HW08 - Enthalpy & Fossil Fuels

You might need to grab some data from here for the bond energy problems.
Stuck on bomb calorimeters? Here's a video: Thermodynamics - Calorimetry Pt II - Bomb Calorimeter Example
Still feel like you aren't fully there with the conceptual part of calorimetry? Here's a video: Thermodynamics - Calorimetry - Part I

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1 1 points

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-C_6H_{14}? One mole of n-C_6H_{14} is 86.1 g. The specific heat of water is 4.184 J/g·°C.

- -6.33 x 10^6 kJ/mol
- -4.40 x 10^3 kJ/mol
- -4.16 x 10^3 kJ/mol
- -5.25 x 10^3 kJ/mol

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2 2 points

Fill in the blanks to receive credit for each part of this question.

An unknown fuel distilled in a refinery (molar mass 64.0 g/mol) is combusted in a bomb calorimeter holding 991 mL water. When 0.182 grams of the fuel source is combusted in the bomb calorimeter, the temperature of the surroundings raises from 25.0 °C to 27.2 °C. The heat capacity for the hardware component is 2.260 kJ/ °C. The heat capacity of water is 4.184 J/ g °C.

In a bomb calorimeter, the thermometer is in the [ ].

The combustion of the fuel that we are measuring here is [ ]. The enthalpy of this reaction is equal to [ ] kJ. The enthalpy per gram of this reaction is about [ ] kJ/g. The enthalpy per mole of this reaction is closest to [ ] kJ/mol.

[system] [surroundings] [exothermic] [(no way to tell)]
[endothermic] [-26.8] [-8.37] [-22.1] [-8.73] [-14.1]
[-8.36] [-1210] [-2.56] [-22.1] [-77.4] [-4956]
[-120.9] [-163.8] [-1.209] [-288] [-460.7]

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3 2 points

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

$$ClF + CO \longrightarrow COClF$$

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4 2 points

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

$$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$$

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

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

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5 2 points

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

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

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

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6 2 points

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

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

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7 2 points

This is a question that requires you to be completely precise and accurate. The numeric answer to this is exact based on the numbers that you have to use. So the answer is a large integer (4 digits to be exact) and I need you to be EXACTLY right on this. If you follow the steps that I showed in class on 11-16-2021, you should be able to do this easily.
QUESTION: What is the heat of combustion (it is a positive value because it is the heat given off - or released from the combustion) of exactly one mole of heptane? You answer has to be exactly right and in kJ.

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8 2 points

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

- wood
- coal
- octane
- methane
- hydrogen

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9 2 points

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

- reforming
- thermal cracking
- fractional distillation
- catalytic cracking

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10 2 points

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

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

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11 2 points

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

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

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12 2 points

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

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

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13 4 points

Designate the sign of the heat flow (+ or -) for each of the following physical changes:
Vaporization: [ ] Fusion: [ ] Freezing: [ ] Sublimation: [ ]

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14 2 points

What is the heat required to completely melt a 11.33 g sample of silicon (Si, molar mass = 28.09 g/mol) solid that is already at its melting point? ΔH_{fus} = 50.2 kJ/mol. Answer in units of kJ and round to one decimal place.

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15 2 points

(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.**

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16 2 points

(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.**

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17 2 points

(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.**

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18 2 points

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

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19 2 points

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?

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