This print-out should have 72 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

For the reaction

$$2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(\ell)$$

find the value for the work done at 300 K.

1. 2.5 kJ

2. −7.5 kJ

3. 7.5 kJ

4. −2.5 kJ

002 10.0 points

The enthalpy of fusion of methanol (CH_3OH) is 3.16 kJ/mol. How much heat would be absorbed or released upon freezing 25.6 grams of methanol?

1. 2.52 kJ absorbed

2. 0.253 kJ absorbed

3. 2.52 kJ released

4. 3.95 kJ released

5. 3.95 kJ absorbed

6. 0.253 kJ released

003 10.0 points

A 0.2 gram sample of a candy bar is combusted in a bomb calorimeter, increasing the temperature of the 2000 g of water from 25.00°C to 25.47°C. What is ΔU in kJ/g? Ignore any heat loss or gain by the calorimeter itself.

1. 19.6 kJ/g

2. -3.9 kJ/g

3. -0.08 kJ/g

4. -19.6 kJ/g

5. 3.9 kJ/g

6. 0.08 kJ/g

004 10.0 points

For the combustion reaction of ethylene (C_2H_4)

$$C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2\,H_2O$$

assume all reactants and products are gases, and calculate the $\Delta H^0_{\rm rxn}$ using bond energies.

1. 0 kJ/mol

2. 251 kJ/mol

3. 680 kJ/mol

4. −1300 kJ/mol

5. −251 kJ/mol

6. 1300 kJ/mol

7. −680 kJ/mol

005 10.0 points

Methyl tert-butyl ether or MTBE is an octane booster for gasoline. The combustion of 0.9211 grams of MTBE ($C_5H_{12}O(\ell)$, 88.15 g/mol) is carried out in a bomb calorimeter. The calorimeter's hardware has a heat capacity of 1.540 kJ/°C and is filled with exactly 2.022 L of water. The initial temperature was 26.336°C. After the combustion, the temperature was 29.849°C. Analyze this calorimeter data and determine the molar internal energy of combustion (ΔU) for this octane booster.

1. -3362 kJ/mol

2. -3120 kJ/mol

3. -3560 kJ/mol

4. -1957 kJ/mol

5. -2286 kJ/mol

6. -2748 kJ/mol

7. -4293 kJ/mol

---

006 10.0 points

Calculate the standard reaction enthalpy for the oxidation of nitric oxide to nitrogen dioxide

$$2\,NO(g) + O_2(g) \rightarrow 2\,NO_2(g)$$

given

$N_2(g) + O_2 \rightarrow 2\,NO(g)$
$\Delta H^\circ = +180.5\ kJ \cdot mol^{-1}$

$2\,NO_2(g) \rightarrow N_2(g) + 2\,O_2(g)$
$\Delta H^\circ = -66.4\ kJ \cdot mol^{-1}$

1. $-294.6\ kJ \cdot mol^{-1}$

2. $+114.1\ kJ \cdot mol^{-1}$

3. $-114.1\ kJ \cdot mol^{-1}$

4. $+246.9\ kJ \cdot mol^{-1}$

5. $-246.9\ kJ \cdot mol^{-1}$

---

007 10.0 points

You have a 12 oz. can (355 mL) of beer. You test the temperature and see that it reads 0°C. Now this isn't just any beer; this is Guinness and you've heard that Guinness is best at room temperature (20°C). If the specific heat of Guinness is 4.186 J/g·°C, how much heat should you add in order to raise the temperature? The density of Guinness is 1.2 g/mL.

1. 33.6 kJ

2. 83 J

3. 33.6 J

4. 35.6 kJ

---

008 10.0 points

A student runs a reaction in a closed system. In the course of the reaction, 64.7 kJ of heat is released to the surroundings and 14.3 kJ of work is done on the system. What is the change in internal energy (ΔU) of the reaction?

1. -79.0 kJ

2. 50.4 kJ

3. 79.0 kJ

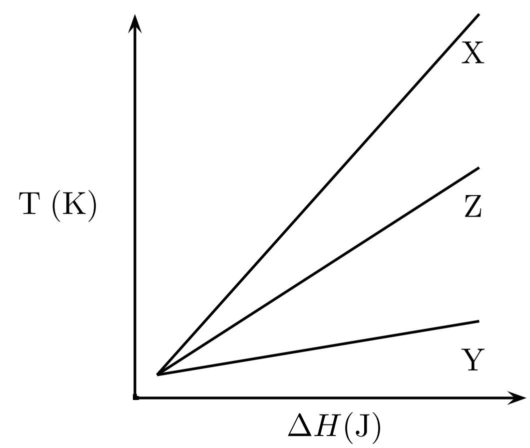
4. -50.4 kJ

5. 90.4kJ

---

009 10.0 points

Consider the plot below for three different samples of pure water.



