HW08 - Enthalpy & Fossil Fuels

Question 1

8 pts

A 1.00 g sample of n-hexane (C_6H_{14}) undergoes complete combustion with excess O_2 in a bomb calorimeter. The temperature of the 1815 g of water surrounding the bomb rises from 26.15°C to 29.97°C. The heat capacity of the hardware component of the calorimeter (everything that is not water) is 5068 J/°C. What is the *change in energy* for the combustion of $n\text{-}C_6H_{14}$? One mole of $n\text{-}C_6H_{14}$ is 86.1 g. The specific heat of water is 4.184 J/g·°C.

- -4.16 x 10^3 kJ/mol
- -5.25 x 10^3 kJ/mol
- -4.40 x 10^3 kJ/mol
- -6.33 x 10^4 kJ/mol

Question 2

6 pts

Calculate the change in enthalpy of the following reaction in kJ/mol using bond energy data:

$$ClF + CO \longrightarrow COClF$$

Question 3

6 pts

Using the bond energy data provided, calculate ΔH for the following reaction:

$$H_2\,(g) + Cl_2\,(g) \rightarrow 2HCl\,(g)$$

Bond	Bond Energy (kJ/mol)
H–H	436
Cl–Cl	242
H–Cl	432

- -186 kJ/mol
- -246 kJ/mol
- 246 kJ/mol
- 186 kJ/mol

Question 4

6 pts

Estimate the change in enthalpy of the following reaction using bond energy data:

$$N_2H_4\,(g) + H_2\,(g) \longrightarrow 2NH_3\,(g)$$

- -1469 kJ/mol
- 1241 kJ/mol
- -183 kJ/mol
- 850 kJ/mol

Question 5

6 pts

What is the value of heat flow for the combustion of hydrogen in kJ/g? ΔH° for this process is -286 kJ/mol.

- -143 kJ/g
- -71.5 kJ/g
- 572 kJ/g
- -572 kJ/g
- -286 kJ/g

Question 6

6 pts

Which of the following is the most efficient fuel based on its combustion enthalpy per gram?

- coal
- methane
- wood
- hydrogen
- octane

Question 7

6 pts

What is the more efficient method to break a high molar mass fraction from a crude oil refinery down to a specific fuel?

- fractional distillation
- reforming
- catalytic cracking
- thermal cracking

Question 8

6 pts

An octane isomer can be made into a more efficient fuel by adding branching through the process of...

- fractional distillation
- thermal cracking
- catalytic reforming
- catalytic cracking

Question 9

6 pts

If you want to calculate the heat flow involving a temperature change, which equation will you use?

- Σn bonds breaking -Σn bonds forming
- $q = mC_p\Delta T$
- $q = m\Delta H$
- $q = 2(m \cdot C_p\Delta T)$
- $q = mC$

Question 10

6 pts

If you want to calculate the heat flow involving a phase change, which equation will you use?

- $q = mC$
- Σn bonds breaking -Σn bonds forming
- $q = mC_p\Delta T$
- $q = m\Delta H_{trans}$
- $q = 2(m \cdot C_p\Delta T)$

Question 11

8 pts

Designate the sign of the heat flow (+ or -) for each of the following physical changes:

Vaporization:

Fusion:

Freezing:

Sublimation:

Question 12

6 pts

(Part 1 of 4) Draw the heating curve for the process of heating 14.0 g pure ice from -18.0 °C to 84 °C and use it to answer the next four questions.

What is the heat required to heat the ice to 0 °C? **Answer in joules to the nearest whole number.**

Question 13

6 pts

(Part 2 of 4) What is the heat required to fully melt the ice at 0 °C? **Answer in joules to the nearest whole number.**

Question 14

6 pts

(Part 3 of 4) What is the heat required to heat the water from 0 °C to 84 °C? **Answer in joules to the nearest whole number.**

Question 15

6 pts

(Part 4 of 4) What is the total heat applied during this process? **Answer in kilojoules (*l*) to three significant figures.**

Question 16

6 pts

The specific heat for liquid argon and gaseous argon is 25.0 J/mol·°C and 20.8 J/mol·°C, respectively. The enthalpy of vaporization of argon is 6506 J/mol. How much energy is required to convert 1 mole of liquid Ar from 5 °C below its boiling point to 1 mole of gaseous Ar at 5 °C above its boiling point?

- 229 J
- 6631 J
- 6735 J
- 125 J
- 6610 J