Final Test Form C Chem 1310 Fall 2008 12/11/2008 Dr. Williams

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This test is closed note/book. Two 8.5 x 11 handwritten crib sheets (two sided) are permitted.

Use a #2 pencil. Calculators are permitted. Computers, PDAs, and other electronic devices with a keyboard are not. Please turn off your cell phone. Cell phones may not be used as calculators.

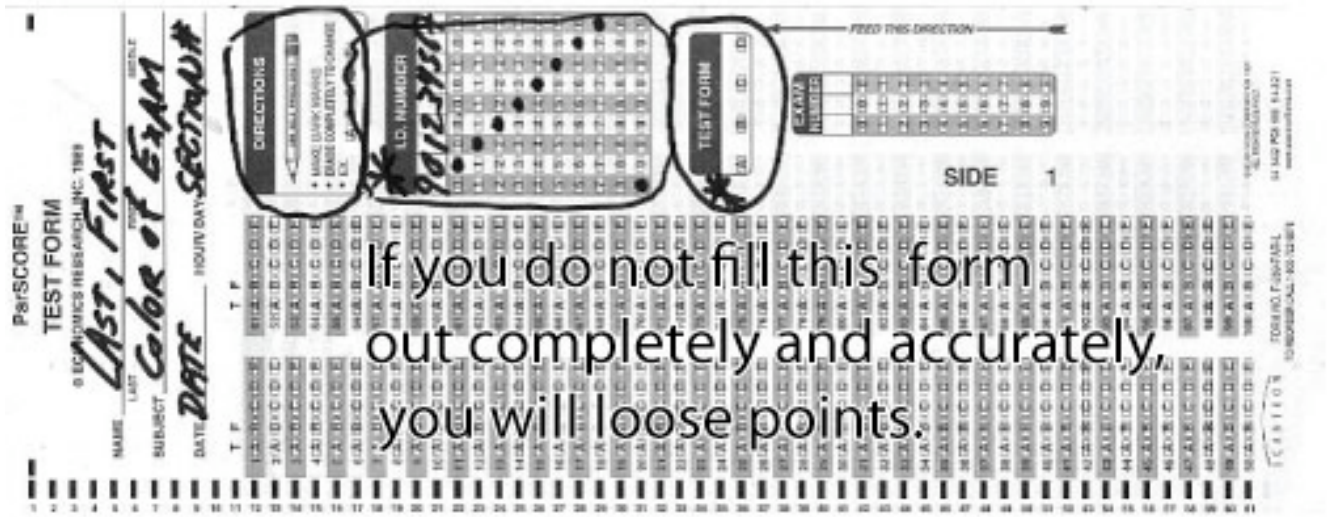
Write your name on this exam. Complete the Scantron card as shown below. You must bubble in your ID number, write in your section number and identify your Test Form (see top of this page). Scantron errors and omissions are punishable by point deductions.

When you take the exam, bubble in the scanton form *and* circle your answers on this exam. You must hand in both the scantron and the exam.

A total of three hours is allotted for the exam. There are 55 questions. Each is worth five points. In addition there are seven extra credit questions at the end. Answer every question. There is no penalty for guessing.

Circle Your Section Number (or minus 5 points)

A1	M 2-3PM	CoC 52
A2	M 2-3PM	CoC 53
A3	M 2-3PM	MSE 1201A
A4	M 2-3PM	MSE 1222
A5	M 2-3PM	MSE 1224
B1	M 3-4PM	CoC 52
B2	M 3-4PM	CoC 53
B3	M 3-4PM	MSE 12101A
B4	M 3-4PM	MSE 1222
B5	M 3-4PM	MSE 1224



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Section 1

1. Which of the following statements about salty water ($NaCl_{aq}$) is false?
   A) It has a relatively high boiling point.
   B) Boiling it disrupts hydrogen bonds.
   C) Boiling it disrupts London dispersion forces.
   D) It readily dissolves CH_3CH_3.
   E) It has a high molar heat capacity.

Answer: D, Chapter 4

2. For the reaction of 3.0 g hydrogen with 21 g oxygen, calculate the theoretical yield of water (H_2O).

$$H_2 + 1/2O_2 \rightarrow H_2O$$

   A) 54 grams of H_2O
   B) 12 grams of H_2O
   C) 46 grams of H_2O
   D) 23 grams of H_2O
   E) 14 grams of H_2O

Answer: D, Chapter 3
H2: $(3g)(2g/mol)^{-1}$= 1.5 mol
O2: $(21g)(32g/mol)^{-1}$= 0.65 mol
1.5 mol H2 will consume 0.75 mole O2; O2 is limiting
H_2O; (0.65 mol)(18g/mol)(2) = 23g

