

# HW10 - First Law & Calorimetry

Started: Nov 1 at 9:01am

## Quiz Instructions

### Homework 10 - 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?

64.21 kJ

48.37 kJ

67.79 kJ

62.47 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.

$\Delta U$

$w$

$q$

#### 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?

-0.608 kJ

-2.61 kJ

0

+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 gained 90 kJ of energy as heat.

The system gained 60 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 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  $\Delta V$  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

temperature

work

enthalpy

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.

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

The internal energy of the universe is always increasing.

The universe is an isolated system.

**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  $\Delta U$  for the process?

+3.09 kJ

-4.91 kJ

+4.91 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.

-9.5 J g<sup>-1</sup> °C<sup>-1</sup>

1.3 x 10<sup>4</sup> J g<sup>-1</sup> °C<sup>-1</sup>

9.5 J g<sup>-1</sup> °C<sup>-1</sup>

-1.3 x 10<sup>4</sup> J g<sup>-1</sup> °C<sup>-1</sup>

**Question 11**

**1 pts**

Consider the following specific heat capacities:

H<sub>2</sub>O (s) = 2.09 J/g·°C

H<sub>2</sub>O (l) = 4.18 J/g·°C

H<sub>2</sub>O (g) = 2.03 J/g·°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.

21 kJ

52 kJ

38 kJ

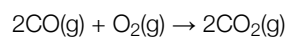
7 kJ

**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?

 6610 J 6631 J 125 J 6735 J 229 J**Question 13****1 pts**

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



$\Delta H$  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 135 kcal 1620 kcal 812 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.

 16.8 g 29.7 g

10.9 g

126 g

**Question 15**

**1 pts**

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

1606 kJ

2409 kJ

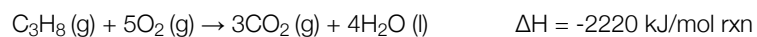
268 kJ

803 kJ

**Question 16**

**1 pts**

Consider the following chemical equation:



How much heat is given off when 11.0 g of propane gas ( $\text{C}_3\text{H}_8$ ) 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  $\Delta\text{H}$  for this process?

-98 kJ

6 kJ

-6 kJ

98 kJ

**Question 18**

**1 pts**

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

is endothermic.

is exothermic.

is not spontaneous.

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 <sup>3</sup> )
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

84.7°C

1.18°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  $22.64^\circ C$  to  $29.30^\circ C$ . The heat capacity of the hardware component of the calorimeter (everything that is not water) is  $4042 J/^\circ C$ . What is  $\Delta U$  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  $4.184 J/g \cdot ^\circ C$ .

- $-9.96 \times 10^3 \text{ kJ/mol}$
- $-4.52 \times 10^3 \text{ kJ/mol}$
- $-5.92 \times 10^3 \text{ kJ/mol}$
- $-1.15 \times 10^4 \text{ kJ/mol}$

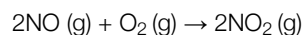
**Question 21****1 pts**

When 0.485 g of compound X is burned completely in a bomb calorimeter containing 3000 g of water, a temperature rise of  $0.285^\circ C$  is observed. What is  $\Delta U$  of the reaction for the combustion of compound X? The hardware component of the calorimeter has a heat capacity of  $3.81 \text{ kJ}/^\circ C$ . The specific heat of water is  $4.184 \text{ J/g} \cdot ^\circ C$ , and the MW of X is  $56.0 \text{ g/mol}$ .

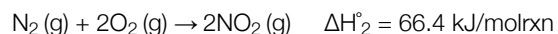
- $-4660 \text{ kJ/mol}$
- $538 \text{ kJ/mol}$
- $-538 \text{ kJ/mol}$
- $4660 \text{ kJ/mol}$

**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.



- $-100.3 \text{ kJ/mol rxn}$



-246.9 kJ/mol rxn

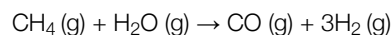
-252.4 kJ/mol rxn

-114.1 kJ/mol rxn

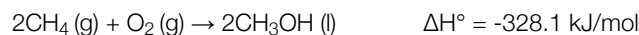
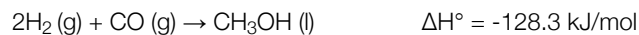
### Question 23

1 pts

Calculate the standard reaction enthalpy for the following chemical equation.



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



+42.0 kJ/mol

+216 kJ/mol

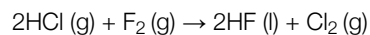
+155.5 kJ/mol

+206.1 kJ/mol

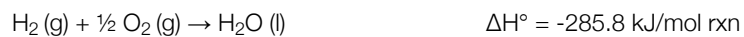
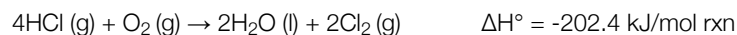
### Question 24

1 pts

Calculate the standard enthalpy change for the following chemical equation.



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



-516.6 kJ/mol rxn

+1116.6 kJ/mol rxn

-1587.2 kJ/mol rxn

+1587.2 kJ/mol rxn

-1015.4 kJ/mol rxn

+516.6 kJ/mol rxn

+1088.2 kJ/mol rxn

+1015.4 kJ/mol rxn

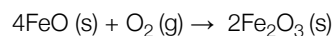
-1088.2 kJ/mol rxn

-1116.6 kJ/mol rxn

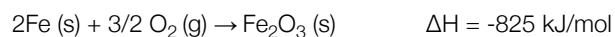
**Question 25**

**1 pts**

Calculate the standard enthalpy change for the following chemical equation.



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



-2726 kJ/mol

-574 kJ/mol

-556 kJ/mol

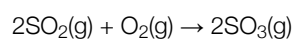
574 kJ/mol

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.

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

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

+5.0 kJ/mol rxn

-10.0 kJ/mol rxn

-77.6 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 (aq)

$\text{F}_2(\text{g})$

Na (s)

HCl (g)

**Question 28**

**1 pts**

Calculate the average S-F bond energy in  $\text{SF}_6$  using the following  $\Delta H_f$  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

327 kJ/mol bonds

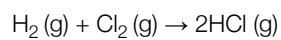
196 kJ/mol bonds

582 kJ/mol bonds

416 kJ/mol bonds

**Question 29****1 pts**

Using the bond energy data provided, calculate  $\Delta H$  for the following reaction:



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

- 246 kJ/mol
- 246 kJ/mol
- 186 kJ/mol
- 186 kJ/mol

**Question 30****1 pts**

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

- $-48.59 \text{ kJ/mol}$
- $2433 \text{ kJ/mol}$
- $-2525 \text{ kJ/mol}$
- $-43.63 \text{ kJ/mol}$

Quiz saved at 9:02am

Submit Quiz