CHEM 143

ASSIGNMENT

CHAPTER 6

Student Name­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student I.D Number\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Instructions:**

* **Solve any 9 of the first 12 questions and write the final answers in the table below. For numerical questions show your answers to the correct number of significant figures followed by the proper units.**

**Show your solution or explanation for 5 of these questions on a separate page(s).**

* **Answer all the questions numbered 13 to 16 by indicating T or F in the table below. Show your explanation for 2 of the True or False questions.**
* **Your answers should be submitted in a file with your name being the file name.**
* **The answers should be submitted no later than May 4th, 2020.**
* **The maximum score on this assignment is 20 points.**

**Answer Sheet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Q#** | **Answer** | **Q#** | **T or F** |
| **1** | 150 j | **13** |  |
| **2** |  | **14** |  |
| **3** |  | **15** |  |
| **4** |  | **16** |  |
| **5** |  |  | |
| **6** |  |
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| **8** |  |
| **9** |  |
| **10** |  |
| **11** |  |
| **12** |  |

***PROBLEMS AND QUESTIONS (Q1-12)***

*Remember to write your answers in the answer sheet above for 9 of the 12 questions and show your solution and/or explanation to 5 of them on a separate sheet.*

1. A system delivers 575 J of heat and receives 425 J of work. Calculate the change in the internal energy, *E*, of the system.

2. What is the heat capacity of 1.87 × 103 g of water expressed in J/°C?

3. A Snickers® candy bar contains 280. Calories, of which the fat content accounts for 120. Calories. If the candy bar is burned in the presence of excess oxygen in a bomb calorimeter, what is the energy absorbed by the calorimeter, in kJ?

4. A 1.00-mol sample of propane was placed in a bomb calorimeter with excess oxygen and ignited. The reaction was

C3H8*(g)* + 5O2*(g)* 🡪 3CO2*(g)* + 4H2O*(l)*

The initial temperature of the calorimeter was 25.000 °C and its total heat capacity was 97.1 kJ/°C. The reaction raised the temperature of the calorimeter to 27.282 °C.

What is the heat of reaction of propane with oxygen expressed in kilojoules per mole of C3H8 burned?

5. A 275-g sample of nickel at l00.0°C is placed in 100.0 mL of water at 22.0°C. What is the temperature change of the water? Assume that no heat is lost to or gained from the surroundings. Specific heat capacity of nickel = 0.444 J/(g·K)

6. A common laboratory reaction is the neutralization of an acid with a base. When 50.0 mL of 0.500 *M* HCl at 25.0°C is added to 50.0 mL of 0.250 *M* NaOH at 25.0°C in a coffee cup calorimeter, the temperature of the mixture rises to 28.2°C. What is the heat of reaction per mole of acid reacted? Assume the mixture has a specific heat capacity of 4.18 J/(g·K) and that the densities of the reactant solutions are both 1.00 g/mL.

7. Galena is the ore from which elemental lead is extracted. In the first step of the extraction process, galena is heated in air to form lead(II) oxide.

|  |  |
| --- | --- |
| 2PbS(*s*) + 3O2(*g*)  2PbO(*s*) + 2SO2(*g*) | *H* = -827.4 kJ |

What is the volume of sulfur dioxide produced at STP if 975 kJ of heat are liberated?

8. Consider the following three thermochemical equations:

(1) CH3OH*(l)* + O2*(g)* 🡪HCHO2*(l)* + H2O*(l)* *H* ° = -411 kJ

(2) CO*(g)* + 2H2*(g)* 🡪 CH3OH*(l)* *H* ° = -128 kJ

(3) HCHO2*(l)* 🡪CO*(g)* + H 2O*(l)* *H* ° = -33 kJ

Suppose Equation (1) is reversed and divided by 2, Equations (2) and (3) are multiplied by 1/2 , and then the three adjusted equations are added. What is the value of *H*° for the net reaction?

9. The following are two reactions showing the formation of 1 mol of SO3*(g)*:

SO2*(g)* + 1/2 O2*(g)* 🡪 SO3*(g)* and S*(s)* + 3/2 O2*(g)*🡪 SO3*(g)*

Should the enthalpy changes for both reactions be labeled as *H*°f for SO3*(g)* if they occur at 25°C and 1 atm?

1. Yes B. No, only for the first

C. No, only for the second D. None of the above

10. Use the following data to calculate the standard heat (enthalpy) of formation, *H*°f , of solid manganese(II) oxide.

|  |  |
| --- | --- |
| 2MnO2(*s*)  2MnO(*s*) + O2(*g*) | *H*° = 264 kJ |
| MnO2(*s*) + Mn(*s*)  2MnO(*s*) | *H*° = -240 kJ |

11. Use the following thermochemical equations,

8Mg*(s)* + Mg(NO3)2  🡪 Mg3N2*(s)* + 6MgO*(s)* *H°* = -3884 kJ

Mg3N2*(s)* 🡪 3Mg*(s)* + N2*(g)* *H°* = +463 kJ

2MgO*(s)* 🡪2Mg*(s)* + O2*(g)* *H°* = +1203 kJ

to calculate the standard heat of formation (in kilojoules) of Mg(NO3)2.

12. An important step in the synthesis of nitric acid is the conversion of ammonia to nitric oxide.

2 NH3(*g*) + 2 ½ O2(*g*)  2 NO(*g*) + 3 H2O(*g*)

Given *H*°f [NH3(*g*)] = -45.9 kJ/mol

*H*°f [NO(*g*)] = 90.3 kJ/mol

*H*°f [H2O(*g*)] = -241.8 kJ/mol,

calculate *H*° for the above reaction.

***TRUE OR FALSE (Q13-16):***

*Remember to indicate T or F in the answer sheet and show your explanation to 2 of these questions on a separate sheet.*

13. The heat released by the reaction in question 4 above is *qP*and **rxn is negative.

14. The relationship *H = E + PV* is always correct but *E* = *H* - *P**V* is not.

15. The reaction of HCl and NaOH in question 6 above is exothermic because it is carried out in a calorimeter.

16. Enthalpy is a state function because *H* for an overall reaction is a function of the physical states of reactants and products.