Based on the plot, which answer choice below is a correct statement regarding the three samples of pure water?

1. All three samples have the same heat capacity.

2. Sample Z has the greatest heat capacity.

3. Sample X has the smallest mass.

4. All three samples have different specific heat capacities.

5. Sample Y would require the least heat to raise its temperature by 1 K.

---

010 10.0 points

What is the total heat flow when 12 grams of ice at -40°C are heated to become water at 25°C?

1. 0.97 kJ

2. 2.26 kJ

3. 29.39 kJ

4. 4.01 kJ

5. 27.12 kJ

6. 6.27 kJ

---

011 10.0 points

A CD player and its battery together do 500 kJ of work, and the battery also releases 250 kJ of energy as heat and the CD player releases 50 kJ as heat due to friction from spinning. What is the change in internal energy of the system, with the system regarded as the battery and CD player together?

1. +200 kJ

2. −700 kJ

3. −750 kJ

4. −200 kJ

5. −800 kJ

---

012 10.0 points

3 g of a hydrocarbon fuel is burned in a bomb calorimeter that contains 200 grams of water initially at 25.00°C. After the combustion reaction, the temperature is 27.00°C. How much heat is evolved per gram of fuel burned? The heat capacity of the calorimeter (hardware only) is 150 J/°C.

1. 21220 J/g

2. 1673 J/g

3. 1973 J/g

4. 557 J/g

5. 7505 J/g

6. 7073 J/g

7. 300 J/g

8. 657 J/g

---

013 10.0 points

The specific heat of water is 1.00 cal/g·°C, the heat of vaporization of water is 540 cal/g, and the heat of fusion of water is 80 cal/g. How much heat would be required to convert 10 grams of ice at 0°C to 10 grams of water at 75°C?

1. 15.5 cal

2. 6150 cal

3. 155 cal

4. 1.55 kcal

5. 61.5 kcal

---

014 10.0 points

1 g of cake is combusted in a bomb calorimeter. The heat capacity of the calorimeter hardware is 12 calories $\cdot$ K^{-1}. The calorimeter contains 4 L of water; the specific heat capacity of water is 1 calorie $\cdot g^{-1} \cdot K^{-1}$ and the density of water is 1 $g \cdot mL^{-1}$. You detonate the cake and the temperature of the water increases by 1.2 K. Calculate the calories in the one-gram sample of cake, ΔU.

1. 4814.4 calories

2. 1150.7 calories

3. 20083.2 calories

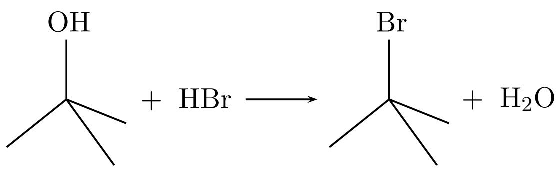
4. 20143.4 calories

5. 4800.0 calories

6. 1147.2 calories

015 10.0 points

Reaction of tertiary butyl alcohol with hydrobromic acid produces tertiary butyl bromide by the following reaction. Use bond energies (provided in preamble) to estimate the change in enthalpy, ΔH, for this reaction.



1. +105 kJ/mol

2. +186 kJ/mol

3. +24 kJ/mol

4. −105 kJ/mol

5. −24 kJ/mol

6. −186 kJ/mol

016 10.0 points

Estimate the heat released when 1-butene ($CH_3CH_2CH{=}CH_2$) reacts with bromine to give $CH_3CH_2CHBrCH_2Br$. Bond enthalpies are
C—H : 412 kJ/mol; C—C : 348 kJ/mol; C=C : 612 kJ/mol; C—Br : 276 kJ/mol; Br—Br : 193 kJ/mol.

1. 317 kJ/mol

2. 288 kJ/mol

3. 181 kJ/mol

4. 507 kJ/mol

5. 95 kJ/mol

017 10.0 points

Which of the following is/are a reason that water is a desirable heat sink for use in calorimeters?

I) Water's heat specific capacity is very precisely known.
II) Water is readily available.
III) Water has an unusually large specific heat capacity.