3. What is the total volume after adding water to a 20.0 mL solution of 0.96 M NaCl(aq) to give a final solution of 0.480 M (aq)?
   A) 8.1 mL
   B) 40 mL
   C) 10 mL
   D) 36 mL
   E) 20 mL

Answer: B, Chapter
$M_1V_1=M_2V_2$; (20ml)(0.95mol/L)/0.48mol/L = 39.6 ml

4. Which of the following statements about a nitrogen atom is false?
   A) The electrons occupy discrete energy levels.
   B) The primary quantum number of an electron (n) can be increased by the absorption of light.
   C) Light is absorbed and emitted at discrete wavelengths
   D) Light is absorbed and emitted at discrete frequencies
   E) None of the statements above are false

Answer: E, Chapter 12

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5. Which of the following statements about electromagnetic radiation (in a vacuum) is false?
   A) The photon energy specifies the wavelength (i.e., if you know the wavelength you know the energy).
   B) The photon frequency specifies the wavelength.
   C) The photon energy specifies the amplitude.
   D) The photon frequency does not specify the phase.
   E) The wavelength emitted by an atom is determined by differences in energy levels.

Answer: C, Chapter 12

6. Which of the following statements about atomic orbitals is false?
   A) An orbital can hold only one electron.
   B) Orbitals do not have precise boundaries
   C) Hydrogen has fewer occupied orbitals than lithium.
   D) An orbital is not an orbit.
   E) The number of probability nodes increases with increasing n (primary quantum number)

Answer: A, Chapter 12

7. Which of the following frequencies corresponds to electromagnetic radiation with the greatest energy per photon?
   A) $3.00 \times 10^{13}\ s^{-1}$
   B) $8.50 \times 10^{20}\ s^{-1}$
   C) $4.12 \times 10^{5}\ s^{-1}$
   D) $9.12 \times 10^{12}\ s^{-1}$
   E) $3.20 \times 10^{9}\ s^{-1}$

Answer: B, Chapter 12, E=hν

8. Which are possible quantum numbers of the unpaired electron of a fluorine atom?
   (hint: l=0=>s; l=1=>p; l=2=>d; l=3=>f)

	n	*l*	$m_{(l)}$	$m_{(s)}$
A)	1	1	0	–½
B)	2	0	0	½
C)	2	1	–1	½
D)	2	1	3	–½
E)	4	2	0	½

Answer: C, Chapter 12

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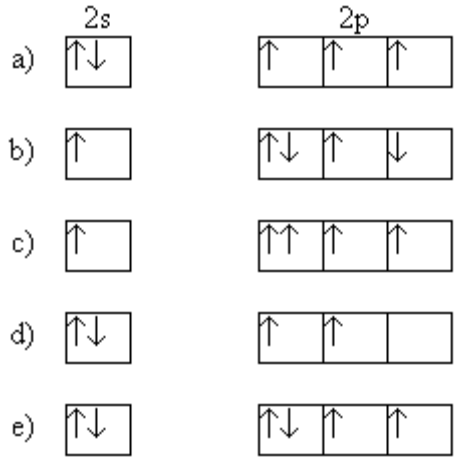
9. What is the correct electron arrangement of a neutral nitrogen atom in the ground state?



Answer: A, Chapter 12

10. Which of the following molecules has a net dipole moment?
    A) CBr_4
    B) NF_3
    C) CO_2
    D) BI_3
    E) NH_4^+

Answer: B, Chapter 13

11. Which bond has the smallest dipole moment?
    A) H-F
    B) C-N
    C) N-N
    D) C-O
    E) C-F

Answer: C, Chapter 13

12. Which of the following statements is incorrect?
    A) Ionic bonding results from the transfer of one or more electrons from one atom to another.
    B) A bond dipole indicates the unequal distribution of electrons around the atoms in the bond.
    C) The electrons in a polar bond are found nearer to the more electronegative atom.
    D) A molecule with very polar bonds necessarily has a net dipole moment.
    E) Linear molecules can have a net dipole moment.

