

HW07 - Thermodynamics

1 5 points

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

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

2 5 points

Which of the following best describes an endothermic reaction?

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

3 5 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
- The act of melting was endothermic
- If the boiled water condenses, it will be an exothermic process.
- The act of boiling was exothermic.

4 5 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
- I, III, and IV
- II and IV
- I and III

6 5 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.

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

9 5 points

What mass of liquid ethanol (C₂H₅OH) must be burned to supply 500 kJ of heat? The standard enthalpy of combustion of ethanol at 298 K is -1368 kJ/mol.

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

10 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
- 0.477 J/g °C
- 0.401 J/g °C
- 0.389 J/g °C
- 0.712 J/g °C

11 5 points

Carbon monoxide reacts with oxygen to form carbon dioxide by the following reaction: 2CO(g) + O₂(g) → 2CO₂(g)

ΔH 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?

- 1620 kcal
- 812 kcal
- 412 kcal
- 135 kcal

12 5 points

Burning 1 mol of methane in oxygen to form CO₂ (g) and H₂O (g) produces 803 kJ of energy. How much energy is produced when 3 mol of methane is burned?

- 803 kJ
- 268 kJ
- 2409 kJ
- 1606 kJ

13 5 points

The specific heat capacity is...

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

14 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...

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

15 5 points

Wood, by weight, is 45% combustible fuel, i.e. cellulose, which can be treated here as an equivalent mass of glucose, C₆H₁₂O₆. The enthalpy of combustion of glucose is -2805 kJ/mol

Gasoline, by weight, is nearly 100% combustible fuel, which can be treated here as octane, C₈H₁₈. The enthalpy of combustion of octane is -5460 kJ/mol.

Given all this information, is gasoline or wood able to release more combustion energy per unit mass of material?

- Gasoline, by a factor of 6
- Wood, by a factor of 6
- Gasoline, by a factor of 10
- Gasoline, by a factor of 7
- Wood, by a factor of 7
- Wood, by a factor of 10

16 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

17 5 points

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

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

18 5 points

(part 3 of 3) What is the value for ΔH for the CsOH dissolving?

Answer in kJ/g to 3 significant figures.

Type your answer...

19 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 ΔH 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...

20 5 points

Which of the following hydrocarbon groups (shown as number of carbons in the chain) makes it all the way to the top of a distillation tower at a crude oil refinery?

- > C₂₀
- C₁₅-C₁₈
- C₅-C₁₂
- C₁₂-C₁₆
- C₁-C₄