

HW10 - (replaced) First Law & Calorimetry

 This is a preview of the published version of the quiz

Started: Jul 1 at 8:11am

Quiz Instructions

Homework 10 - First Law & Calorimetry (attempting to allow up to 5 attempts now)

Question 1

1 pts

A 100 W electric heater ($1 \text{ W} = 1 \text{ J/s}$) operates for 11 min to heat the gas in a cylinder. At the same time, the gas expands from 1 L to 6 L against a constant atmospheric pressure of 3.527 atm. What is the change in internal energy of the gas?

☐ 62.47 kJ

☐ 67.79 kJ

☐ 64.21 kJ

☐ 48.37 kJ

Question 2

1 pts

The definition of internal energy is

$$\Delta U = q + w$$

Which of these three values are state functions? Select all of the correct answers.

☐ q

☐ w

☐ ΔU

Question 3**1 pts**

When 2.00 kJ of energy is transferred as heat to nitrogen in a cylinder fitted with a piston with an external pressure of 2.00 atm, the nitrogen gas expands from 2.00 to 5.00 L. What is the change in internal energy of this system?

- ☐ +2.61 kJ
- ☐ 0
- ☐ -0.608 kJ
- ☐ -2.61 kJ
- ☐ +1.39 kJ

Question 4**1 pts**

A system had 150 kJ of work done on it and its internal energy increased by 60 kJ. How much energy did the system gain or lose as heat?

- ☐ The system lost 90 kJ of energy as heat.
- ☐ The system gained 60 kJ of energy as heat.
- ☐ The system lost 210 kJ of energy as heat.
- ☐ The system gained 210 kJ of energy as heat.
- ☐ The system gained 90 kJ of energy as heat.

Question 5**1 pts**

If a process is carried out at constant pressure and the volume of the system decreases, then ΔV is

and the work is .

Question 6**1 pts**

Which of the following will best help determine the direction of heat flow in a system?

☐ internal energy

☐ work

☐ enthalpy

☐ temperature

☐ pressure

Question 7**1 pts**

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

☐ The universe is an isolated system.

☐ Internal energy lost by a system is always gained by the surroundings.

☐ The internal energy of the universe is always increasing.

Question 8**1 pts**

What is the value of work when a piston of volume 0.2 L expands against an external pressure of 200 kPa to a volume of 3.4 L?

☐ 3.40 kJ

☐ -640 J

☐ 640 J

☐ -3.40 kJ

Question 9**1 pts**

When 4.00 kJ of energy is transferred as heat to nitrogen in a cylinder fitted with a piston at an external pressure of 3.00 atm, the nitrogen gas expands from 1.00 L to 4.00 L against this constant pressure. What is ΔU for the process?

- ☐ +4.91 kJ
- ☐ -4.91 kJ
- ☐ +3.09 kJ
- ☐ -0.912 kJ

Question 10**1 pts**

A piece of metal with a mass of 22 g at 92 °C is placed in a calorimeter containing 53.7 g of water at 21 °C. The final temperature of the mixture is 55.3 °C. What is the specific heat capacity of the metal? Assume that there is no energy lost to the surroundings.

- ☐ $-1.3 \times 10^4 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$
- ☐ $-9.5 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$
- ☐ $1.3 \times 10^4 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$
- ☐ $9.5 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$

Question 11**1 pts**

Consider the following specific heat capacities:

$$\text{H}_2\text{O (s)} = 2.09 \text{ J/g}\cdot^\circ\text{C}$$

$$\text{H}_2\text{O (l)} = 4.18 \text{ J/g}\cdot^\circ\text{C}$$

$$\text{H}_2\text{O (g)} = 2.03 \text{ J/g}\cdot^\circ\text{C}$$

The heat of fusion for water is 334 J/g and its heat of vaporization is 2260 J/g. Calculate the amount of heat required to convert 93 g of ice at -36°C completely to liquid water at 35°C .

- ☐ 38 kJ

☐ 7 kJ

☐ 52 kJ

☐ 21 kJ

Question 12

1 pts

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?