Answer: D, Chapter 13

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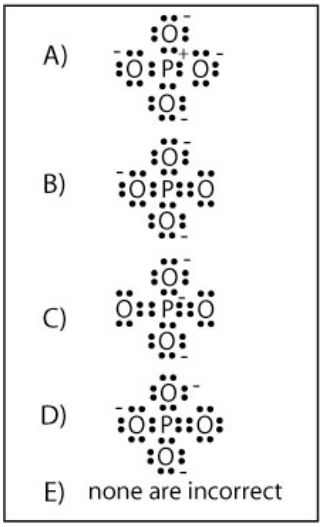
13. The shape of PO_4^{3-} is
    A) Square Pyramidal
    B) Tetrahedral
    C) Truncated Octahedral
    D) Distorted Tetrahedral
    E) Seriously Bent

Answer: B, Chapter 13

14. Phosphorus has the molecular formula P_4 while sulfur has the molecular formula S_8. How many grams of phosphorus contain the same number of molecules as 4.61 g of sulfur?
    A) 2.2 g
    B) 3.2 g
    C) 6.2 g
    D) 6.4 g
    E) none of these

Answer: A, Chapter 3
4.61g/(8x32.1g/mol) = 0.018 mol S8; (0.018mol)(4x31g/mol) = 2.2g

15. Which one of these structures is incorrect (this image will be projected during the exam?



Answer: D

Section 2

16. Consider three flasks at 1000K. Flask A contains 1 mole of He at 0.02 atm, flask B contains 1 mole of Ne at 0.04 atm, and flask C contains 1 mole of Xe at 0.06 atm. Assume that all three gases are ideal.

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In which flask do the gas particles have the highest average kinetic energy?

A) insufficient information
B) flask A
C) flask B
D) flask C
E) All are the same

Answer: E (KE=3/2RT)

17. A sample of 106 g of butanetriol, a non-dissociating, non-volatile liquid with the formula $C_4H_{10}O_3$, is dissolved in 582 g water. What is the vapor pressure of this solution at 100°C?

A) 684 torr
B) 760 torr
C) 76 torr
D) 23 torr
E) 738 torr

Answer: E

n_{H2O} = 582g/(18g/mol) = 32.3 mol

$n_{butanetriol}$ = 106g/(106g/mole) = 1.0 mol

X_{H2O} = n/(n+1) = 32.3/33.3 = 0.97

$P_{H2O}=X_{H2O}\ P°_{H2O}$ = 0.97(760 torr) = 738 torr

18. For the reaction:

$$aA(g) + bB(g) \rightleftharpoons cC(g) \quad \Delta H°=-32kJ/mol$$

with a = 1, b=1 and c=1. An increase in total pressure (at constant Temperature).

A) increases the number of moles of A
B) decreases the number of moles of A
C) does not change the number of moles of A
D) has undetermined effect on the number of moles of A

Answer: B

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19. For the reaction:

$$aA(g) + bB(g) \rightleftharpoons cC(g) \quad \Delta H°=-32kJ/mol$$

with a = 1, b=1 and c=1. An increase in Temperature (at constant pressure).

A) increases the number of moles of A
B) decreases the number of moles of A
C) does not change the number of moles of A
D) has undetermined effect on the number of moles of A

Answer: A

20. Four identical 1.0-L flasks contain the gases H_2, Cl_2, CH_4, and NH_3, each at 0°C and 0.1 atm pressure. Assume that all gases behave ideally.

Which gas has the greatest number of molecules?

A) NH_3
B) H_2
C) Cl_2
D) CH_4
E) all the same

Answer: E

21. Consider two samples of helium (1 and 2) at the same temperature in separate containers. $V_1 = 2V_2$, $P_1 = 3P_2$ and both 1 and 2 behave ideally.

Calculate the ratio n_1/n_2.

A) 3:1
B) 2:1
C) 6:1
D) 1:2
E) 1:6

Answer: C

$n_1 = P_1V_1/RT$ $n_2=P_2V_2/RT$ $n_1/n_2 = P_1V_1/P_2V_2 = 3P_2 2V_2/P_2V_2 = 6/1$

22. The value of an equilibrium constant can vary with

A. Temperature
B. The reaction quotient (Q)
C. Concentration
D. Time
E. Pressure

Answer: A

23. For the following reaction:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

How can the reaction be shifted to the left?

A) increase the pressure by changing the volume
B) remove PCl_3
C) add more PCl_5
D) remove Cl_2
E) decrease the pressure by changing the volume

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Answer: A

24. Identify the primary the attractive forces between species in a sample of NaCl dissolved H_2O.
A) Hydrogen bonding, London dispersion, Dipole-Dipole, Dipole-Induced dipole
B) Hydrogen bonding, London dispersion, Dipole-Induced dipole, Charge-Induced dipole, Charge-Charge, Covalent bonds, Ionic bonds
C) Hydrogen bonding, London dispersion, Dipole-Induced dipole
D) Hydrogen bonding, London dispersion, Dipole-Dipole, Dipole-Induced dipole, Charge-Induced Dipole, Charge-Charge
E) London dispersion, Dipole-induced dipole, Charge-Induced dipole

Answer: D, the sodium is cationic and the chloride is anionic, so there are charge-charge interactions

