Chemistry 115 Name

Dr. Cary Willard

Exam 3a April 13, 2011

 Multiple Choice (30 points)

 Page 5 (19 points)

 Page 6 (19 points)

 Page 7 (19 points)

 Page 8 (16 points)

 Total (103 points)

 Percent

All work must be shown to receive credit. Give all answers to the correct number of significant figures

PV=nRT

Avogadros number = 6.022 x 1023 /mol

Ideal gas constant = 0.0821 L atm/mol K

 = 62.4 L torr/mol K

1 atm = 760 torr = 760 mm Hg = 101.3 kPa = 14.7 psi

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

Part I – Multiple Choice (30 points)

Exam 1 multiple choice questions

1. The ability of an atom to attract the shared electrons in a covalent bond is its \_\_\_\_\_\_\_\_.
	1. electronegativity
	2. bonding ability
	3. polarity
	4. ionic character
	5. nonpolarity
2. The bond in Cl2 is a(n) \_\_\_\_\_\_\_\_ bond.
	1. metallic
	2. polar ionic
	3. polar covalent
	4. ionic
	5. nonpolar covalent
3. The VSEPR theory allows us to determine the \_\_\_\_\_\_\_\_.
	1. charge on an ion
	2. color of a compound
	3. shape of a molecule
	4. bond type for a molecule
	5. formula for a compound
4. Which of the following elements has the lowest electronegativity?
	1. C
	2. N
	3. Li
	4. O
	5. F
5. How many covalent bonds will an oxygen atom normally make?
	1. 1
	2. 2
	3. 3
	4. 4
	5. 5
6. Which is the most polar bond in the following list?
	1. O-H
	2. S-O
	3. C-S
	4. I-I
	5. P-H
7. In water, the melting point is unusually high because of
	1. covalent bonds in the individual molecules.
	2. ionic bonds in the individual molecules.
	3. hydrogen bonding between the molecules.
	4. dipole-dipole attractions between the molecules.
	5. the heat content of the hydrogen-oxygen bonds.
8. Hydrogen bonds are a major factor in the structure of \_\_\_\_\_\_\_\_.
	1. DNA
	2. hydrogen chloride
	3. dry ice
	4. air
	5. table salt
9. Water has a boiling point of 100 °C, and alcohol has a boiling point of 78 °C, even though water is a smaller molecule. This large difference in boiling point is due to
	1. weak dipole-dipole attractions in the alcohol molecules.
	2. more hydrogen bonds between the water molecules.
	3. ionic bonds between the water molecules.
	4. covalent bonds in the alcohol molecules.
	5. more hydrogen bonds between the alcohol molecules.
10. When a solid is converted directly to a gas, the change of state is called \_\_\_\_\_\_\_\_.
	1. freezing
	2. melting
	3. boiling
	4. condensation
	5. sublimation
11. Vapor pressure can be described as
	1. the temperature at which bubbles of vapor appear in a liquid.
	2. the pressure exerted on the earth by the particles in the air.
	3. the pressure exerted by a gas above the surface of its liquid.
	4. the temperature at which the vapor pressure of a liquid equals atmospheric pressure.
	5. the pressure within the lungs during inhalation.
12. In response to Boyle's law, the pressure of a gas increases as the volume decreases because
	1. the gas particles get bigger.
	2. the kinetic energy of the gas particles increases.
	3. the temperature of the gas increases.
	4. the gas particles strike the walls of the container with more force.
	5. the gas particles strike the walls of the container more often.
13. What unit of temperature is used in gas law calculations?
	1. Kelvin
	2. Fahrenheit
	3. Celsius
	4. either Celsius or Fahrenheit
	5. either Celsius or Kelvin
14. As you rise higher in Earth's atmosphere, the atmospheric pressure \_\_\_\_\_\_\_\_.
	1. decreases
	2. increases
	3. remains the same
15. A barometer is a device for measuring \_\_\_\_\_\_\_\_.
	1. blood pressure
	2. gas pressure in a container
	3. atmospheric pressure
	4. gas pressure in the lung
	5. vapor pressure

Part 2 – Problems and Short Answer (70 points)

1. (15 points) Given the following balanced equation, answer the questions below:

3 TiO2(s) + 4 BrF3(l) 🡪 3 TiF4(s) + 2 Br2(l) + 3 O2(g)

* 1. (3 points) How many formula units of TiF4 will be produced by the reaction of 32 molecules of BrF3 with excess TiO2?

$$?units TiF\_{4}=32 molec BrF\_{3}×\frac{3 units TiF\_{4} }{4 molec BrF\_{3}}=24 units TiF\_{4}$$

* 1. (3 points) How many moles of BrF3 are required to react with 5.97 moles of TiO2?

$$?mol BrF\_{3}=5.97 mol TiO\_{2}×\frac{4 mol BrF\_{3}}{3 mol TiO\_{2}}=7.96 mol BrF\_{3} $$

* 1. (4 points) How many molecules of BrF3 are required to make 52.4 grams of oxygen gas (O2)?

$$?molec BrF\_{3}=52.4 g O\_{2}×\frac{1 mol O\_{2}}{32.00 g O\_{2}}×\frac{4 mol BrF\_{3} }{3 mol O\_{2}}×\frac{6.02×10^{23}molec BrF\_{3}}{1 mol BrF\_{3}}=1.31×10^{24}molec BrF\_{3} $$

* 1. (5 points) If 5.73 grams of bromine (Br2) are formed from the reaction of 7.00 grams of titanium(IV) oxide (TiO2) and 7.00 grams of bromine trifluoride (BrF3), what is the percent yield?

