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...

1. the sign of heat flow with respect to the system?
2. the sign of the temperature change of the surroundings?

- ◯ +, +
- ◯ -, +
- ◯ +, -
- ◯ -, -

5 5 points

Consider the following descriptions. Choose all that are exothermic.

I. A combustion reaction releases 12.5 kJ of heat
II. You are standing in the surroundings of a chemical reaction and you feel it get colder
III. You are standing in the surroundings of a chemical reaction and you feel it get warmer
IV. 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 (C_2H_5OH) 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:
$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$
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 CO_2 (g) and H_2O (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 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, $C_6H_{12}O_6$. 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, C_8H_{18}. 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?

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

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?

- ◯ > C_{20}
- ◯ C_{15}-C_{18}
- ◯ C_5-C_{12}
- ◯ C_{12}-C_{16}
- ◯ C_1-C_4