25. The elements of group 5A, the nitrogen family, form compounds with hydrogen listed below:

	Boiling Point
SbH_3	–17° C
AsH_3	–55° C
PH_3	–87° C
NH_3	–33° C

The first three elements illustrate a trend where the boiling point decreases as the molecular weight decreases. However, ammonia (NH_3) does not follow the trend because
A) London dispersion forces
B) dipole-induced dipole
C) charge-charge (ionic) forces
D) hydrogen bonding
E) covalent forces

Answer: D

26. Consider the Bragg Equation. If the energy of a 400 nm beam of light is increased as it is reflected from two parallel mirrors (partially transparent) 800 nm apart, one might expect to see
A) An increase in the angle of diffraction (Θ)
B) A decrease in the angle of diffraction
C) No change in the diffraction pattern
D) Rainbows
E) The image of Elvis Presley

Answer: B

Energy up => wavelength down => angle Θ down; $n\lambda=2d\sin\Theta$. A rainbow results from white light (a range of wavelengths).

27. Nitric oxide, an important pollutant in air, is formed from the elements nitrogen and oxygen at high temperatures, as when gasoline burns in an automobile engine. At 2000°C, K = 0.01 for the reaction

$$N_2\,(g) + O_2\,(g) \rightleftharpoons 2NO\,(g)$$

Predict how the system will reach equilibrium at 2000°C if 0.4 moles of N_2, 0.1 moles of O_2, and 0.008 moles of NO are placed in a 1.0-liter container.
A) More information is necessary.
B) The concentration of NO will decrease; the concentrations of N_2 and O_2 will remain unchanged.
C) The system will remain unchanged.
D) The concentration of NO will decrease; the concentrations of N_2 and O_2 will increase.

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E) The concentration of NO will increase; the concentrations of N_2 and O_2 will decrease.

Answer: E

$Q=P^2_{NO}/P_{O2}P_{N2} = (0.008)^2/(0.4)(0.2) = 0.0008$

Q<K, reaction will go to the right (toward products)

28. A cylinder is fitted with a movable piston containing an ideal gas. The pressure inside the cylinder is P_i and the volume is V_i. What is the new pressure in the system when the piston decreases the volume of the cylinder by half, at constant T?
    A) $2V_iP_i$
    B) $(1/4)P_i$
    C) P_i^2
    D) $2P_i$
    E) $(1/2)P_i$

Answer D

29. The vapor pressure of a solution depends on
    A) the volume of the solution
    B) the temperature
    C) the volume of the vapor
    D) the amount of non-volatile soluble contaminants
    E) several of the factors listed above

Answer E (B and D are correct)

30. The following acids are listed in order of acid strength in water

    HI > HNO_2 > CH_3COOH > HClO > HCN

    Which of the following is the weakest base?
    A) I^-
    B) NO_2^-
    C) CH_3COO^-
    D) ClO^-
    E) CN^-

Answer A (strongesgt acid => weakest conjugate base)

Section 3

31. Consider the diprotic ascorbic acid (H_2As).

	K_a	pK_a
$H_2As \rightleftharpoons H^+ + HAs^-$	7.9×10^{-5}	4.10
$HAs^- \rightleftharpoons H^+ + As^{2-}$	1.6×10^{-12}	11.8

What major species are present at pH 4.10?
A) As^{2-} and HAs^-
B) HAs^- and H_2As
C) HAs^- only
D) H_2As only
E) H_2As and H^+

Answer: B

Chapter 8

32. During isothermal compression of an ideal monatomic gas, heat is released to the surroundings as the volume decreases at constant temperature. In this process, the energy of the gas
A) increases
B) decreases

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C) stays the same
D) cannot be determined from the information given
Answer: C
The energy of a perfect monatomic gas depends only on the temperature (KE=3/2RT).

33. Calculate ΔE for a system that releases 35 J of heat to the surroundings while 54 J of work is done on it.
A) –89 J
B) –19 J
C) 19 J
D) 89 J
E) 35 J
Answer: C
$\Delta E = q + w = -35\ J + 54\ J = +19\ J$
Chapter 9

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34. Calculate the work for the expansion of an ideal gas from 3.0 to 6.0 L against an external pressure of 1.6 atm at constant temperature.

A) 4.8 L•atm
B) –4.8 L•atm
C) 0.0 L•atm
D) 5.6 L•atm
E) –1.9 L•atm

Answer: B
w = -PΔV = -1.6 atm (6.0 L - 3.0 L) = -4.8 L-atm
Chapter 9

Consider the following process carried out on 1.0 mol of a monatomic ideal gas at constant pressure:
Start: (3.00 atm, 20.0 L)
End: (3.00 atm, 50.0 L).