1. I only

2. II and III

3. I and II

4. I, II and III

5. II only

6. I and III

7. III only

018 10.0 points

Consider a thermodynamic system that is simultaneously releasing heat and doing work. The internal energy of this system will:

1. Decrease

2. Increase, decrease, or stay the same depending on the magnitudes of heat and work

3. Stay exactly the same.

4. Increase

019 10.0 points

Which of the following statements is/are true?

I) For a given process, ΔH must be zero when external pressure is zero.
II) For a given process, ΔU and ΔH must have different values.
III) For a given process, ΔU_{sys} and ΔU_{surr} must have the same magnitude.

1. I, II

2. I, II, III

3. I only

4. III only

5. II, III

6. II only

7. I, III

---

020 10.0 points

If you drop a piece of potassium metal into water you get the following exothermic reaction:

$$2\,K(s) + 2\,H_2O(\ell) \rightarrow 2\,KOH(aq) + H_2(g)$$

What are the values of q and w for this reaction, at constant temperature and pressure?

1. Both are positive.

2. q is negative and w is positive.

3. q is positive and w is negative.

4. Both are negative.

---

021 10.0 points

The formation of chemical bonds from separated atoms

1. is never spontaneous.

2. increases entropy.

3. may be either endothermic or exothermic.

4. is always exothermic.

5. is always endothermic.

---

022 10.0 points

Which of

$O_2(g)$, $O_2(\ell)$, $H_2(g)$, $H_2(\ell)$, $H_2O(g)$, $H_2O(\ell)$

have a standard enthalpy of formation equal to zero?

1. $O_2(g)$, $O_2(\ell)$, $H_2(g)$, $H_2(\ell)$, $H_2O(g)$, $H_2O(\ell)$

2. $O_2(g)$, $H_2(g)$, $H_2O(g)$

3. $O_2(g)$, $O_2(\ell)$, $H_2(g)$, $H_2(\ell)$

4. $O_2(g)$, $H_2(g)$

5. All of them, but only at absolute zero

---

023 10.0 points

When 1 mol of methane is burned at constant pressure, −890 kJ/mol of energy is released as heat. If a 3.64 g sample of methane is burned at constant pressure, what will be the value of ΔH? (Hint: Convert the grams of methane to moles. Also make sure your answer has the correct sign for an exothermic process.)

1. -61.1875
2. -202.475
3. -176.888
4. -268.669
5. -257.544
6. -233.625
7. -132.387
8. -140.731
9. -264.219
10. -115.144

Answer in units of kJ.

---

024 10.0 points

Calculate the quantity of energy required to change 3.00 mol of liquid water at 100°C to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.

1. 300 kJ

2. 122 kJ

3. None of these

4. 40.6 kJ

5. 13.5 kJ

---

025 10.0 points

Calculate the heat of formation for 2.6 mol of sulfur dioxide (SO_2) from its elements, sulfur and oxygen. Use the balanced chemical equation and the following information.

$$S(s) + \frac{3}{2} O_2(g) \longrightarrow SO_3(g) \qquad \Delta H^0_c = -395.2 \text{ kJ/mol}$$

$$2\,SO_2(g) + O_2(g) \longrightarrow 2\,SO_3(g) \qquad \Delta H^0 = -198.2 \text{ kJ/mol}$$

1. -414.54
2. -562.59
3. -384.93
4. -769.86
5. -592.2
6. -503.37
7. -651.42
8. -710.64
9. -621.81
10. -532.98

Answer in units of kJ.

---

026 10.0 points

__?__ heat capacity is the amount of heat required to raise the temperature of one __?__ of an object by 1°C. It is an __?__ property.

1. Specific; gram; extensive

2. Molar; gram; intensive

3. Specific; mole; extensive

4. Molar; gram; extensive

5. Specific; gram; intensive

6. Molar; mole; extensive

---

027 (part 1 of 3) 10.0 points

Consider the following chemical and physical changes:

A. $H_2O(l) \longrightarrow H_2O(g)$

B. $H_2O(l) \longrightarrow H_2O(s)$

C. $\frac{1}{2}H_2(g) + \frac{1}{2}F_2(g) \rightarrow HF(g)$
$\Delta H = -271.1$ kJ/mol

D. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

E. $N_2(g) + O_2(g) \rightarrow 2NO(g)$
$\Delta H = 180.50$ kJ/mol

Which change(s) are endothermic?

