

HW13 - First Law & Calorimetry

ⓘ This is a preview of the published version of the quiz

Started: Nov 8 at 5:47pm

Quiz Instructions

Homework 13 - First Law & Calorimetry

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
- 64.21 kJ
- 48.37 kJ
- 67.79 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
- ΔU
- w

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?

- 0
- 2.61 kJ
- +2.61 kJ
- +1.39 kJ
- 0.608 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 gained 90 kJ of energy as heat.
- The system gained 210 kJ of energy 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.

Question 5

1 pts

If a process is carried out at constant pressure and the volume of the system decreases, then ΔV is [Select] and the work is [Select] .

Question 6

1 pts

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

- internal energy
- work
- temperature
- pressure
- enthalpy

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?

- 640 J
- 3.40 kJ
- 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? Note: $1 \text{ L}\cdot\text{atm} = 0.1013 \text{ kJ}$.

- +3.09 kJ
- 4.91 kJ
- 0.912 kJ
- +4.91 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.

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

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
- 21 kJ
- 52 kJ

7 kJ

Question 12

1 pts

The specific heat for liquid argon and gaseous argon is $25.0 \text{ J/mol}\cdot^\circ\text{C}$ and $20.8 \text{ J/mol}\cdot^\circ\text{C}$, 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?

6610 J

125 J

6631 J

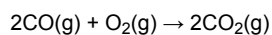
229 J

6735 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.

412 kcal

812 kcal

135 kcal

1620 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 .

29.7 g

16.8 g

126 g

10.9 g

Question 15

1 pts

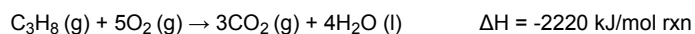
Burning 1 mol of methane in oxygen to form CO_2 (g) and H_2O (g) produces 803 kJ of energy. How much energy is produced when 3 mol of methane is burned?

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

Question 16

1 pts

Consider the following chemical equation:



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

- 26.0 kJ
- 555 kJ
- 2220 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?

- 98 kJ
- 6 kJ
- 98 kJ
- 6 kJ

Question 18

1 pts

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

- is not spontaneous.
- is endothermic.
- is exothermic.
- must be spontaneous.

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.

- 37.0°C
- 84.7°C
- 1.43°C
- 1.18°C

Question 20

1 pts

A 1.00 g sample of n-hexane (C₆H₁₄) undergoes complete combustion with excess O₂ 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-C₆H₁₄? One mole of n-C₆H₁₄ is 86.1 g. The specific heat of water is 4.184 J/g·°C.

- 5.92 x 10³ kJ/mol
- 9.96 x 10³ kJ/mol
- 1.15 x 10⁴ kJ/mol
- 4.52 x 10³ kJ/mol

Question 21

1 pts

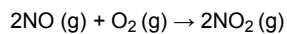
When 0.485 g of compound X is burned completely in a bomb calorimeter containing 3000 g of water, a temperature rise of 0.285°C is observed. What is ΔU of the reaction for the combustion of compound X? The hardware component of the calorimeter has a heat capacity of 3.81 kJ/°C. The specific heat of water is 4.184 J/g·°C, and the MW of X is 56.0 g/mol.

- 538 kJ/mol
- 538 kJ/mol
- 4660 kJ/mol
- 4660 kJ/mol

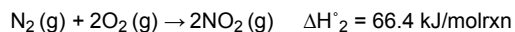
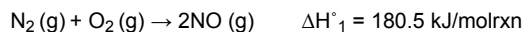
Question 22

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.

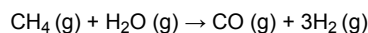


- 100.3 kJ/mol rxn
- 252.4 kJ/mol rxn
- 246.9 kJ/mol rxn
- 114.1 kJ/mol rxn

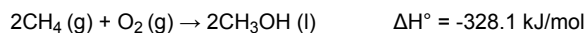
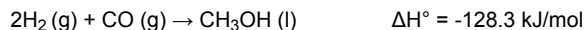
Question 23

1 pts

Calculate the standard reaction enthalpy for the following chemical equation.



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

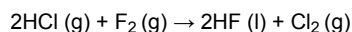


- +206.1 kJ/mol
- +155.5 kJ/mol
- +42.0 kJ/mol
- +216 kJ/mol

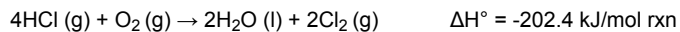
Question 24

1 pts

Calculate the standard enthalpy change for the following chemical equation.



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



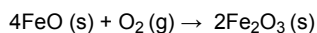
- 1116.6 kJ/mol rxn
- +1088.2 kJ/mol rxn
- 516.6 kJ/mol rxn
- 1088.2 kJ/mol rxn

- +1116.6 kJ/mol rxn
- +1015.4 kJ/mol rxn
- 1587.2 kJ/mol rxn
- 1015.4 kJ/mol rxn
- +516.6 kJ/mol rxn
- +1587.2 kJ/mol rxn

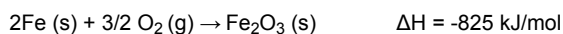
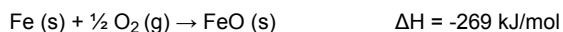
Question 25

1 pts

Calculate the standard enthalpy change for the following chemical equation.



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

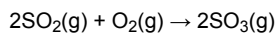


- 556 kJ/mol
- 2726 kJ/mol
- 574 kJ/mol
- 556 kJ/mol
- 574 kJ/mol

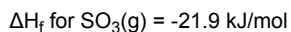
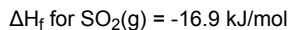
Question 26

1 pts

Calculate the enthalpy change for the following chemical equation.



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



- 77.6 kJ/mol rxn
- 10.0 kJ/mol rxn
- 5.0 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.

- Na (s)
- F₂ (g)
- HCl (g)
- C (s, diamond)
- HCl (aq)
- C (s, graphite)

Question 28**1 pts**

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

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

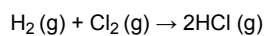
$$\text{S}(\text{g}) = 279 \text{ kJ/mol}$$

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

- 289 kJ/mol bonds
- 196 kJ/mol bonds
- 582 kJ/mol bonds
- 327 kJ/mol bonds
- 416 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
- 186 kJ/mol
- 246 kJ/mol
- 246 kJ/mol

Question 30**1 pts**

The standard molar enthalpy of formation of NH₃ (g) is -46.11 kJ/mol. What is the standard molar internal energy of formation of NH₃ (g)?

-2525 kJ/mol

2433 kJ/mol

-48.59 kJ/mol

-43.63 kJ/mol

Quiz saved at 5:47pm

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