35. Calculate the work, *w*.

A) -90 L•atm
B) 90 L•atm
C) -30 L•atm
D) 30 L•atm
E) 0 L•atm

Answer: A
w = -PΔV = -3 atm (50 L - 20 L) = - 90 L-atm
Chapter 9

36. Calculate the heat, *q*.

A) 226 L•atm
B) -226 L•atm
C) 135 L•atm
D) -135 L•atm
E) none of these

Answer: A
T(A) = PV/nR = (3 atm)(20 L)/[(1.0 mol)(0.082 L-atm mol^{-1} mol^{-1} K^{-1})] = 731 K
T(B) = PV/nR = (3 atm)(50 L)/[(1.0 mol)(0.082 L-atm mol^{-1} K^{-1})] = 1830 K
ΔT=1099 K
q = $nC_p\Delta T$ = (1 mol)(5/2 R J mol^{-1} K^{-1})(101 J/L-atm)$^{-1}$(1099 K)
= (5/2 x 8.31) 1099/101 = 226 L-atm

37. As a cold brick (the system) spontaneously warms in a hot pool of water (the surroundings), the [entropy (S) / free energy (G) / enthalpy (H)] of the brick

A) decreases / decreases /increases
B) increases / decreases / increases
C) decreases / increases / increases
D) decreases / increases / decreases
E) increases / increases / increases

Answer: B
Chapter 10

38. As a cold brick (the system) spontaneously warms in a hot pool of water (the surroundings), the [entropy (S) / enthalpy (H)] of the surroundings

A) decreases / increases
B) increases / increases
C) decreases / increases
D) decreases / decreases

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E) increases / increases

Answer: D

Chapter 10

39. In a reaction where a diatomic molecule (for example O_2) spontaneously forms from its atoms at standard temperature and pressure, what are the signs of ΔH, ΔS, and ΔG, respectively?

A) + + +

B) + – –

C) – + +

D) – – +

E) – – –

Answer: E

Chapter 10

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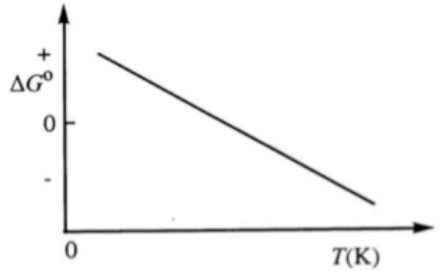
40. Consider the spontaneous freezing of liquid water at –10°C. For this process what are the signs for ΔH, ΔS, and ΔG, respectively?

A) + – 0
B) – + 0
C) – + –
D) + – –
E) – – –

Answer: E
Chapter 10

41. This graph illustrates the relationship between $\Delta G^{o}_{reaction}$ and absolute temperature. For this reaction, one can conclude that:



A) $\Delta H° > 0, \Delta S° > 0$
B) $\Delta H° < 0, \Delta S° > 0$
C) $\Delta H° > 0, \Delta S° < 0$
D) $\Delta H° < 0, \Delta S° < 0$
E) The signs of $\Delta H°$ and $\Delta S°$ cannot be determined.

Answer A

42. A hot metal block (85 g, 97.9 C) is added to an insulating container holding 250 g H_2O at 22.3 C. If the final temperature measured is 27.4 C, then what is the specific heat of the metal?

A) 19.7 J/g-°C
B) 0.89 J/g-°C
C) 0.45 J/g-°C
D) 0.21 J/g-°C
E) 1.77 J/g-°C

Answer: B
(250 g)(4.18 J/g-K)(27.4-22.3) = 85(C_m)(97.9-27.4)
C_m=0.9

43. For ammonia (NH_3), K_b is 1.8 x 10^{-5}. The buffering capacity of a 1 M solution of NH_4Cl is at a maximum at a pH of

A) 4.7
B) 7.2
C) 12.2
D) 9.3
E) none of these

Answer: D
pK_b = -4.75
pK_a = 9.3, buffering capacity is max when pH = pK_a
Chapter 8

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44. For nitrous acid (HNO_2) $K_a = 4.0 \times 10^{-4}$. Calculate the pH of 0.25 M HNO_2.

A) 2.00
B) 2.30
C) 2.70
D) 3.70
E) 4.31

Answer: A

45. Consider a solution with both he following systems:

$H_2CO_3 \rightleftharpoons HCO_3^- + H^+ \quad pK_a = 6.4$

$H_2PO_4^- \rightleftharpoons HPO_4^{2-} + H^+ \quad pK_a = 7.2$

At pH 6.4, which one of the following are true?