1. C and D only

2. B and E only

3. C only

4. A, D, and E only

5. A, C, and D only

6. A and E only

---

028 (part 2 of 3) 10.0 points

For which change(s) would $\Delta H = \Delta U$?

1. B and E only

2. C and D only

3. A and B only

4. A and D only

5. B, C, and E only

---

029 (part 3 of 3) 10.0 points

For which change(s) would $\Delta H_{rxn} = \Delta H_f$ of the product?

1. A, B, and C only

2. C only

3. A and C only

4. A, B, C, and E only

5. C and E only

---

030 10.0 points

The standard enthalpy of formation of $Br_2(\ell)$ is

1. negative.

2. zero.

3. positive.

---

031 10.0 points

Consider the combustion reaction below.

$$2\,CH_3OH(g) + 3\,O_2(g) \rightarrow 2\,CO_2(g) + 4\,H_2O(\ell)$$

If this reaction took place in a closed, rigid container, work would be (positive/negative/zero) and heat would be (positive/negative/zero).

1. positive, zero

2. positive, negative

3. zero, positive

4. negative, positive

5. negative, zero

6. zero, negative

---

032 10.0 points

Which of the reactions below is a formation reaction?

1. $2\,Fe(s) + 3\,O(g) \rightarrow Fe_2O_3(s)$

2. $B_2(s) + 2\,I_2(\ell) + Cl_2(g) \rightarrow 2\,BI_2Cl(g)$

3. $C_{\text{diamond}}(s) + \frac{1}{2}\,O_2(g) \rightarrow CO(g)$

4. $N_2(g) + 2\,H_2(g) + \frac{1}{2}\,O_2(g) \rightarrow N_2H_4O(g)$

---

033 10.0 points

Energy in the amount of 455 J is added to a 67.0 g sample of water at a temperature of 7.00°C. What will be the final temperature of the water?

1. 26.7039
2. 8.62465
3. 15.1616
4. 27.1092
5. 17.8501
6. 30.404
7. 29.7016
8. 13.5327
9. 15.6545
10. 3.29054

Answer in units of °C.

---

034 10.0 points

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

1. The system gained 60 kJ of energy as heat.

2. The system gained 90 kJ of energy as heat.

3. The system lost 210 kJ of energy as heat.

4. The system lost 90 kJ of energy as heat.

5. The system gained 210 kJ of energy as heat.

---

035 10.0 points

An important reaction that takes place in the atmosphere is

$$NO_2(g) \longrightarrow NO(g) + O(g)$$

which is brought about by sunlight. Calculate the standard enthalpy of the reaction from the following information

reaction	ΔH° (kJ)
$O_2(g) \rightarrow 2\,O(g)$	+498.4
$NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$	−200.0
$\frac{3}{2}O_2(g) \longrightarrow O_3(g)$	+142.7

1. 306.5 kJ

2. 820.5 kJ

3. 320.2 kJ

4. 555.7 kJ

5. 963.8 kJ

6. 106.5 kJ

7. 449.2 kJ

---

036 10.0 points

What is the value of work when an external pressure of 2 atm compresses a piston from an initial volume of 11.2 liters to a final volume of 2 liters.

1. −18.4 kJ

2. 18.4 kJ

3. 1.86 kJ

4. −1.86 kJ

---

037 10.0 points

A bomb calorimeter with a heat capacity of 30 J/C contains 1000 g of water with an initial temperature of 25°C. A 0.5 g sample of a candy bar is placed in a bomb calorimeter and ignited, resulting in a new water temperature of 30°C. What is ΔE for this reaction?

1. −42 kJ/g

2. 0 kJ/g

3. +21 kJ/g

4. −300 kJ/g

5. +300 kJ/g

6. −21 kJ/g

7. +42 kJ/g

---

038 10.0 points

For the combustion reaction of ethylene (C_2H_4)

$$C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2\,H_2O$$

assume all reactants and products are gases, and calculate the $\Delta H^0_{\rm rxn}$ using bond energies from the list below.

C—H : 413 kJ/mol; H—O : 463 kJ/mol;
O—O : 146 kJ/mol; O=O : 498 kJ/mol.
C—C : 346 kJ/mol; C=C : 602 kJ/mol.
C—O : 358 kJ/mol; C=O : 799 kJ/mol.

1. 0 kJ/mol

2. −251 kJ/mol

3. −680 kJ/mol

4. −1300 kJ/mol

5. 1300 kJ/mol

6. 680 kJ/mol

7. 251 kJ/mol

---

039 10.0 points

2.26 g of liquid water at 23.5 °C was completely converted to ice at 0 °C. How much heat was (absorbed/released) by the system during this process?

