

## HW08 - Enthalpy & Fossil Fuels

(NOTE: the links in this pdf do not work. The links are active when inside of canvas.)

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](#)

1 6 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  $\Delta H$  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.

- $-6.33 \times 10^4$  kJ/mol  
  $-4.40 \times 10^3$  kJ/mol  
  $-4.16 \times 10^3$  kJ/mol  
  $-5.25 \times 10^3$  kJ/mol

2 5 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 rises 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

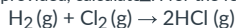
3 6 points

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



4 6 points

Using the bond energy data provided, calculate  $\Delta H$  for the following reaction:

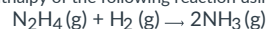


Bond	Bond Energy (kJ/mol)
H-H	436
Cl-Cl	242
H-Cl	432

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

5 6 points

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



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

6 6 points

What is the value of heat flow for the combustion of hydrogen in kJ/g?  $\Delta H^\circ$  for this process is -286 kJ/mol.

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

7 5 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? Your answer has to be exactly right and in kJ.

8 6 points

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

- wood  
 coal  
 octane  
 methane  
 hydrogen

9 6 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

10 6 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

11 4 points

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

- $q = mC_s\Delta T$   
  $q = m\Delta H$   
  $q = mc$   
  $\Sigma n$  bonds breaking -  $\Sigma n$  bonds forming  
  $q = 2(m - C_s\Delta T)$

12 4 points

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

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

13 4 points

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

Fusion:  Freezing:

Sublimation:

14 5 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?  $\Delta H_{fus} = 50.2$  kJ/mol. Answer in units of kJ and round to one decimal place.

15 5 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.

16 5 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.

17 5 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.

18 5 points

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

19 5 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