Chemistry 141 Name

Martin Larter

Exam 2A March 26. 2014

Multiple Choice (30 points)

Page 5 (16 points)

Page 6 (16 points)

Page 7 (15 points)

Page 8 (8 points)

Page 9 (20 points)

Total (105 points)

Chemistry Constants

F = 9.65 x 104 C

h = 6.626 x 10-34 J sec

c= 2.9979 x 108 m/sec

mass electron = 9.109 x 10-31 kg RE = 2.18 x 10-18 J e = 1.602 x 10-19 C

Avogadros number = 6.022 x 1023 /mol R = 0.0821 L atm/mol K = 62.4 L torr/mol K = 8.31 J/mol K

c (H2O) = 4.184 J/g\*K Density of H*2*O(l) = 1.00 g/mL

ΔHfo, B5H9*(l)* = 73.2 kJ/mol

ΔHfo, B2O3*(s)* = −1263.6 kJ/mol

ΔHfo, H2O*(l)* = −285.8 kJ/mol

ΔHfo, H2O *(g)* = −-241.8 kJ/mol

Grossmont College

Periodic Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| IA |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  | VIIA | NOBLE GASES |
| 1  **H**  1.008 | IIA |  |  |  |  |  |  |  |  |  | |  | IIIA | IVA | VA | VIA | 1  **H**  1.008 | 2  **He**  4.002 |
| 3  **Li**  6.941 | 4  **Be**  9.012 |  |  |  |  |  |  |  |  |  | |  | 5  **B**  10.81 | 6  **C**  12.01 | 7  **N**  14.01 | 8  **O**  16.00 | 9  **F**  19.00 | 10  **Ne**  20.18 |
| 11  **Na**  23.00 | 12  **Mg**  24.30 | IIIB | IVB | VB | VIB | VIIB | VIII VIII VIII | | | | IB | IIB | 13  **Al**  27.00 | 14  **Si**  28.09 | 15  **P**  30.97 | 16  **S**  32.06 | 17  **Cl**  35.45 | 18  **Ar**  39.95 |
| 19  **K**  39.10 | 20  **Ca**  40.08 | 21  **Sc**  44.96 | 22  **Ti**  47.90 | 23  **V**  50.94 | 24  **Cr**  52.00 | 25  **Mn**  54.94 | 26  **Fe**  55.85 | 27  **Co**  58.93 | 28  **Ni**  58.70 | | 29  **Cu**  63.55 | 30  **Zn**  65.38 | 31  **Ga**  69.72 | 32  **Ge**  72.59 | 33  **As**  74.92 | 34  **Se**  78.96 | 35  **Br**  79.90 | 36  **Kr**  83.80 |
| 37  **Rb**  85.47 | 38  **Sr**  87.62 | 39  **Y**  88.91 | 40  **Zr**  91.22 | 41  **Nb**  92.91 | 42  **Mo**  95.94 | 43  **Tc**  (99) | 44  **Ru**  101.1 | 45  **Rh**  102.9 | 46  **Pd**  106.4 | 47  **Ag**  107.9 | | 48  **Cd**  112.4 | 49  **In**  114.8 | 50  **Sn**  118.7 | 51  **Sb**  121.8 | 52  **Te**  127.6 | 53  **I**  126.9 | 54  **Xe**  131.3 |
| 55  **Cs**  132.9 | 56  **Ba**  137.3 | 57  **La**  138.9 | 72  **Hf**  178.5 | 73  **Ta**  180.9 | 74  **W**  183.9 | 75  **Re**  186.2 | 76  **Os**  190.2 | 77  **Ir**  192.2 | 78  **Pt**  195.1 | 79  **Au**  197.0 | | 80  **Hg**  200.6 | 81  **Tl**  204.4 | 82  **Pb**  207.2 | 83  **Bi**  209.0 | 84  **Po**  (209) | 85  **At**  (210) | 86  **Rn**  (222) |
| 87  **Fr**  (223) | 88  **Ra**  226.0 | 89  **Ac**  227.0 | 104  **Rf**  (261) | 105  **Db**  (262) | 106  **Sg**  (263) | 107  **Bh**  (262) | 108  **Hs**  (265) | 109  **Mt**  (266) | 110  **??**  (269) |  | |  |  |  |  |  |  |  |