☐ 125 J

☐ 6631 J

☐ 229 J

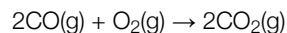
☐ 6735 J

☐ 6610 J

Question 13

1 pts

Carbon monoxide reacts with oxygen to form carbon dioxide by the following reaction:



ΔH for this reaction is -135.28 kcal. How much heat would be released if 12.0 moles of carbon monoxide reacted with sufficient oxygen to produce carbon dioxide? Use only the information provided in this question.

☐ 812 kcal

☐ 135 kcal

☐ 1620 kcal

☐ 412 kcal

Question 14**1 pts**

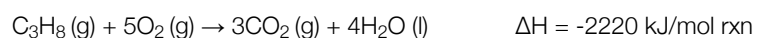
What mass of liquid ethanol ($\text{C}_2\text{H}_5\text{OH}$) must be burned to supply 500 kJ of heat? The standard enthalpy of combustion of ethanol at 298 K is -1368 kJ/mol.

☐ 126 g☐ 29.7 g☐ 10.9 g☐ 16.8 g**Question 15****1 pts**

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?

☐ 268 kJ☐ 803 kJ☐ 2409 kJ☐ 1606 kJ**Question 16****1 pts**

Consider the following chemical equation:



How much heat is given off when 11.0 g of propane gas (C_3H_8) is burned at constant pressure?

☐ 555 kJ☐ 2220 kJ☐ 26.0 kJ☐ 1670 kJ

Question 17**1 pts**

For a certain reaction at constant pressure, the change in internal energy is -52 kJ. In addition, the system does 46 kJ of expansion work. What is ΔH for this process?

☐ -6 kJ☐ 6 kJ☐ -98 kJ☐ 98 kJ**Question 18****1 pts**

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

☐ is not spontaneous.☐ is exothermic.☐ must be spontaneous.☐ is endothermic.**Question 19****1 pts**

The specific heats and densities of several materials are given below:

Material	Specific Heat (cal/g·°C)	Density (g/cm ³)
Brick	0.220	2.0
Concrete	0.270	2.7
Steel	0.118	7
Water	1.00	1.00

Calculate the change in temperature produced by the addition of 1 kcal of heat to 100 g of steel.

☐ 1.43°C

☐ 1.18°C

☐ 84.7°C

☐ 37.0°C

Question 20

1 pts

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 1502 g of water surrounding the bomb rises from 22.64°C to 29.30°C. The heat capacity of the hardware component of the calorimeter (everything that is not water) is 4042 J/°C. What is ΔU 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.

☐ -4.52×10^3 kJ/mol

☐ -1.15×10^4 kJ/mol

☐ -5.92×10^3 kJ/mol

☐ -9.96×10^3 kJ/mol

Question 21

1 pts

When 0.485 g of compound X is burned completely in a bomb calorimeter containing 3000 g of water, a temperature rise of 0.285°C is observed. What is ΔU of the reaction for the combustion of compound X? 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, and the MW of X is 56.0 g/mol.

☐ -4660 kJ/mol

☐ 4660 kJ/mol

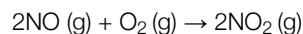
☐ 538 kJ/mol

☐ -538 kJ/mol

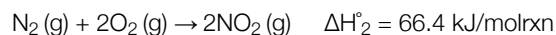
Question 22

1 pts

Nitric acid can be manufactured in a multi-step process, during which nitric oxide is oxidized to create nitrogen dioxide.



Calculate the standard reaction enthalpy for the above reaction using the following thermodynamic data.



☐ -246.9 kJ/mol rxn

☐ -100.3 kJ/mol rxn

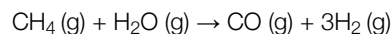
☐ -114.1 kJ/mol rxn

☐ -252.4 kJ/mol rxn

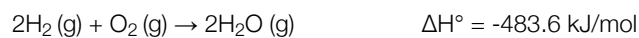
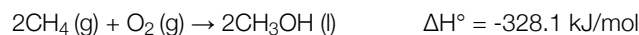
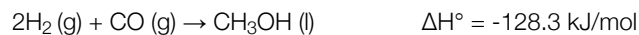
Question 23

1 pts

Calculate the standard reaction enthalpy for the following chemical equation.



