

## HW07 - Thermodynamics

1 4 points

Which of the following statements concerning the first law of thermodynamics is/are true? Select all of the correct answers.

- Internal energy lost by a system is always gained by the surroundings.
- The universe is an isolated system.
- The internal energy of the universe is always increasing.

2 4 points

Which of the following best describes an endothermic reaction?

- Heat flows into the system, and the surroundings feel colder
- Heat flows out of the system, and the surroundings feel warmer
- Heat flows into the system, and the surroundings feel warmer
- Heat flows out of the system, and the surroundings feel colder

3 3 points

You take an ice cube out of the freezer, let it melt, and then you boil it. Select all true statements.

- If the boiled water condenses, it will be an endothermic process
- The act of boiling was endothermic
- If the boiled water condenses, it will be an exothermic process.
- The act of melting was endothermic
- The act of boiling was exothermic.

4 2 points

A system releases heat. What is...

- the sign of heat flow with respect to the system?
- the sign of the temperature change of the surroundings?

- +, -
- , +
- , -
- +, +

5 5 points

Consider the following descriptions. Choose all that are exothermic.

- A combustion reaction releases 12.5 kJ of heat
- You are standing in the surroundings of a chemical reaction and you feel it get colder
- You are standing in the surroundings of a chemical reaction and you feel it get warmer
- A metal bar is heated from 25 °C to 36 °C

- I and II
- II and IV
- I, III, and IV
- I and III

6 2 points

Fire is...

- not hot
- hot

7 5 points

If the products of a reaction have higher heat content than the reactants, then the reaction...

- is exothermic.
- is endothermic.

8 5 points

How much heat (in kJ) is required to raise 2.4 cups of water at room temperature to 66 °C?

Note: Look up any data necessary for this problem online.

- 4.2 kJ
- 6.6 kJ
- 97 kJ
- 160 kJ
- 40.1 kJ

9 5 points

What mass of liquid ethanol (C<sub>2</sub>H<sub>5</sub>OH) must be burned to supply 500 kJ of heat? The standard enthalpy of combustion of ethanol at 298 K is -1368 kJ/mol.

- 126 g
- 10.9 g
- 16.8 g
- 29.7 g

10 4 points

When 217 J heat is added to a 4.12 g sample at 21 °C, the temperature of the substance shoots to 35 °C. What is the specific heat capacity of this substance? Answer in J/g °C and round your final answer to two decimal places.

Type your answer...

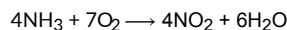
11 5 points

A piece of metal with a mass of 54.9 g at 97.3 °C is placed in a calorimeter containing 75.6 g of water at 22.8 °C. The final temperature of the mixture is 28.5 °C. What is the specific heat capacity of the metal? Assume that there is no energy lost to the surroundings.

- 0.248 J/g °C
- 0.712 J/g °C
- 0.401 J/g °C
- 0.477 J/g °C
- 0.389 J/g °C

12 4 points

Consider the following balanced chemical equation:



The enthalpy of combustion for this balanced equation (the heat *released*) is equal to 905 kJ per reaction. How much heat is released when 16.0 moles of NH<sub>3</sub> react with 21.0 moles of O<sub>2</sub>?

- 14500 kJ
- 905 kJ
- 3620 kJ
- 19005 kJ
- 226 kJ
- 302 kJ
- 2715 kJ

13 5 points

Carbon monoxide reacts with oxygen to form carbon dioxide by the following reaction:  
 $2\text{CO(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO}_2\text{(g)}$   
 $\Delta H$  for this reaction is -135.28 kcal. How much heat would be released if 12.0 moles of carbon monoxide reacted with 12.0 moles oxygen to produce carbon dioxide?

- 412 kcal  
 1620 kcal  
 135 kcal  
 812 kcal

14 5 points

Burning 1 mol of methane in oxygen to form  $\text{CO}_2\text{(g)}$  and  $\text{H}_2\text{O(g)}$  produces 803 kJ of energy. How much energy is produced when 3 mol of methane is burned?

- 2409 kJ  
 803 kJ  
 268 kJ  
 1606 kJ

15 4 points

The specific heat capacity is...

- the heat required to raise one mole of substance one degree Celsius  
 the heat required to raise the temperature of any sample of a substance one degree Celsius  
 the temperature required to add 1 J to one gram of substance  
 the heat required to raise one gram of a substance one degree Celsius

16 5 points

1000 J is added to a variety of substances (each with the same mass). In the end, the hottest substance (the one with the highest temperature) will be...

- they should all be the same temperature.  
 the one with the highest specific heat capacity.  
 the one with the lowest specific heat capacity.

17 5 points

Consider the following data for two experimental fuels:

Name of Experimental Fuel	Molar Mass (g/mol)	Enthalpy of Combustion (kJ/mol)
Hyper Fuel	28.4	1364
Uber Fuel	66.1	1582

Convert the enthalpy of combustion to kJ/g to compare the fuel efficiency for both fuels. Which fuel releases more energy per unit mass?

- Hyper fuel by a factor of 2x  
 Uber fuel by a factor of 2.7x  
 Uber fuel by a factor of 2x  
 Hyper fuel by a factor of 2.7x  
 Hyper fuel by a factor of 1.2x  
 Uber fuel by a factor of 1.2x

18 5 points

A 30.0 g sample of CsOH (a strong base) is dissolved into 450 mL of 25 °C water in a coffee-cup calorimeter. The temperature climbs to 32.6 °C after all the base dissolves. Answer the following three questions about this experiment (part 1 of 3) Is the dissolution process for CsOH exothermic or endothermic?

- exothermic  
 endothermic

19 5 points

(part 2 of 3) Which of the following equations best represents the value of  $q$  for the calorimeter?

- $q_{\text{cal}} = C_{s,\text{water}} \cdot \Delta T_{\text{water}}$   
  $q_{\text{cal}} = m_{\text{CsOH}} \cdot C_{s,\text{CsOH}} \cdot \Delta T_{\text{water}}$   
  $q_{\text{cal}} = m_{\text{water}} \cdot C_{s,\text{water}} \cdot \Delta T_{\text{water}}$   
  $q_{\text{cal}} = m_{\text{CsOH}} \cdot C_{s,\text{water}} \cdot \Delta T_{\text{salt}}$

20 5 points

(part 3 of 3) What is the value for  $\Delta H$  for the CsOH dissolving? Answer in kJ/g to 3 significant figures.

Type your answer...

21 5 points

When a certain amount of compound X is burned completely in a bomb calorimeter containing 3000 g of water, a temperature rise of 0.697 °C is observed. What is  $\Delta H$  for the burning of the fuel?

Answer in kJ to 3 significant figures and get the sign right

The hardware component of the calorimeter has a heat capacity of 3.81 kJ/°C. The specific heat of water is 4.184 J/g·°C.

Type your answer...

22 8 points

A piping hot block of lead ( $C_s = .160 \text{ J/g} \cdot ^\circ\text{C}$ ) is placed in a coffee cup calorimeter containing 350 g water ( $C_s = 4.184 \text{ J/g} \cdot ^\circ\text{C}$ ). The lead cools from 99.0 °C to 24.0 °C, while the water in the calorimeter heats from 22.5 °C to 24.0 °C.

If we consider the lead to be our system, it can be concluded that this process

choose your answer... . The mass of lead is about

choose your answer... g.