A) $[H_2CO_3] > [HCO_3^-]$ and $[H_2PO_4^-] > [HPO_4^{2-}]$
B) $[H_2CO_3] = [HCO_3^-]$ and $[H_2PO_4^-] > [HPO_4^{2-}]$
C) $[H_2CO_3] = [HCO_3^-]$ and $[HPO_4^{2-}] > [H_2PO_4^-]$
D) $[HCO_3^-] > [H_2CO_3]$ and $[HPO_4^{2-}] > [H_2PO_4^-]$
E) $[H_2CO_3] > [HCO_3^-]$ and $[HPO_4^{2-}] > [H_2PO_4^-]$

Answer: B

Section 4

46. For the decomposition of nitrous oxide (N_2O) to N_2 and O_2:
Rate = $k[N_2O]^2$. Several mechanisms are proposed:

A. $N_2O \rightarrow N_2 + O$ $N_2O + O \rightarrow N_2 + O_2$	***B.*** $N_2O \rightarrow N + NO$ $N_2O + N + NO \rightarrow N_3 + O_2$ $2N_3 \rightarrow 3N_2$
C. $2N_2O \rightarrow N_4O_2$ $N_4O_2 \rightarrow 2N_2 + O_2$	***D.*** $3N_2O \rightarrow N_6O_3$ $2N_6O_3 \rightarrow 6N_2 + 3O_2$

Which of the mechanisms above is most likely to be correct?

A. Mechanism A.
B. Mechanism B.
C. Mechanism C.
D. Mechanism D.
E. None of these mechanisms are consistent with the experimental rate law.

Answer: C

47. The rate of a reaction can change with

A. Temperature.
B. The addition of a catalyst or enzyme.
C. Reactant concentrations.
D. None of the above (a-c).
E. All of the above (a-c).

Answer: E

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48. The rate of disappearance of ozone in the reaction $2O_3(g) \rightarrow 3O_2(g)$ is 9.0×10^{-3} atm s^{-1}. What is the rate of appearance of O_2?
    A. 1.3×10^{-2} atm s^{-1}
    B. 9.0×10^{-3} atm s^{-1}
    C. 6.0×10^{-3} atm s^{-1}
    D. 3.0×10^{-5} atm s^{-1}
    E. 2.7×10^{-5} atm s^{-1}

Answer: A
$(3/2)9.0 \times 10^{-3} = 1.3 \times 10^{-2}$ atm/s

49. The balanced equation for the reaction of bromate with bromide to produce bromine (Br_2) in acidic solution is given by:

$$BrO(aq) + 5Br^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(aq)$$

When $d[Br^-]/dt$ is -1.0×10^{-3} mol L^{-1} s^{-1}, what is $d[Br_2]/dt$?
    A. -0.6×10^{-3} mol L^{-1} s^{-1}
    B. $+0.6 \times 10^{-3}$ mol L^{-1} s^{-1}
    C. -1.0×10^{-3} mol L^{-1} s^{-1}
    D. $+1.0 \times 10^{-3}$ mol L^{-1} s^{-1}
    E. $+1.7 \times 10^{-3}$ mol L^{-1} s^{-1}

Answer B:
$(3/5)(1.0 \times 10^{-3}) = 0.6 \times 10^{-3}$

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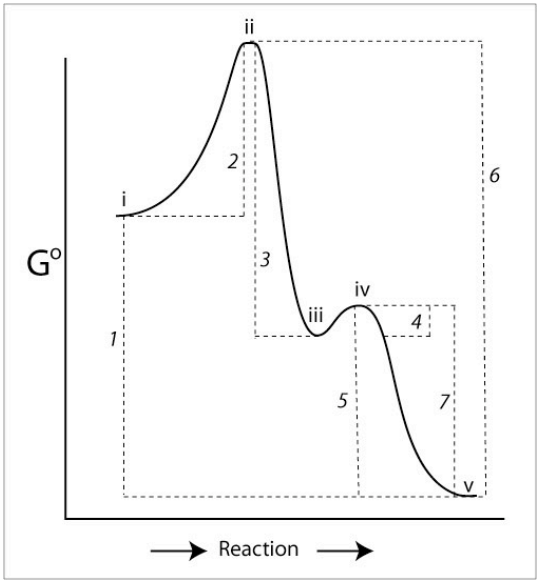
50. Which is correct (see graph)

A. i is the reactant, iii is a transition state, v is the product.
B. v is the reactant, iv is the first transition state, iii is an intermediate, ii is the second transition state, i is the product.
C. iiii is the reactant, ii is the one transition state, iv is another transition state, i and v are products.
D. i is the reactant, ii is the first intermediate, iii is the second intermediate, iv is the third intermediate, v is the product.
E. i is the reactant, ii is the first transition state, iii is the intermediate, iv is the second transition state, v is the product.

