001
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TTh 9:30 am - 11:00 am

Exam 4

Dec 3, 2018

Monday 7:30 - 9:00 PM

A - Mi in BUR 106

Mo - Z in JES A121A

Remember to refer to the Periodic Table handout that is separate from this exam copy.

NOTE: Please keep this exam copy intact (all pages still stapled - including this cover page). You must turn in ALL the materials that were distributed. This means that you turn in your exam copy (name and signature included), bubble sheet, periodic table handout, and all scratch paper. Please also have your UT ID card ready to show as well.

This print-out should have 20 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Msci 15 0201b
001 5.0 points

Which one of the following thermodynamic quantities is NOT a state function?

1. pressure

2. entropy

3. temperature

4. free energy

5. heat

First Law Simple Calc 18
002 5.0 points

WITHDRAWN

PV Work Expansion Compression
003 5.0 points

Calculate the value of work when a gas-phase reaction compresses from 43.7 L to 36.3 L at 1.85 atm and constant temperature. Is work done on or by the system?

1. 1387 J, on the system

2. -1387 J, on the system

3. 13.69 J, on the system

4. 0.1351 J, by the system

5. -0.1351 J, on the system

6. 1387 J, by the system

Heating Curve Heating
004 5.0 points

A 14.0 g sample of ice at -18.0°C is placed on a hot plate and heated to a final temperature of 84.0°C. Calculate the heat of this process.

1. 16.2 kJ

2. -11.0 kJ

3. 10.7 kJ

4. 10.1 kJ

5. 5.8 kJ

Thermo Work Conceptual 18
005 5.0 points

The atmospheric photochemical oxidation of nitrogen dioxide is an important contributor to rising HNO_3 levels in coastal acid rains. To simulate the first steps of this process, you run the following reaction in a piston:

$$2NO_2(g) + NaCl(s) \rightarrow NOCl(g) + NaNO_3(s)$$

Which of the following is true regarding this reaction?

1. $\Delta U_{sys} < \Delta H_{sys}$

2. $\Delta U_{sys} = \Delta nRT$

3. Work is done by the system

4. $\Delta U_{sys} = \Delta H_{sys}$

5. $\Delta U_{sys} > \Delta H_{sys}$

Bomb Calo Calc 18
006 5.0 points

When a 0.6890 g sample of a petroleum extract (molecular weight = 62.15 g/mol) is combusted in a rigid container, the temperature increases from 25.317°C to 28.918°C. The total volume of water is 1.018 L. The sum of all hardware components of the calorimeter have a heat capacity of 1.78 kJ/$^{\circ}$C. Calculate the internal energy of combustion for one mole of this petroleum extract.

1. +4.416 kJ/mol

2. -1962 kJ/mol

3. +21.75 kJ/mol

4. +31.56 kJ/mol

5. -4.416 kJ/mol

6. +6420 kJ/mol

7. +1962 kJ/mol

8. -21.75 kJ/mol

Enthalpy Stoich Rev Reaction
007 5.0 points

The enthalpy change, ΔH, associated with the following reaction is +81 kJ/ mol rxn.

$$NBr_3(g) + 3\,H_2O(g) \rightleftharpoons 3\,HOBr(g) + NH_3(g)$$

What is the expected enthalpy change for the reverse reaction of nine moles of HOBr and two moles of NH_3?

1. -162 kJ

2. -81 kJ

3. +243 kJ

4. -243 kJ

5. +81 kJ

6. +365 kJ

7. -365 kJ

8. +162 kJ

ChemPrin3e T06 43
008 5.0 points

Calculate the standard reaction enthalpy for the reaction

$$N_2H_4(\ell) + H_2(g) \rightarrow 2\,NH_3(g)$$

given

$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$
$\Delta H^\circ = -543\ \text{kJ} \cdot \text{mol}^{-1}$

$2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(g)$
$\Delta H^\circ = -484\ \text{kJ} \cdot \text{mol}^{-1}$

$N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$
$\Delta H^\circ = -92.2\ \text{kJ} \cdot \text{mol}^{-1}$

1. $-59\ \text{kJ} \cdot \text{mol}^{-1}$

2. $-151\ \text{kJ} \cdot \text{mol}^{-1}$

3. $-1119\ \text{kJ} \cdot \text{mol}^{-1}$

4. $-243\ \text{kJ} \cdot \text{mol}^{-1}$

5. $-935\ \text{kJ} \cdot \text{mol}^{-1}$

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bond E - COClF
009 5.0 points

Chlorine monofluoride (ClF) will react with carbon monoxide (CO) to give carbonyl chlorofluoride (COClF):

$$ClF + CO \longrightarrow COClF$$

Use bond energies (provided elsewhere) to estimate the change in enthalpy (ΔH) for this reaction.

1. -193 kJ/mol

2. -376 kJ/mol

3. -571 kJ/mol

4. -444 kJ/mol

5. -298 kJ/mol

ID Formation Reaction 18
010 5.0 points

Which of the following is a formation reaction where $\Delta H^\circ_{rxn} = \Delta H^\circ_f$?

1. $SO_2(g) + \frac{1}{2}\,O_2(g) \rightarrow SO_3(g)$

2. $Na(s) + \frac{1}{2}\,Cl_2(g) \rightarrow NaCl(s)$

3. $CO_2(s) \rightarrow CO_2(g)$

4. $2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(\ell)$

Second Law Conceptual 18
011 5.0 points

Mercury has a melting point substantially below room temperature (-38.89°C). Which of the following is true regarding the fusion of mercury at room temperature?

