Exam 2 Test Form A Chem 1310 Spring 2008 10/24/2008 Dr. Williams

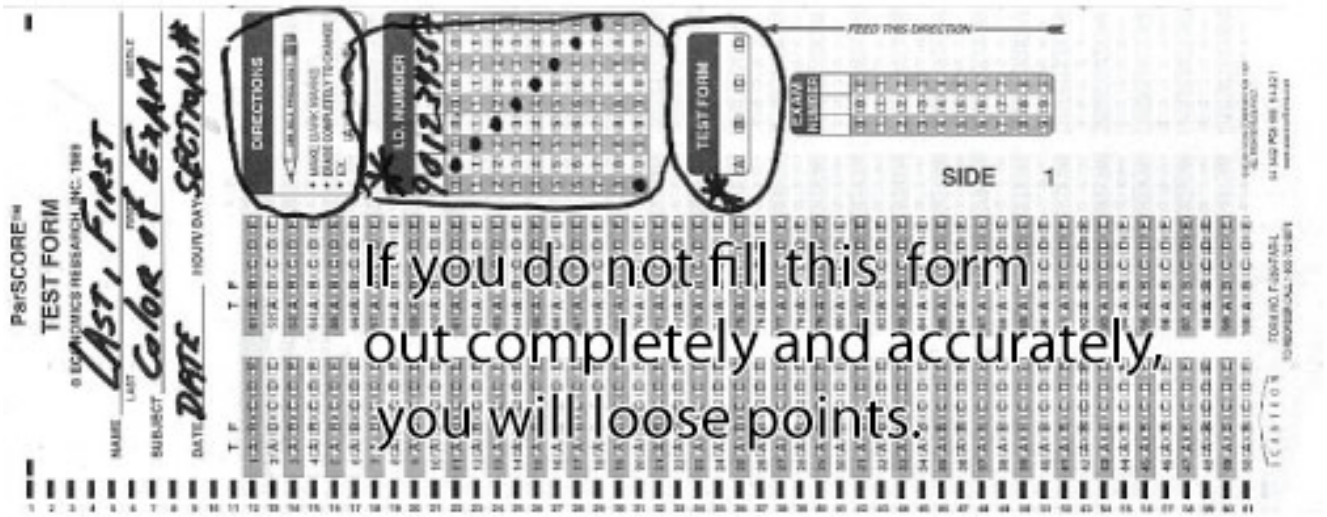
Print Name_____ Signature _____

This test is closed note/book. One 8.5 x 11 handwritten crib sheet (one sided) is 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 50 minutes is allotted for the exam. There are 20 questions. Each is worth five points. Answer every question. There is no penalty for guessing.

Circle Your Section Number

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



1. The reaction for the oxidation of nitric oxide to nitrogen dioxide is

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

If 100 mL of NO reacts completely with 400 mL of O_2 at STP, what is the partial pressure of NO_2 in the final reaction mixture.

A) 1.00 atm
B) 0.29 atm
C) 0.25 atm
D) 0.20 atm
E) 0.33 atm

Answer: D
n_{NO} (initial) = PV/RT = (1 atm)(0.10L)/(0.082 L atm mol^{-1} K^{-1})(298 K)
= NO_2 (final) = 4.1 x 10^{-3} mol
V_f = 0.50 L
$P_f(NO_2)$ = nRT/V_f = (4.1 x 10^{-3} mol)(0.082 L atm mol^{-1} K^{-1})(298 K)/0.50 L) = 0.20 atm

2. If the equilibrium constant for the reaction

$$H_2\ (g) + Cl_2\ (g) \rightleftharpoons 2HCl\ (g)$$

is K_p, then the equilibrium constant for the reaction

$$HCl\ (g) \rightleftharpoons (1/2)H_2\ (g) + (1/2)Cl_2\ (g)$$

is:

A) $\sqrt{K_p}$
B) $\frac{1}{K_p^{\,2}}$
C) $K_p^{\,2}$
D) $\frac{1}{\sqrt{K_p}}$

Answer: D

3. 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 0.08 moles of NO are placed in a 1.0-liter container.

A) The concentration of NO will decrease; the concentrations of N_2 and O_2 will increase.
B) More information is necessary.
C) The concentration of NO will decrease; the concentrations of N_2 and O_2 will remain unchanged.
D) The system will remain unchanged.
E) The concentration of NO will increase; the concentrations of N_2 and O_2 will

decrease.

Answer: A

$Q=P^2_{NO}/P_{O2}P_{N2} = (0.08)^2/(0.4)(0.2) = 0.08$

Q>K, reaction will go to the left (toward reactants)

4. 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) all the same
C) H_2
D) Cl_2
E) CH_4

Answer: B

5. Consider two samples of helium (1 and 2) in separate containers. $V_1 = V_2$, $P_1 = P_2$, $T_1 = 4T_2$ and both 1 and 2 behave ideally.

Calculate the ratio n_1/n_2.

A) 4:1
B) 2:1
C) 1:1
D) 1:2
E) 1:4

Answer: E

$n_1RT_1 = n_2RT_2$ $n_1/n_2 = T_2/T_1 = 1/4$

6. The value of an equilibrium constant can vary with

I. Temperature
II. The nature of the reactants and products.
III. The concentration of the reactants.
IV. The concentration of the products.