Answer: E



51. In the reaction coordinate graph above

A. *1* is $\Delta G^\circ_{reaction}$, *2* is $\Delta G^{\circ\ddagger}_{forward\ first\ step}$, *4* is $\Delta G^{\circ\ddagger}_{forward\ second\ step}$
B. *1* is $\Delta G^\circ_{reaction}$, *2* is $\Delta G^{\circ\ddagger}_{forward\ first\ step}$, *7* is $\Delta G^{\circ\ddagger}_{forward\ second\ step}$
C. *1* is $\Delta G^\circ_{reaction}$, *3* is $\Delta G^{\circ\ddagger}_{forward\ first\ step}$, *4* is $\Delta G^{\circ\ddagger}_{forward\ second\ step}$
D. *6* is $\Delta G^\circ_{reaction}$, *2* is $\Delta G^{\circ\ddagger}_{forward\ first\ step}$, *4* is $\Delta G^{\circ\ddagger}_{forward\ second\ step}$
E. *6* is $\Delta G^\circ_{reaction}$, *1* is $\Delta G^{\circ\ddagger}_{forward\ first\ step}$, *5* is $\Delta G^{\circ\ddagger}_{forward\ second\ step}$

Answer A:

52. From the reaction coordinate graph above

A. $k_{reverse\ second\ step} > k_{forward\ first\ step} > k_{forward\ second\ step}$
B. $k_{forward\ first\ step} > k_{forward\ second\ step} > k_{reverse\ second\ step}$
C. $k_{forward\ second\ step} > k_{forward\ first\ step} > k_{reverse\ first\ step}$
D. $k_{forward\ first\ step} > k_{forward\ second\ step} > k_{reverse\ first\ step}$
E. Cannot be determined

Answer C: $k_{reverse\ second\ step}$ is greater than all other k because the $\Delta G^{\circ\ddagger}$ (iii on graph) for that step is smallest, etc.

53. From the reaction coordinate graph above

A. K = 1
B. K > 1
C. K < 1
D. K cannot be determined

Answer B: Well this makes no sense as written does it? It should have been K=1, K>1, K<1, not K=0, K>0, K<0 (is now fixed). Everyone gets this one right.

54. A moderately spontaneous reaction, with a small forward driving force

A. is necessarily a slow forward reaction.
B. is necessarily a fast forward reaction.
C. is necessarily a slow reverse reaction.
D. is necessarily a fast reverse reaction.
E. None of these are correct

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Answer: E. Don't confuse kinetics and thermodynamics

55. The following data were obtained for the reaction of NO with O_2. Concentrations are in M and rates are in M s^{-1}.

$[NO]_0$	$[O_2]_0$	Initial Rate
1×10^{18}	1×10^{18}	2.0×10^{16}
2×10^{18}	1×10^{18}	8.0×10^{16}
3×10^{18}	1×10^{18}	18.0×10^{16}
1×10^{18}	2×10^{18}	4.0×10^{16}
1×10^{18}	3×10^{18}	6.0×10^{16}

Which of the following is the rate law for this reaction?

A. Rate = $k[NO][O_2]$
B. Rate = $k[NO][O_2]^2$
C. Rate = $k[NO]^2[O_2]$
D. Rate = $k[NO]^2$
E. Rate = $k[NO]^2[O_2]^2$

Answer: C

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Extra Credit: The following questions are worth just two points (2 pt) each!

Consider the gas-phase reaction

$$H_2\,(g) + (1/2)\,O_2\,(g) \rightleftharpoons H_2O\,(g).$$

Standard gas phase thermodynamic information is available:

$\Delta H°_f\,(H_2) = 0.0$ $S°_f\,(H_2) = 131$ J/mol-K
$\Delta H°_f\,(O_2) = 0.0$ $S°_f\,(O_2) = 205$ J/mol-K
$\Delta H°_f\,(H_2O) = -242$ kJ /mol $S°_f\,(H_2O) = 189$ J/mol-K

56. What is $\Delta H°_r$ for this reaction?
A) + 121 kJ/mol B) - 121 kJ/mol C) - 242 kJ/mol D) + 242 kJ/mol
E) Cannot be determined from the information given.
Answer: C

57. What is $\Delta S°_r$ for this reaction?
A) - 44 J/mol-K B) + 44 J/mol-K C) + 147 J/mol-K D) -147 J/mol-K
E) Cannot be determined.
Answer: A
189-(1/2)205-131 = -44

58. What is $\Delta G°_r$ for this reaction at 298K?
A) -255 kJ/mol B) +229 kJ/mol C) -229 kJ/mol D) +255 kJ/mol
E) Cannot be determined.
Answer: C
-242-(298)(-44/1000) = -229

