Non Sibi High School

Andover's Chem 550/580: Advanced Chemistry

Chapter 13, Review Quiz 1

1

If 125 kilograms of methanol is burned according to the combustion equation below, how much heat will be released?

$$2CH_3OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(l) \;\; \Delta H = -1453\,\text{kJ/mol}$$

2

If 3.55 kJ of heat are absorbed during the decomposition reaction below, how many milliliters of sulfur trioxide gas, measured at 22°C and 712 mmHg, will decompose?

$$2SO_3(g) \longrightarrow 2SO_2(g) + O_2(g) \;\; \Delta H = 198\,\text{kJ/mol}$$

3

For the reaction $2C_3H_7OH(g) + 9O_2(g) \longrightarrow 6CO_2(g) + 8H_2O(g)$, estimate ΔH using average bond energies.

4

Calculate ΔH for the reaction $C(s) + 2H_2(g) + \frac{1}{2}O_2(g) \longrightarrow CH_3OH(g)$ using the following three reactions:

I) $CO_2(g) \longrightarrow C(s) + O_2(g) \;\; \Delta H_I = 394\,\text{kJ/mol}$

II) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g) \;\; \Delta H_{II} = -242\,\text{kJ/mol}$

III) $2CH_3OH(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(g) \;\; \Delta H_{III} = -1354\,\text{kJ/mol}$

5

Write the balanced formation reaction, including physical states, for solid sodium iodate, $NaIO_3$.

6

Calculate ΔH° for the reaction $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$ using the following information:

Compound	ΔH_f° (kJ/mol)
NO(g)	90.
NO_2(g)	33

7

The specific heat of magnesium metal is 1.05 J/g·°C. How much heat in kilojoules is lost when a 225 gram sample of magnesium metal is cooled from 625°C to 125°C?

8

In an insulated calorimeter, a 475 gram piece of tin metal originally at 132°C was added to 135 grams of water originally at 19°C. The final temperature of the tin-water mixture was 36°C. Determine the specific heat of tin.

9

The specific heat of tungsten metal is 0.13 J/g·°C. In an insulated calorimeter, a 955 gram piece of tungsten metal originally at 375°C was added to 725 grams of water originally at 18°C. Determine the final temperature of the tungsten-water mixture.

10

In an insulated calorimeter, 18.2 grams of solid cesium hydroxide at 22.3°C was dissolved in 135.7 grams of water also at 22.3°C, after which the final temperature of the mixed solution was 36.9°C. If the specific heat of the mixed solution was 3.87 J/g·°C, determine ΔH for the dissolving process $CsOH(s) \longrightarrow CsOH(aq)$ in kJ/mol CsOH.

11

In an insulated calorimeter, 55.7 mL of 1.91 M acetic acid was mixed with 62.6 mL of 1.83 M sodium hydroxide, with both solutions originally at 18.2°C. The final temperature of the mixed solutions was 30.1°C. The density of the mixed solutions was 1.03 g/mL and the specific heat of the mixed solutions was 3.96 J/g·°C. Write a balanced molecular equation, including physical states, and determine ΔH for the neutralization reaction in kJ/mol of water formed.

12

Consider the following data for methanol, CH_3OH:

melting point = -98°C
boiling point = 65°C
ΔH_{fusion} = 3.2 kJ/mol
$\Delta H_{vaporization}$ = 38 kJ/mol
specific heat of liquid methanol = 2.5 J/g·°C
specific heat of methanol vapor = 1.7 J/g·°C

Sketch a heating curve that depicts solid methanol at -98°C being heated to 88°C and then calculate the total amount of heat in kilojoules absorbed when 77 grams of methanol undergoes this process.

13

Given the reaction $2H_2O(g) \longrightarrow 2H_2(g) + O_2(g)$ $\Delta H = 484\,kJ/mol$, use the table of average bond energies to calculate the H−H bond energy.

14

Given the reaction $2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(l)$ $\Delta H^\circ = -2602\,kJ/mol$, use the information below to calculate the standard enthalpy of formation, ΔH_f°, for $C_2H_2(g)$:

Compound	ΔH_f° (kJ/mol)
$CO_2(g)$	-394
$H_2O(l)$	-286

15

ΔH for the dissolving process $KClO_3(s) \longrightarrow KClO_3(aq)$ is $+41.4\,kJ/mol\ KClO_3$. In an insulated calorimeter, 14.1 grams of solid $KClO_3$ at 24.6°C was dissolved in 102.5 grams of water also at 24.6°C. If the specific heat of the mixed solution was 3.91 J/g·°C, determine the final temperature in the calorimeter.

16

Consider the reaction $Sr(OH)_2(aq) + 2HNO_3(aq) \longrightarrow 2H_2O(l) + Sr(NO_3)_2(aq)\ \ \Delta H^\circ = -112\,kJ/mol$. In an insulated calorimeter, 65.4 mL of 2.96 M strontium hydroxide at 22.5°C was mixed with 72.6 mL of 2.84 M nitric acid also at 22.5°C. If the density of the mixed solution was 1.06 g/mL and the specific heat of the mixed solution was 3.89 J/g·°C, determine the final temperature in the calorimeter.

17

If 8.5 grams of ice at -12°C is added to an insulated calorimeter containing 65 grams of water at 75°C, and all the ice melts, sketch a heating/cooling curve for the process and determine the final temperature of the liquid water in the calorimeter.

18

Calculate the lattice energy of potassium bromide using the information below. Show all relevant reactions, including states of matter.

$$\Delta H_{sublimation} \text{ of potassium} = 88\,kJ/mol$$

$$\Delta H_{vaporization} \text{ of } Br_2 = 31\,kJ/mol$$

$$Br_2 \text{ bond energy} = 193\,kJ/mol$$

$$\text{first ionization energy of potassium} = 419\,kJ/mol$$

$$\text{first electron affinity of bromine} = -325\,kJ/mol$$

$$\Delta H_f^\circ \text{ of solid potassium bromide} = -394\,kJ/mol$$