$$?g Br\_{2}=7.00 g TiO\_{2}×\frac{1 mol TiO\_{2}}{79.88 g TiO\_{2}}×\frac{3 mol Br\_{2}}{3mol TiO\_{2}}×\frac{159.8 g Br\_{2}}{1 mol Br\_{2}}=14.0 g Br\_{2} $$

$$?g Br\_{2}=7.00 g BrF\_{3}×\frac{1 mol BrF\_{3}}{136.9 g BrF\_{3}}×\frac{3 mol Br\_{2}}{4 mol BrF\_{3}}×\frac{159.8 g Br\_{2}}{1 mol Br\_{2}}=6.12 g Br\_{2} $$

$$\% yield=\left(\frac{5.73 g Br\_{2} }{6.12 g Br\_{2}}\right)×100=93.6\% yield$$

1. (4 points) How do endothermic reactions differ from exothermic reactions? How would you design an experiment to determine whether a reaction was endothermic or exothermic?

Endothermic reactions require heat to proceed and exothermic reactions generate heat. To determine whether a reaction was endothermic or exothermic I would test to see if the reaction increased the temperature of the environment (exothermic) or decreased it (endothermic).

1. (6 points) Draw Lewis Electron Dot Structures for the following molecules.
	1. CBr4

* 1. CS2

1. (5 points) Draw Lewis Electron Dot Structures for the thiocyanate ion (SCN-1). Include reasonable resonance structures. (carbon is the central atom)



1. (8 points) Predict the orbital or molecular geometry of the numbered atoms:

Orbital geometry P1  tetrahedral

Molecular geometry S2 bent

Orbital geometry N3 trigonal planar

Molecular geometry C4 linear

1. (3 points) What are intermolecular forces and how are they different than covalent bonds?

Intermolecular forces and the forces that hold one molecule close to another. They are forces holding one atom close to another not covalent bonds which hold one atom close to another in a molecule.

1. (4 points) Give an example of a non-polar molecule. What kind of intermolecular forces are most important in this molecule?

Cl2 is non-polar. Non-polar molecules such as chlorine gas are have dispersion forces only.

1. (4 points) Glycerol has a higher viscosity than water. What can you say about the relative strength of the intermolecular forces in the two compounds? Which has a higher boiling point?

Glycerol must have stronger intermolecular forces because it is more viscous. The glycerol should also have the higher boiling point.

1. (4 points) Explain why a sealed bag of chips expands when you take it to a higher altitude.

As you go to higher altitude, the atmospheric pressure decreases. With reduced pressure, the volume of the bag of chips increases.

1. (4 points) A 0.427 mol sample of helium gas is pumped into a balloon and its volume is 7.39 L. How many more moles of helium must be pumped into the balloon to increase its volume to 12.5 L? (Pressure and temperature are constant)

$$PV=nRT$$

$$\frac{V\_{1}}{n\_{1}}=\frac{V\_{2}}{n\_{2}} \rightarrow \rightarrow n\_{2}=n\_{1}\left(\frac{V\_{2}}{V\_{1}}\right)=0.427 mol\left(\frac{12.5 L}{7.39 L}\right)=1.24 mol He$$

 Total moles of helium in balloon 0.722 mol moles He added 0.295 mol

1. (4 points) A sample of a gas has an initial volume of 37.2 L at a pressure of 6.44 atm and a temperature of 51oC. If the pressure is increased to 8.72 atm and the temperature is increased to 77oC, what will the volume of the gas?

$$PV=nRT$$

$$\frac{P\_{1}V\_{1}}{T\_{1}}=\frac{P\_{2}V\_{2}}{T\_{2}}\rightarrow \rightarrow V\_{2}=V\_{1}\left(\frac{P\_{1}}{P\_{2}}\right)\left(\frac{T\_{2}}{T\_{1}}\right)=37.2 L\left(\frac{6.44 atm}{8.72 atm}\right)\left(\frac{350 K}{324 K}\right)=29.7 L$$

1. (4 points) What is the mass of 3.76 L of chlorine gas (Cl2) in a 4.62 L tank with a pressure of 38.5 atm at a temperature of 27oC?

$$PV=nRT\rightarrow \rightarrow n=\frac{PV}{RT}=\frac{\left(38.5 atm\right)\left(4.62 L\right)mol K}{\left(0.0821 L atm\right)\left(300 K\right)}=7.22 mol Cl\_{2}$$

$$?g Cl\_{2}=7.22 mol Cl\_{2}×\frac{70.9 g Cl\_{2}}{1 mol Cl\_{2}}=512 g Cl\_{2} $$

1. (4 points) Nitrogen dioxide reacts with water to produce oxygen and ammonia.

4 NO2(g) + 6 H2O(g) 🡪 7 O2(g) + 4 NH3(g)

How many liters of oxygen gas can be produced by the complete reaction of 5.34 L of NO2 with excess water at 3.50 atm pressure and 41.3oC?

$$?L O\_{2}=5.34 L H\_{2}O×\frac{7 L O\_{2}}{6 L H\_{2}O}=6.23 L O\_{2}$$

1. (4 points) A gas mixture contains each of the following gases at the indicated partial pressure. N2 (586 torr), O2 (375 torr), and H2(878 torr). What is the total pressure of the mixture in atm?

$$total pressure=586 torr N\_{2}+375 torr O\_{2}+ 878 torr H\_{2}=1839 torr$$

$$?atm=1839 torr×\frac{1 atm}{760 torr}=2.420 atm$$