59. For this reaction, at about what temperature is $\Delta G°_r = 0$?
A) 5.5 K B) 5500 K C) 300 K D) 5200 K
E) Cannot be determined.
Answer: B
T=242/.044 = 5500K

60. For this reaction, what is the approximate value of $\ln(K_{eq})$ at T = 1000 K?
A) 24 B) 29 C) 34 D) -24
E) Cannot be determined.
Answer: A
-242-1000(-0.044) = -198 = $-\ln(K_{eq})/RT$
$\ln(K_{eq})$ = (8.31 J/mol K)(1000)(198 kJ mol) = 23.8

61. The maximum work (in absolute value) obtainable from this reaction at 1000 K, and Q = 0.0025 (Q is the reaction quotient) is approximately:
A) 0 kJ/mol B) 150 kJ/mol C) 250 kJ/mol D) 200 kJ/mol
E) Cannot be determined.
Answer: C

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w = -198000 + 8.3*1000ln(0.0025) = -198000 J/mol – 50000 J/mol = -248 kJ/mol

62.

A) This is Test Form "C". My Scantron is filled in completely and correctly.

B) This is Test Form "D". My Scantron is filled in completely and correctly.

C) My Scantron is not filled in completely or correctly probably because I did not bother to bubble in my GT ID (minus 10 points for this answer).

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1 mole atoms = 6.022×10^{23} *atoms*

$h = 6.626x10^{-34}\,Js$ 1 J (Joule) = 1 kg $\frac{m^2}{s^2}$

1 J (Joule) = .0099 L - atm (or 101 J/L - atm)

$c = 3.0x10^{8}\,m/s$

$R = 0.0821\frac{L-atm}{mol-K}$ $R = 8.31\frac{J}{mol-K}$

$P^{o}_{H20,\,373} = 760$ torr $P^{o}_{H20,\,298} = 23.8$ torr

Formal Charge = V – (L + 0.5 S)
V = # valence e⁻; L = # lone pair e⁻; S = # shared e⁻

$P_1 = X_1 \bullet P_1^o$ $X_1 = \frac{n_1}{n_{total}}$

$m = \frac{\text{mol of solute}}{kg \text{ of solvent}}$ $M = \frac{\text{mol of solute}}{L \text{ of solution}}$

$\Delta T_f = -m \bullet K_f$ $\Delta T_b = m \bullet K_b$ $\Pi = MRT$

$q = mC\Delta T$ $q_v = nC_V\Delta T$

$q_p = nC_p\Delta T$ $dS = \frac{dq}{T}$

$\Delta G = \Delta H - T\Delta S$ $\Delta G^o = -RT\ln K$

$\Delta G = \Delta G^o + RT\ln Q$ $K = k_f/k_r$

$T_c = \frac{\Delta H^o}{\Delta S^o}$ $C_{water} = 4.184\frac{J}{g-K}$

$n\lambda = 2d\sin\Theta$

$c = \lambda\nu$ $E = h\nu$ $\lambda = \frac{h}{p}$

$\hat{H}\psi = E\psi$ $\Delta x * m\Delta v \geq \frac{h}{4\pi}$ $E = mc^2$

Maximum Occupancy = $2n^2$

$pH = -\log[H^+]$ $pOH = -\log[OH^-]$

$K_w = K_aK_b$ $pH + pOH = 14$

$HA(aq) \Leftrightarrow H^+(aq) + A^-(aq)$

$K_a = \frac{[H^+][A^-]}{[HA]}$ $pKa = -\log K_a$

$pH = pKa + \log\left(\frac{[base]}{[acid]}\right)$

$K_w = 10^{-14}$ at 25^oC $pKw = 14$ at 25^oC

$B(aq) \Leftrightarrow BH^+(aq) + OH^-(aq)$

$K_b = \frac{[BH^+][OH^-]}{[B]}$

$\Delta E = q + w$

$w = -P_{ext}\Delta V$ $w_{rev} = -nRT\ln\frac{V_f}{V_i}$

Monatomic ideal gas; $C_p = \frac{5}{2}R$ $C_v = \frac{3}{2}R$

$\Delta H = q_p$ (const T)

$KE_{mol} = \frac{3}{2}RT$ $KE_{ave} = \frac{1}{2}m\bar{u}^2$

Rate = $-k[A]^a[B]^b$ $\Delta G°^{\ddagger}_f = -RT\ln k$

integrated rate laws; a=0, b=0: $[A] = -kt + [A]_o$; a=1, b=0: $\ln[A] = -kt + \ln[A]_o$; a=2, b=0: $[A]^{-1} = kt + [A]_o^{-1}$

Final Test Form C Chem 1310 Fall 2008 12/11/2008 Dr. Williams

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The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)