1. 1478 J; absorbed

2. 755 J; absorbed

3. 1478 J; released

4. 977 J; absorbed

5. 977 J; released

6. 755 J; released

---

040 10.0 points

Which of the following reactions **is** an enthalpy of formation reaction?

1. $\frac{1}{2}\,N_2(\ell) + \frac{3}{2}\,H_2(g) \rightarrow NH_3(g)$

2. $NaOH(aq) + HCl(g) \rightarrow H_2O(\ell) + NaCl(aq)$

3. $2\,Fe(s) + \frac{3}{2}\,O_2(g) \rightarrow Fe_2O_3(s)$

4. $CH_4(g) \rightarrow C_{graphite} + 2\,H_2(g)$

---

041 10.0 points

Consider a system where 2.50 L of ideal gas expands to 6.25 L against a constant external pressure of 330 torr. Calculate the work (w) for this system.

1. −1238 J

2. +1238 J

3. −1.63 J

4. +165 J

5. +1.63 J

6. −165 J

---

042 10.0 points

Calculate the standard reaction enthalpy for the reaction

$$C_2H_5OH(\ell) + 3\,O_2(g) \rightarrow 2\,CO_2(g) + 3\,H_2O(\ell)$$

given

$C_2H_5OH(\ell) \rightarrow 2\,C_{graphite}(s) + 3\,H_2(g) + 1/2\,O_2(g)$
$\Delta H^\circ = 228\ kJ \cdot mol^{-1}$

$CO_2(g) \rightarrow C_{graphite}(s) + O_2(g)$
$\Delta H^\circ = 394\ kJ \cdot mol^{-1}$

$H_2(g) + 1/2\,O_2(g) \rightarrow H_2O(\ell)$
$\Delta H^\circ = -286\ kJ \cdot mol^{-1}$

1. $730\ kJ \cdot mol^{-1}$

2. $-846\ kJ \cdot mol^{-1}$

3. $-1,418\ kJ \cdot mol^{-1}$

4. $336\ kJ \cdot mol^{-1}$

5. $-452\ kJ \cdot mol^{-1}$

---

043 10.0 points

Calculate the standard reaction enthalpy (ΔH°_{rxn}) for the final stage in the production of nitric acid, when nitrogen dioxide dissolves in and reacts with water:

$$3NO_2(g) + H_2O(\ell) \rightarrow 2HNO_3(aq) + NO(g)$$

1. −370 kJ

2. +70 kJ

3. −104 kJ

4. +136 kJ

5. −304 kJ

6. −137 kJ

---

044 10.0 points

The molar heat capacity of $C_6H_6(\ell)$ is 136 J/mol ·°C and of $C_6H_6(g)$ is 81.6 J/mol ·°C. The molar heat of fusion for benzene is 9.92 kJ/mol and its molar heat of vaporization is 30.8 kJ/mol. The melting point of benzene is 5.5°C, its boiling point is 80.1°C, and its molecular weight 78.0 g/mol. How much heat would be required to convert 234 g of solid benzene ($C_6H_6(s)$) at 5.5°C into benzene vapor ($C_6H_6(g)$) at 100.0°C?

1. 97.2715 kJ

2. 157.468 kJ

3. 4931.72 kJ

4. 60.1968 kJ

5. 152.597 kJ

---

045 10.0 points

Calculate the standard reaction enthalpy for the reaction

$$NO_2(g) \rightarrow NO(g) + O(g)$$

given +142.7 kJ/mol for the standard enthalpy of formation of ozone and

$O_2(g) \rightarrow 2\,O(g)$ $\Delta H^\circ = +498.4$ kJ/mol

$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$

$\Delta H^\circ = -200$ kJ/mol

Remember the definition of the standard enthalpy of formation of a substance.

1. +306 kJ/mol

2. +355 kJ/mol

3. +192 kJ/mol

4. +592 kJ/mol

5. +555 kJ/mol

---

046 10.0 points

A coffee cup calorimeter measures the heat at constant __?__ whereas a bomb calorimeter measures the heat at constant __?__

1. pressure ($q_p = \Delta H$); volume ($q_v = \Delta U$)

2. pressure ($q_p = \Delta U$); volume ($q_v = \Delta H$)

3. volume ($q_v = \Delta H$); pressure ($q_p = \Delta U$)

4. volume ($q_v = \Delta U$); pressure ($q_p = \Delta H$)

---

047 10.0 points

You have two liquids of identical mass, and both with initial temperatures of 15°C. One is ethanol, C_2H_5OH, with a specific heat of 2.46 J/g°C and the other is benzene, C_6H_6, with a specific heat of 1.74 J/g°C. If both liquids absorb the same amount of heat, which one will have the highest final temperature? Assume that neither liquid reaches its boiling point.