A) II, III
B) It is dependent on three of the above choices.
C) It is not dependent on any of the above choices.
D) III, IV
E) I, II

Answer: E

7. 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

Answer: A

8. Identify attractive forces in a pure sample of H_2O.

A) Charge-Charge (Ionic), Hydrogen bonding, London dispersion, Dipole-induced dipole, Charge-induced dipole
B) Hydrogen bonding, London dispersion, Dipole-induced dipole
C) Hydrogen bonding, London dispersion, Dipole-induced dipole, Charge-induced dipole
D) hydrogen bonding, Dipole-induced dipole
E) London dispersion, Dipole-induced dipole, Charge-induced dipole

Answer: B

9. Identify the major attractive force in pure Cl_2.

A) Charge-Charge (Ionic)
B) Hydrogen bonding
C) London dispersion
D) Dipole-induced dipole
E) Charge-induced dipole

Answer: C

10. 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-dipole forces
C) charge-charge (ionic) forces
D) hydrogen bonding
E) Covalent forces

Answer: D

11. Consider the Bragg Equation. If a beam of white visible light (all wavelengths from 400 to 700 nm) is reflected from two parallel mirrors (partially transparent) exactly 400 nm apart, one might expect to see

A) Many closely spaced spots
B) The Fourier Transform of Elvis Presley
C) A few widely spaced spots
D) Rainbows
E) An irregular pattern of spots

Answer: D

12. Consider three 1.0-L flasks at STP. Flask A contains He, flask B contains O_2, and flask C contains N_2. Assume that all three gases are ideal.

In which flask do the gas particles have the lowest average kinetic energy?
A) insufficient information
B) flask C
C) All are the same
D) flask A
E) flask B

Answer: C

13. A sample of 106 g of butanetriol, a non-dissociating, non-volatile liquid with the formula $C_4H_{10}O_3$, is dissolved in 162 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: A
n_{H2O} = 162g/(18g/mol) = 9.0 mol
$n_{butanetriol}$ = 106g/(106g/mole) = 1.0 mol
X_{H2O} = 9/(9+1) = 0.9
$P_{H2O}=X_{H2O}\ P°_{H2O}$ = 0.9(760 torr) = 684 torr

14. For the reaction:

$$aA(g) + bB(g) \rightleftharpoons cC(g) + \text{heat}$$

with a = 1, b=1 and c=3. 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: A

15. Polyethylene is a synthetic polymer with many uses. 1.4 g of polyethylene was dissolved in benzene to a final volume of 100 mL. The osmotic pressure relative to pure benzene was found to be 1.86 torr at 25°C. Determine the molar mass of the polyethylene.
A) 1.1 x 10^8 g/mol

B) 1.2 x 10^4 g/mol
C) 5700 g/mol
D) 3.4 x 10^6 g/mol
E) 1.4 x10^5 g/mol

Answer E $\Pi = MRT$ = 1.86 torr/(760 torr/atm) = 1.4 g (0.082 L-atm/K-mol)(298K) /[(MWt g/m) (0.10 L)]
.0024 atm = 342 atm/(MWt g/m)
MWt=1.4x10^5

16. What is the molality of a solution of 39.6 g of ethanol (CH_3CH_2OH) in 442 mL of water? The density of water is 1 g/ml.
A) 89.6 *m*
B) 0.0350 *m*
C) 1.78 *m*
D) 1.94 *m*
E) 0.0338 *m*

answer D

17. Consider three 1 L flasks containing gases, all at the same temperature and pressure. Flask A contains CO (g), flask B contains N_2 (g), and flask C contains O_2 (g).
Which flask contains the gas with the lowest density?
A) flask A
B) flask B
C) flask C
D) all three are the same
E) two of the flasks contain gases at the same density

Answer E

18. 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

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

answer B

20. This is Test Form (look at the bottom of the page):

A) A
B) B
C) C
D) D

answer A

Formal Charge =
V – (L + 0.5 S)
V = # of Valence Electrons,
L = # of Lone Pair Electrons,
S = # of Shared Electrons

$$Density = \frac{mass}{volume}$$

$$Molarity = M = \frac{\text{mole of solute}}{\text{L of solvent}}$$

$$\text{n (number of moles)} = \frac{\text{mass}}{\text{Molar Mass}}$$

$$M_1V_1 = M_2V_2$$

Bragg Equation

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

$$m = molality = \frac{\text{mol of solute}}{kg \text{ of solvent}}$$

$$M = molarity = \frac{\text{mol of solute}}{\text{volume of solution}}$$

$$X_1 = \text{ mole fraction } = \frac{n_1}{n_{total}}$$

$$\Delta T_f = m \bullet K_f$$

$$\Delta T_b = m \bullet K_b$$

$$\Pi = MRT$$

$$P = X_1 \bullet P^o$$

1 mole = $6.022 \times 10^{23} atoms$

$$h = 6.626x10^{-34} Js$$

$$1 \text{ J (Joule)} = 1 \text{ kg}\frac{m^2}{s^2}$$

$$c = 3.0x10^8 m/s$$

Mass of an Electron = $9.10939 \times 10^{-31} kg$

Mass of a Proton = $1.67 \times 10^{-27} kg$

Mass of a Neutron = $1.67 \times 10^{-27} kg$

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

$$R = 8.31\frac{J}{molK}$$

Vapor Pressure (H_2O, 373K) = 760 torr

$$P_1V_1 = P_2V_2$$

$$V_1T_2 = V_2T_1$$

$$PV = nRT$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$Kelvin = {}^oC + 273.15$$

$$(P + a\frac{n^2}{V^2})(V - nb) = nRT$$

$$P_{total} = P_1 + P_2 + ... + P_n$$

$$KE(mol) = \frac{3}{2}RT \text{ (monoatomic)}$$

$$\text{KE (particle)} = \frac{1}{2}mu^2$$

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)