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| 58  **Ce**  140.1 | 59  **Pr**  140.9 | 60  **Nd**  144.2 | 61  **Pm**  (147) | 62  **Sm**  150.4 | 63  **Eu**  152.0 | 64  **Gd**  157.3 | 65  **Tb**  158.9 | 66  **Dy**  162.5 | 67  **Ho**  164.9 | 68  **Er**  167.3 | 69  **Tm**  168.9 | 70  **Yb**  173.0 | 71  **Lu**  175.0 |
| 90  **Th**  232.0 | 91  **Pa**  231.0 | 92  **U**  238.0 | 93  **Np**  (237) | 94  **Pu**  (244) | 95  **Am**  (243) | 96  **Cm**  (247) | 97  **Bk**  (247) | 98  **Cf**  (251) | 99  **Es**  (252) | 100  **Fm**  (257) | 101  **Md**  (258) | 102  **No**  (259) | 103  **Lr**  (260) |

Lanthanide series

Actinide series

Multiple Choice (30 points) – Give the best answer for each of the following questions.

1. Define heat capacity (C).
   1. the quantity of heat required to lower the temperature of 1 gram of a substance by 1°C
   2. the quantity of heat required to raise the temperature of 1 g of a substance by 1°F
   3. the quantity of heat required to lower the temperature of 1 liter of a substance by 1°C
   4. the quantity of heat required to lower the temperature of 1 mole of a substance by 1°C
   5. the quantity of heat required to change a system's temperature by 1°C
2. The law of \_\_\_\_\_\_\_\_ states that energy that can be neither created nor destroyed.
   1. the conservation of energy b) kinetic energy c) enthalpy
3. potential energy e) thermochemistry
4. Choose the reaction that illustrates ΔH°f for CsHCO3.
   1. Cs(s) + H2(g) + C(s) + O2(g) → CsHCO3(s)
   2. Cs+(aq) + HCO3 -1(aq) → CsHCO3(s)
   3. Cs+(aq) + H2O(l) + CO2(g) → CsHCO3(s)
   4. Cs(s) + ½ H2(g) + C(s) + 3/2 O2(g) → CsHCO3(s)
   5. Cs(s) + 2 H(g) + C(s) + 3 O(g) → CsHCO3(s)
5. Which of the following processes is endothermic?
   1. the freezing of water
   2. the combustion of butane
   3. a hot cup of coffee (system) cools on a countertop
   4. the vaporization of rubbing alcohol
   5. the chemical reaction in a "hot pack" often used to treat sore muscles
6. Calculate the change internal energy (ΔE) for a system that is giving off 65.0 kJ of heat and is performing 855 J of work on the surroundings.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. -65.9 kJ | 1. 64.1 kJ | 1. -64.1 kJ | 1. 9.00 x 102 kJ | 1. -9.00 x 102 kJ |

1. Rank the following in order of decreasing rate of effusion.

F2 SF6 He Ar

a) SF6 > Ar > F2 > He b) Ar > He > SF6 > F2 c) F2 > Ar > He > SF6

d) He > F2 > SF6 > Ar e) He > F2 > Ar > SF6

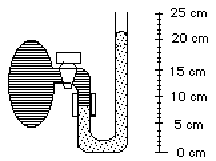
1. A mixture of 1.0 mol He and 1.0 mol Ne are at STP in a rigid container. Which of the following statements is TRUE?
   1. Both gases have the same average kinetic energy.
   2. Both gases contribute equally to the density of the mixture under these conditions.
   3. Both gases have the same molecular speed.
   4. The mixture has a volume of 22.4 L
   5. All of the above are TRUE.
2. Which of the following substances (with specific heat capacity provided) would show the greatest temperature change upon absorbing 100.0 J of heat?