1. Cannot tell without more information given.

2. ethanol

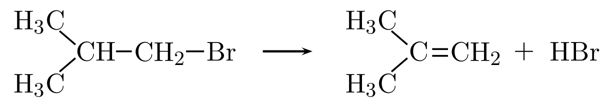
3. Both liquids will have the same final temperature.

4. benzene

---

048 10.0 points

1-bromo-isobutane will undergo and elimination reaction to yield isobutene and hydrogen bromide as shown in the reaction below. Use bond energies (provided in preamble) to estimate the change in enthalpy, ΔH, for this gas phase reaction.



1. −270 kJ/mol

2. +270 kJ/mol

3. −76 kJ/mol

4. +337 kJ/mol

5. +76 kJ/mol

6. −337 kJ/mol

---

049 10.0 points

Which is true, considering the first law of thermodynamics?

1. $\Delta U = q - w$, where heat and work can both be positive for the same process

2. $\Delta U = q + w$, where heat and work can never both be positive for the same process

3. $\Delta U = q - w$, where heat and work can never both be positive for the same process

4. $\Delta U = q + w$, where heat and work can both be positive for the same process.

---

050 10.0 points

For which of the following chemical equations would $\Delta H^\circ_{rxn} = \Delta H^\circ_f$?

1. $O_2(g) + H_2(g) \rightarrow H_2O_2(\ell)$

2. $C(s, graphite) + \frac{3}{2}O_2(g) + H_2(g) \rightarrow CO_2(g) + H_2O(g)$

3. $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

4. $N_2(\ell) + 3\,F_2(g) \rightarrow 2\,NF_3(\ell)$

---

051 10.0 points

The combustion of methane gas (CH_4) forms CO_2(g)+ $H_2O(\ell)$. Calculate the heat produced by burning 1.98 mol of the methane gas. Use these ΔH_f^0 data to help:

CH_4(g)= -74.9 kJ/mol
CO_2(g)= -393.5kJ/mol
$H_2O(\ell)$= -285.8kJ/mol.

1. 1566.75
2. 1513.34
3. 1290.79
4. 1459.93
5. 1726.99
6. 1175.06
7. 1424.32
8. 1201.77
9. 1121.65
10. 1762.6

Answer in units of kJ.

---

052 10.0 points

Calculate the standard reaction enthalpy for the reaction.

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3\,H_2(g)$$

given

$2\,H_2(g) + CO(g) \rightarrow CH_3OH(\ell)$ $\quad\Delta H^\circ = -128.3\ \text{kJ}\cdot\text{mol}^{-1}$

$2\,CH_4(g) + O_2(g) \rightarrow 2\,CH_3OH(\ell)$ $\quad\Delta H^\circ = -328.1\ \text{kJ}\cdot\text{mol}^{-1}$

$2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(g)$ $\quad\Delta H^\circ = -483.6\ \text{kJ}\cdot\text{mol}^{-1}$

1. $+155.5\ \text{kJ}\cdot\text{mol}^{-1}$

2. $+206.1\ \text{kJ}\cdot\text{mol}^{-1}$

3. $+216\ \text{kJ}\cdot\text{mol}^{-1}$

4. $+412.1\ \text{kJ}\cdot\text{mol}^{-1}$

5. $+42.0\ \text{kJ}\cdot\text{mol}^{-1}$

---

053 10.0 points

A system absorbs 237 J of heat while it performs 435 J of work. What is the change in the internal energy of the system?

1. 672 J

2. 198 J

3. −198 J

4. −672 J

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054 10.0 points

Calculate the enthalpy change that occurs when 1.00 kg of acetone condenses at its boiling point (329.4 K). The standard enthalpy of vaporization of acetone is $29.1\ \text{kJ}\cdot\text{mol}^{-1}$.

1. −29.1 kJ

2. +29.1 kJ

3. +501 kJ

4. −501 kJ

5. -2.91×10^4 kJ

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055 10.0 points

For which of the following reactions at room temperature (25°C) would there be 5.0 kJ of work done on the system?

