QUIZ: II: THERMODYNAMICS

SCH4U_20018 - 2019_V1 NAME: _____

Multiple Choice (7)

1. Which one of the following compounds would be expected to have the highest crystal lattice energy?

A. CaSe B. Na_2Se C. CaTe D. Na_2Te

2. What is the correct equation for the lattice enthalpy of magnesium chloride?

A. $Mg^{+2}_{(g)} + 2Cl^{-1}_{(g)} \longrightarrow MgCl_{2(s)}$
B. $Mg_{(s)} + Cl_{2(g)} \longrightarrow MgCl_{2(s)}$
C. $Mg^{+2}_{(g)} + 2Cl^{-1}_{(g)} \longrightarrow MgCl_{2(g)}$
D. $Mg_{(s)} + 2Cl_{(g)} \longrightarrow MgCl_{2(s)}$

3. Consider the following equation for the combustion of hydrogen:

$$2\,CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)} + 560\ kJ$$

How much energy is released when 14.0 g of carbon monoxide are completely combusted?

A. 1120 kJ B. 560 kJ C. 280 kJ D. 140 kJ

4. The enthalpies of combustion of ethene, C_2H_4, and butene, C_4H_8, are represented below as ΔH_1 and ΔH_2:

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2\,H_2O \qquad \Delta H_1$$
$$C_4H_8 + 6O_2 \longrightarrow 4CO_2 + 4\,H_2O \qquad \Delta H_2$$

What is the value for the enthalpy of the reaction of C_2H_4 to form C_4H_8?

$$2\,C_2H_4 \longrightarrow C_4H_8 \qquad \Delta H = ?$$

A. $\Delta H = \Delta H_1 - \Delta H_2$
B. $\Delta H = \Delta H_1 + \Delta H_2$
C. $\Delta H = 2\Delta H_1 - \Delta H_2$
D. $\Delta H = 2\Delta H_1 + \Delta H_2$

5. Why does the temperature of boiling water remain constant even though heat is supplied at a constant rate?

A. Heat is lost to the surroundings.
B. The heat is used to overcome the intermolecular forces of attraction between water molecules.
C. Heat is also taken in by the container.
D.The heat is used to break the covalent bonds in the water molecules.

6. The following equation shows the formation of magnesium oxide from magnesium metal.

$$2\ Mg_{(s)} + O_{2\ (g)} \longrightarrow 2\ MgO_{(s)} \quad \Delta H^0 = -1204\ kJ$$

Which statement is correct for this reaction?

A. 1204 kJ of energy are released for every mol of magnesium reacted.
B. 602 kJ of energy are absorbed for every mol of magnesium oxide formed.
C. 602 kJ of energy are released for every mol of oxygen gas reacted.
D. 1204 kJ of energy are released for every two mol of magnesium oxide formed.

7. Consider the two reactions involving iron and oxygen.

$$2Fe_{(s)} + O_{2(g)} \rightarrow 2FeO_{(s)} \quad \Delta H^\theta = -544\ kJ$$
$$4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)} \quad \Delta H^\theta = -1648\ kJ$$

What is the enthalpy change, in kJ, for the reaction below?

$$4FeO_{(s)} + O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$$

A. –1648 – 2(–544)
B. –544 – (–1648)
C. –1648 – 544
D. –1648 – 2(544)

Multiple Choice Answers

1	2	3	4	5	6	7

PROBLEMS (23)

In order to receive full credit, the method used and the steps involved in arriving at your answer must be shown clearly. It is possible to receive partial credit but, without your supporting work, you may receive little credit. You must pay particular attention to significant figures and to units.

1.(a) Calculate the energy released when 1.00 kg of HI is produced from its elements, given the following thermochemical equation: 3

$$\tfrac{1}{2}\ H_{2(g)} + \tfrac{1}{2}\ I_{2\ (g)} \longrightarrow HI_{(g)} \quad \Delta H = -365.75\ kJ$$

energy: _____

(b) Use the above equation to determine the enthalpy change for the following reaction: 2

$$2\ HI_{(g)} \longrightarrow H_{2(g)} + I_{2(g)} \qquad \Delta H = ???$$

energy: _____

2. (a) Define the term standard molar enthalpy change of formation, $\Delta H_f^{\ 0}$. 2

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_____

_____

b. Write a thermochemical equation for the enthalpy of formation of nitroglycerine, $C_3H_5(NO_3)_{3\ (l)}$, $\Delta H^0_f = -1452\ kJ\ mol^{-1}$. 2

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3. Ammonia can be combusted according to the following equation: 4

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

Show how the following three equations can be rearranged and added to determine the heat of reaction for the combustion of ammonia, hence calculate the enthalpy for the above reaction.

$$\tfrac{1}{2}\ N_{2\ (g)} + 3/2\ H_{2(g)} \longrightarrow NH_{3(g)} \qquad \Delta H_1 = -46.2\ kJ$$
$$\tfrac{1}{2}\ N_{2\ (g)} + O_{2\ (g)} \longrightarrow NO_{2(g)} \qquad \Delta H_2 = +33.8\ kJ$$
$$H_{2\ (g)} + \tfrac{1}{2}\ O_{2\ (g)} \longrightarrow H_2O_{(g)} \qquad \Delta H_3 = -241.8\ kJ$$

enthalpy: _____

4. The oxidation of hydrazine, N_2H_4, by dinitrogen tetroxide, N_2O_4, has been used in rocket propulsion:

$$2N_2H_{4(l)} + N_2O_{4(l)} \longrightarrow 3\,N_{2(g)} + 4\,H_2O_{(g)}$$

(i) Use the following standard enthalpy changes of formation to calculate the enthalpy change for the above reaction. 4

Compound	**ΔH^0_f (kJ mol^{-1})**
$N_2H_{4(l)}$	50.63
$N_2O_{4(l)}$	9.16
$H_2O_{(g)}$	–241.8

enthalpy change: _____

ii. State why the value for the ΔH^0_f for $N_{2(g)}$ is not given above 1

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_____

(iii) Explain what information may be obtained from your calculation to part (4) (i), about the bonds made and the bonds broken in the reaction. 1

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5. a. Define the term standard molar enthalpy of combustion. 2

b. Write a thermochemical equation for the enthalpy of combustion of ethanol, $C_2H_5OH_{(l)}$, ΔH^0_c = — 1380 kJ mol^{-1}. 2