a. 10.0 g Pb, CPb= 0.128 J/g°C b. 10.0 g Cu, CCu = 0.385 J/g°C

c. 10.0 g H2O, CH2O = 4.18 J/g°C d. 10.0 g EtOH, CEtOH = 2.42 J/g°C

e. 10.0 g Al, CAl = 0.903 J/g°C

1. Some assumptions from the kinetic molecular theory are listed below. Which one is most frequently cited to explain compressibility of a gas?
   1. A gas consists of tiny particles moving in random straight line motion.
   2. The volume of the particles is negligible compared to the volume of the gas.
   3. The average kinetic energy of gas particles is proportional to the Kelvin temperature.
   4. Collisions of gas particles are elastic and total kinetic energy of the gas is constant.
   5. None of the above’
2. Which of the following will cause the volume of an ideal gas to triple in value?
3. Raising the temperature from 25°C to 75°C at constant pressure.
4. Lowering the absolute temperature by a factor of 3 at constant pressure.
5. Lowering the pressure by a factor of 3 while the temperature stays constant.
6. Raising the absolute temperature by a factor of 3 while increasing the pressure by a factor of 3.
7. Lowering the absolute temperature by a factor of 3 while increasing the pressure by a factor of 3.
8. There is a gas trapped in the egg-shaped bulb (on the left in the following sketch) by the mercury in a manometer. What is the pressure of the gas if atmospheric pressure is 1.00 atm?



(a) 0.17 atm (b) 0.83 atm (c) 1.00 atm

(d) 1.17 atm (e) 2.00 atm

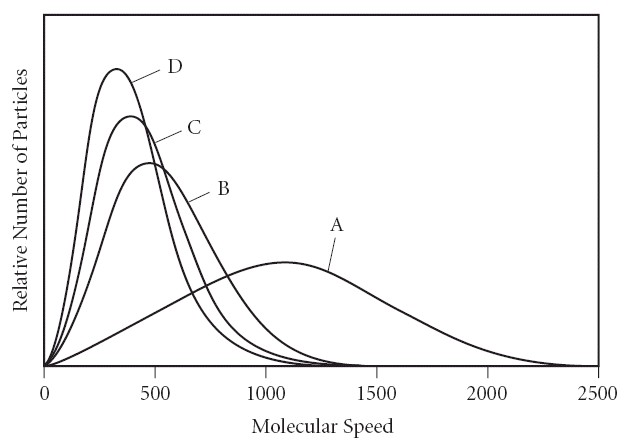
1. Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains C2H4, flask B contains O3, and flask C contains F2. Which flask contains the largest number of molecules?

a. flask A f b. flask B c. flask C d. All contain same number of molecules.

1. Determine the oxidizing agent in the following reaction.

Ni(s) + 2 AgClO4(aq) → Ni(ClO4)2(aq) + 2 Ag(s)

|  |  |  |
| --- | --- | --- |
| * 1. Ni | * 1. Ag | * 1. Cl |
| * 1. O | * 1. This is not an oxidation-reduction reaction | |

1. Which of the gases in the graph at the right has the largest molar mass?
   1. A
   2. B
   3. C
   4. D
   5. There is not enough information to determine.