1. $N_2H_2(g) + CH_3OH(g) \rightarrow CH_2O(g) + N_2(g) + 2\,H_2(g)$

2. $CH_2O(g) + N_2(g) + 2\,H_2(g) \rightarrow N_2H_2(g) + CH_3OH(g)$

3. $2\,H_2O(\ell) + O_2(g) \rightarrow 2\,H_2O_2(\ell)$

4. $CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2\,H_2O(g)$

5. $2\,H_2O_2(\ell) \rightarrow 2\,H_2O(\ell) + O_2(g)$

6. $CO_2(g) + 2\,H_2O(g) \rightarrow CH_4(g) + 2\,O_2(g)$

056 10.0 points

The value of ΔH for the reaction

$$C_3H_8(g) + 5\,O_2(g) \rightarrow 3\,CO_2(g) + 4\,H_2O(\ell)$$

is -2220 kJ/mol rxn. How much heat is given off when 33.0 g of propane gas (C_3H_8) is burned at constant pressure?

1. 1665 kJ

2. 22420 kJ

3. 2220 kJ

4. 25.96 kJ

5. 555 kJ

6. 50.5 kJ

7. 6660 kJ

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057 10.0 points

The two reactions shown below are both endothermic. For which reaction is $\Delta H < \Delta U$?

$N_2(g) + O_2(g) \rightarrow 2NO(g)$
$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

1. $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

2. Neither reaction has $\Delta H < \Delta U$.

3. Both reactions have $\Delta H < \Delta U$.

4. $N_2(g) + O_2(g) \rightarrow 2NO(g)$

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058 10.0 points

Consider the following reaction

$$H_2(g) + CO_2(g) \rightarrow H_2O(g) + CO(g)\,.$$

ΔH_f for $CO_2(g)$ is -22.5 kJ/mol;
ΔH_f for $CO(g)$ is -6.3 kJ/mol;
ΔH_f for $H_2O(g)$ is -13.8 kJ/mol.

1. ΔH of the reaction is negative.

2. ΔH of the reaction is zero.

3. ΔH of the reaction is positive.

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059 10.0 points

Consider the following specific heats: copper, 0.384 J/g·°C; lead, 0.159 J/g·°C; water, 4.18 J/g·°C; glass, 0.502 J/g·°C. Which substance, once warmed, would be more likely to maintain its heat and keep you warm through a long football game on a cold night?

1. water

2. glass

3. copper

4. lead

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060 10.0 points

A block of aluminum at 25 °C and 1 atm is heated until it is a liquid at 700 °C. It is then cooled back down until it is back in the initial state of being a solid at 25 °C and 1 atm. For this entire process (heating and cooling) ΔH is...

1. positive

2. less than ΔU

3. zero

4. greater than ΔU

5. negative

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061 10.0 points

Which statement about internal energy is true?

1. The internal energy of a system is equal to w at constant volume.

2. The internal energy of a system is constant at constant volume.

3. The internal energy of a system is equal to w at constant pressure.

4. The internal energy of a system is equal to q at constant volume.

5. The internal energy of a system is equal to q at constant pressure.

6. The internal energy of a system is constant at constant pressure.

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062 10.0 points

When 0.100 g of graphite is burned completely in a bomb calorimeter (heat capacity = 3.344 kJ/°C), containing 3000 g of water, a temperature rise of 0.21°C is observed. What is ΔE for the combustion of graphite? The specific heat of liquid water is 4.184 J/g·°C.

1. $\Delta E = +3.34$ kJ/mol

2. $\Delta E = -40.1$ kJ/mol

3. $\Delta E = -285.$ kJ/mol

4. $\Delta E = -3.34$ kJ/mol

5. $\Delta E = -401.0$ kJ/mol

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063 10.0 points

When a given reaction was run at a constant pressure of 1 atm, the system absorbed 5 kJ of heat and the gases were consumed, causing the volume to decrease from 3.5 L to 1.5 L. What are ΔH and ΔU, respectively?

1. +5 kJ, +0.2 kJ

2. -5 kJ, -4.8 kJ

3. +5 kJ, +5.2 kJ

4. +5.2 kJ, +5 kJ

5. +5 kJ, +4.8 kJ

6. -4.8 kJ, +0.2 kJ

7. -5 kJ, -5.2 kJ

8. +5 kJ, +5 kJ

9. -5 kJ, -5 kJ

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064 10.0 points

Juan freezes a bottle of water to ice (500.mL) in preparation for a road trip. How much heat can be absorbed by that ice before it is fully melted?