I. $\Delta S_{\text{universe}} > 0$

II. $\Delta S_{\text{sys}} > 0$

III. $|\Delta S_{\text{sys}}| > |\Delta S_{\text{surr}}|$

IV. This physical reaction proceeds only at temperatures below -38.89°C

1. I and IV only

2. III and IV only

3. I only

4. II only

5. I, II, and III only

6. I, II, and IV only

7. IV only

Entropy Comparison Theoretical
012 5.0 points

Rank the following substances by increasing absolute standard entropy (S°):

$CH_2Cl_2(g)$ Al(s) $CH_3OH(\ell)$ $CH_4(g)$

1. $CH_2Cl_2(g) < CH_4(g) < CH_3OH(\ell) <$ Al(s)

2. $CH_4(g) < CH_2Cl_2(g) < CH_3OH(\ell) <$ Al(s)

3. Al(s) $< CH_3OH(\ell) < CH_4(g) < CH_2Cl_2(g)$

4. Al(s) $< CH_4(g) < CH_2Cl_2(g) < CH_3OH(\ell)$

5. Al(s) $< CH_3OH(\ell) < CH_2Cl_2(g) < CH_4(g)$

Monatomic Gas Calc dS
013 5.0 points

Calculate the change in entropy (ΔS) when 13 moles of neon gas are heated from 25°C to 125°C at constant pressure.

1. +46.9 J/K

2. +31.26 J/K

3. +27.0 kJ/K

4. +93.8 J/K

5. +3.61 J/K

6. +125 J/K

7. +6.01 J/K

8. +78.2 J/K

Entropy of Surroundings 18
014 5.0 points

Calculate the ΔS_{surr} for the formation of iron(II) oxide at 25°C and 1 atm.

$Fe(s) + \frac{1}{2}O_2(g) \rightarrow FeO(s)$

1. 912 J/K

2. 10.9 J/K

3. -912 J/K

4. −10900 J/K

5. 5440 J/K

6. -10.9 J/K

Thermo Signs of Phys Rxn
015 5.0 points

Solid arsenic will sublime when heated to 614°C according to the following reaction:

$$As(s) \rightarrow As(g)$$

What are the signs of ΔH, ΔS, and ΔG for this sublimation reaction at 800°C?

1. $\Delta H > 0, \Delta S > 0, \Delta G = 0$

2. $\Delta H > 0, \Delta S < 0, \Delta G = 0$

3. $\Delta H > 0, \Delta S > 0, \Delta G < 0$

4. $\Delta H > 0, \Delta S > 0, \Delta G > 0$

5. $\Delta H < 0, \Delta S < 0, \Delta G < 0$

Msci 15 1406a
016 5.0 points

Consider the equation

$$NH_4Br(s) \rightarrow NH_3(g) + HBr(g)$$

carefully, and think about the sign of ΔS for the reaction it describes. $\Delta H = +188.3$ kJ. Which response describes the thermodynamic spontaneity of the reaction?

1. All responses are correct.

2. The reaction is spontaneous at all temperatures.

3. The reaction is spontaneous only at relatively low temperatures.

4. The reaction is spontaneous only at relatively high temperatures.

5. The reaction is not spontaneous at any temperatures.

Free Energy Generic Calc
017 5.0 points

An unidentified metal, M, oxidizes at room temperature and pressure to form M_2O_3. Given the thermodynamic data provided in the table below, calculate ΔG°_f.

Substance	ΔH°_f kJ/ mol	S° J/ mol K
M(s)	–	36.2
O_2(g)	–	205
O(g)	249	161
M_2O_3(s)	−653	67.8

1. -560 kJ mol^{-1}

2. 1250 kJ mol^{-1}

3. 653 kJ mol^{-1}

4. −5430 kJ mol^{-1}

5. 560 kJ mol^{-1}

6. 6.1×10^6 kJ mol^{-1}

7. −653 kJ mol^{-1}

8. −1250 kJ mol^{-1}

Spontaneity Concept
018 5.0 points

Consider a spontaneous, exothermic reaction that has a negative change in entropy. Which of the following relationships is/are true for this reaction?

I. $\Delta S_{\text{universe}} < 0$

II. $\Delta H_{\text{sys}} < 0$

III. $\Delta G_{\text{rxn}} < 0$

1. I, II, and III

2. III only

3. I and III only

4. II only

5. I only

6. II and III only

Spontaneity Conceptual
019 5.0 points

Consider the following reaction for the oxidation of lead:

$$Pb(s) + O_2(g) \longrightarrow PbO_2(s)$$

$\Delta G^\circ_{\text{rxn}} = -217\,\text{kJ/mol}$

Read each answer choice carefully and determine the single best explanation for the value of $\Delta G^\circ_{\text{rxn}}$.

1. PbO_2 tends to spontaneously decompose into Pb and O_2.

2. PbO_2 has a lower free energy state than that of the Pb and O_2 mixture.

3. The PbO_2 product has a higher entropy than the combination of Pb and O_2.

4. As the reaction proceeds, work is done by the system to produce a lower free energy.

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q and w of chemical change b
020 5.0 points

Consider the following combustion reaction:

$$2C_3H_8O(\ell) + 9O_2(g) \rightarrow 6CO_2(g) + 8H_2O(\ell)$$

Which of the following statements about q and w for this reaction is correct?

1. q and w are both are negative.

2. q and w are both zero.

3. q is negative and w is positive.

4. q is positive and w is negative.

5. q and w are both are positive.