Problems

1. (10 points) Some CO2 (g) is put in a sealed container at 700 K and a pressure of 10.0 atm and then heated to 1400 K. The pressure rises to 22.5 atm (final pressure) as some of the CO2 decomposes to CO (g) and O2 (g).
2. Write balanced equation for reaction (remember to put in phases)
3. Determine initial pressure of CO2 (g) at 1400 K.
4. Calculate the percentage of CO in the final gas mixture. (If you can’t get part B, ask instructor for default value to do part c)?
5. (6 points) Analysis of an air bubble trapped in amber formed 80 million years ago revealed that the atmosphere before the dinosaurs became extinct was 30.0% O2 and 70.0% N2 (by mass). Calculate the mole fraction and partial pressure (torr) of oxygen in this prehistoric air sample if the total pressure of the air was 1.00 atm.
6. (10 points) Carbon dioxide, CO2, was shown to views through porous plate at a rate of 0.033 moles/ minute. The same quantity of an unknown gas is found to diffuse through the same porous barrier in 104 seconds. Calculate the molecular weight of the unknown gas.
7. Determine Molar mass of unknown gas?
8. What is the density, in g /L, of the unknown gas at STP (if you can’t get part A, ask instructor for default value to do part b and c)?
9. At what Kelvin temperature would the unknown gas have an rms speed of 456.2 m/sec
10. (6 points) A helium balloon is fully inflated at 1.2 L. When the clerk is filling the balloon, she stops to make sure it is not going to explode and checks the pressure. The pressure is 742.8 mm Hg and the temperature at the store is 24oC. The balloon is 950 mL full. She stops when the balloon is 950 ml full and the pressure in the balloon is 729.5 mm Hg. When the customer takes the balloon outside, it explodes. What was the temperature outdoors in Celsius?
11. (4 points) Explain why real gases behave non-ideally at low temperatures and high pressures.
12. (7 points) Consider the reaction of nitrogen dioxide and water to form aqueous nitric acid and nitrogen monoxide gas.

3NO2(*g*) + H2O(*l*) → 2HNO3(*aq*) + NO(*g*) ΔH° = ?

Calculate the ΔH° for this reaction of nitrogen dioxide and water, using the following equations and their ΔH°s. (6 points)

NO(*g*) + ½ O2(*g*) → NO2(*g*) ΔH° = −86.5 kJ

2N2(*g*) + 5O2(*g*) + 2H2O(*l*) → 4HNO3(*aq*) ΔH° = −255 kJ

N2(*g*) + O2(*g*) → 2NO(*g*) ΔH° = 181 kJ

1. (4 points) Most automobile engines are cooled by water circulating through them and a radiator. However, the original Volkswagen Beetle had an air-cooled engine. Why might car designers choose water cooling over air cooling?
2. (8 points) Pentaborane-9, B5H9, is a colorless, highly reactive liquid that will burst into flame when expoed to oxygen. The reaction is

2 B5H9(l) + 12 O2(g) 🡪 5 B2O3(s) + 9 H2O(l)

1. Determine ΔHrxn (Heat of formation data on cover page)
2. Calculate the amount of energy released when a 15.00 g sample of pentaborane-9 is burned in the presence of oxygen.
3. (10 points) The heat of fusion of H2O is 6.00 kJ/mole. The specific heat of ethanol (C2H5OH, molar mass = 46.1) is 2.42 J/g°C and the density of ethanol is 0.788 g/mL. Suppose 45.0 g of ice (i.e., solid H2O) at 0.0 °C is added to 0.500 L of ethanol at 30.0 °C in a well-insulated container. After stirring for some time, all of the ice has melted and a liquid water-ethanol mixture remains. Determine the final temperature (in °C) of the mixture.
4. (10 points) Potassium permanganate solution reacts with sodium oxalate solution in the presence of **sulfuric acid** in an oxidation-reduction reaction. Two of the products of this reaction are the manganese(II) ion and carbon dioxide.

a. Write a balanced net ionic equation for this reaction

MnO4- (aq) + C2O42-(aq)🡪 Mn2+ (aq)+ CO2 (g)

1. If 22.43 mL of 0.03532 M potassium permanganate solution reacts with excess sodium oxalate solution, how many liters of carbon dioxide gas are produced at 759.2 mmHg and 27.5° C?