1. 2090 kJ

2. 167 kJ

3. 0 kJ

4. 1130 kJ

5. 0.500 kJ

6. 1.50 kJ

7. 6.02 kJ

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065 10.0 points

How much heat is absorbed in the complete reaction of 3.00 grams of SiO_2 with excess carbon in the reaction below?

$$SiO_2(g) + 3\,C(s) \rightarrow SiC(s) + 2\,CO(g)$$

ΔH for the reaction is +624.7 kJ/mol rxn.

1. 31.2 kJ

2. 1.33×10^4 kJ

3. 5.06 kJ

4. 366 kJ

5. 1.13×10^5 kJ

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066 10.0 points

Using bond energies, estimate the enthalpy change for the reaction between hydrogen peroxide (H_2O_2) and carbon disulfide (CS_2) to produce carbon dioxide (CO_2) and hydrogen disulfide (H_2S_2) according to the balanced equation:

$$H_2O_2 + CS_2 \rightarrow CO_2 + H_2S_2$$

1. -577 kJ/mol

2. -106 kJ/mol

3. 292 kJ/mol

4. 106 kJ/mol

5. -292 kJ/mol

6. 577 kJ/mol

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067 10.0 points

The following reaction occurs during the production of metallic iron:

$$2\,Fe_2O_3(s) + 3\,C(graphite) \to 4\,Fe(s) + 3\,CO_2(g)$$

Calculate ΔH for this reaction at 25°C and 1 atm.
ΔH_f for $CO_2(g) = -393.51$ kJ/mol, and
ΔH_f for $Fe_2O_3(s) = -824.2$ kJ/mol.

1. There is insufficient information to answer this question.

2. +467.9 kJ

3. -430.7 kJ

4. +430.7 kJ

5. -467.9 kJ

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068 10.0 points

Based on thermodynamic table data calculate ΔH_{rxn} for

$$2\,H_2O(\ell) + 2\,SO_2(g) \longleftrightarrow 2\,H_2S(g) + 3\,O_2(g)$$

1. $560\ kJ \cdot mol^{-1}$

2. $-560\ kJ \cdot mol^{-1}$

3. $1120\ kJ \cdot mol^{-1}$

4. $-1120\ kJ \cdot mol^{-1}$

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069 10.0 points

Calculate the standard reaction enthalpy for the reaction of calcite with hydrochloric acid

$$CaCO_3(s) + 2\,HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(\ell) + CO_2(g)$$

The standard enthalpies of formation are:
for $CaCl_2(aq)$: -877.1 kJ/mol;
for $H_2O(\ell)$: -285.83 kJ/mol;
for $CO_2(g)$: -393.51 kJ/mol;
for $CaCO_3(s)$: -1206.9 kJ/mol;
and for $HCl(aq)$: -167.16 kJ/mol.

1. -38.2 kJ/mol

2. -98.8 kJ/mol

3. -116 kJ/mol

4. -15.2 kJ/mol

5. -72.7 kJ/mol

6. -165 kJ/mol

7. -215 kJ/mol

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070 10.0 points

For an exothermic reaction, the sum of bond energies for the reactants are (greater/lesser) than those of the products.

1. lesser

2. greater

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071 10.0 points

Calculate the standard reaction enthalpy for the reaction

$$H_2S(g) + 2O_2(g) \to SO_3(g) + H_2O(\ell)$$

given

$H_2O(g) \to H_2O(\ell)$ $\quad \Delta H^\circ = -11.0\ kJ \cdot mol^{-1}$

$H_2SO4(\ell) \to H_2S(g) + 2O_2(g)$ $\quad \Delta H^\circ = +78.5\ kJ \cdot mol^{-1}$

$H_2SO4(\ell) \to SO_3(g) + H_2O(g)$ $\quad \Delta H^\circ = +20.5\ kJ \cdot mol^{-1}$

1. +88.0 kJ

2. −69.0 kJ

3. +110.0 kJ

4. −47.0 kJ

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072 10.0 points

When 17.8 g sodium is treated with excess oxygen, 160.2 kJ of heat is produced. What is the ΔH_{rxn} for the below reaction?

$$4Na(s) + O_2(g) \longrightarrow 2Na_2O(s)$$

1. -1682 kJ/mol

2. -15.2 kJ/mol

3. -152 kJ/mol

4. -828 kJ/mol

5. -168.2 kJ/mol