Use the following thermochemical equations to solve for the change in enthalpy.



☐ +42.0 kJ/mol

☐ +155.5 kJ/mol

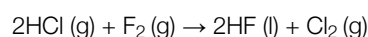
☐ +216 kJ/mol

☐ +206.1 kJ/mol

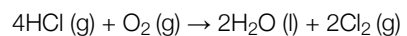
Question 24

1 pts

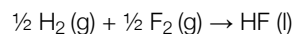
Calculate the standard enthalpy change for the following chemical equation.



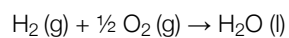
Use the following thermochemical equations to solve for the change in enthalpy.



$$\Delta H^\circ = -202.4 \text{ kJ/mol rxn}$$



$$\Delta H^\circ = -600.0 \text{ kJ/mol rxn}$$



$$\Delta H^\circ = -285.8 \text{ kJ/mol rxn}$$

☐ +1015.4 kJ/mol rxn

☐ -1015.4 kJ/mol rxn

☐ -1088.2 kJ/mol rxn

☐ +516.6 kJ/mol rxn

☐ -1116.6 kJ/mol rxn

☐ -1587.2 kJ/mol rxn

☐ +1587.2 kJ/mol rxn

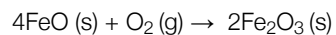
☐ +1088.2 kJ/mol rxn

☐ -516.6 kJ/mol rxn

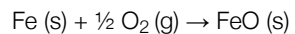
☐ +1116.6 kJ/mol rxn

Question 25**1 pts**

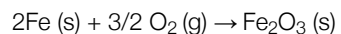
Calculate the standard enthalpy change for the following chemical equation.



Use the following thermochemical equations to solve for the change in enthalpy.



$$\Delta H = -269 \text{ kJ/mol}$$



$$\Delta H = -825 \text{ kJ/mol}$$

☐ -2726 kJ/mol

☐ 574 kJ/mol

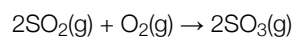
☐ 556 kJ/mol

☐ -574 kJ/mol

☐ -556 kJ/mol

Question 26**1 pts**

Calculate the enthalpy change for the following chemical equation.



Use the following thermochemical data to solve for the change in enthalpy.

$$\Delta H_f \text{ for } \text{SO}_2(\text{g}) = -16.9 \text{ kJ/mol}$$

$$\Delta H_f \text{ for } \text{SO}_3(\text{g}) = -21.9 \text{ kJ/mol}$$

☐ -5.0 kJ/mol rxn

☐ -77.6 kJ/mol rxn

☐ -10.0 kJ/mol rxn

☐ +5.0 kJ/mol rxn

Question 27**1 pts**

Which of the following substances have $\Delta H_f^\circ = 0$? Select all of the correct answers.

☐ HCl (g)

☐ HCl (aq)

☐ F₂ (g)

☐ Na (s)

Question 28**1 pts**

Calculate the average S-F bond energy in SF₆ using the following ΔH_f values:

$$\text{SF}_6(\text{g}) = -1209 \text{ kJ/mol}$$

$$\text{S}(\text{g}) = 279 \text{ kJ/mol}$$

$$\text{F}(\text{g}) = 79 \text{ kJ/mol}$$

☐ 289 kJ/mol bonds

☐ 582 kJ/mol bonds

☐ 416 kJ/mol bonds

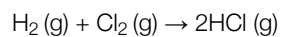
☐ 327 kJ/mol bonds

☐ 196 kJ/mol bonds

Question 29

1 pts

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



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

☐ -186 kJ/mol

☐ 246 kJ/mol

☐ 186 kJ/mol

☐ -246 kJ/mol

Question 30

1 pts

The standard molar enthalpy of formation of $\text{NH}_3(\text{g})$ is -46.11 kJ/mol. What is the standard molar internal energy of formation of $\text{NH}_3(\text{g})$?

☐ -48.59 kJ/mol

☐ -43.63 kJ/mol

☐ -2525 kJ/mol

☐ 2433 kJ/mol

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