)} + 6O_{2(g)} \rightarrow 6H_2O_{(l)} + 4CO_{2(g)}$ ΔH = -2818.4 kJ

12. (3) Calculate the heat of reaction, ΔH, for the following reaction, using the direct method. Use the table of enthalpy values.

$CH_{4\ (g)} + 2\ O_{2\ (g)} \rightarrow CO_{2\ (g)} + 2\ H_2O_{\ (l)}$ ΔH = -890.7 kJ

6. $Q = m \cdot c \cdot \Delta t$

$= 400g (4.184)(2.1)$

$= 3514.56 J$

$\frac{3514.56}{4674} = \frac{60 (c)(100 - 22.1)}{4674}$

$c = 0.7519$

9. $Q = m \cdot c \cdot \Delta t$

$= 2000 \times 4.184 (25.85 - 20.17)$

$= 47530.24 J = 47.5 kJ$

$1.435 g$ $C_{10}H_8$ $\} 0.01121 mol$

$120 + 8 = 128$

$\therefore 4237 kJ$

$C_{10}H_8 + 7O_2 \rightarrow 5CO_2 + 4H_2O + 4237 kJ$

10. $2NH_3 + \frac{7}{2}O_2 \rightarrow 2NO_2 + 3H_2O_{(g)}$

$\Delta H = [2(34) + 3(-241.8)] - [2(-45.9) + 0]$

$= -657.4 + 91.8$

$= -565.6 kJ / 2 mol NH_3$

5. $585000 = 5000 (0.9) \Delta t$

$\Delta t = 130$

$\therefore t_f = 150°C$

11. $2C_2H_5OH + 3O_2 \rightarrow 6H_2O_{(l)} + 4CO_{2(g)}$

$\Delta H = [6(-288.8) + 4(-393.5)]$
$- [2(-235.2) + 0]$
$= (-1714.8 - 1574) + 470.4$
$= -2818.4 \text{ kJ}$

12. $CH_4 + 2O_2 \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

$\Delta H = [-393.5 + 2(-285.8)]$
$- [(-74.4) + 0]$
$= -890.7 \text{ kJ}$