Chemistry 115 Name

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Exam 3a November 15, 2010

 Multiple Choice (30 points)

 Page 5 (17 points)

 Page 6 (19 points)

 Page 7 (15 points)

 Page 8 (19 points)

 Total (100 points)

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. When iron oxide is heated with aluminum, one of the products is molten iron, and much smoke and light are given off. The reaction can be classified as a(n) \_\_\_\_\_\_\_\_ reaction.
	1. endothermic
	2. exothermic
	3. decomposition
	4. potential
	5. fusion
2. The ability of an atom to attract the shared electrons in a covalent bond is its \_\_\_\_\_\_\_\_.
	1. bonding ability
	2. polarity
	3. ionic character
	4. nonpolarity
	5. electronegativity
3. Which of the following substances contains a nonpolar bond?
	1. H2O
	2. NaCl
	3. NH3
	4. N2
	5. MgF2
4. How many covalent bonds will a hydrogen atom normally make?
	1. 1
	2. 2
	3. 3
	4. 4
	5. 5
5. When two or more equivalent dot structures can be written for a given molecule it is said to have \_\_\_\_\_\_\_\_ structures.
	1. equal
	2. identical
	3. polar
	4. resonance
	5. electronegative
6. Hydrogen bonds are a major factor in the structure of \_\_\_\_\_\_\_\_.
	1. hydrogen chloride
	2. dry ice
	3. DNA
	4. air
	5. table salt
7. 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
8. The main interactions between molecules of methane, CH4, are \_\_\_\_\_\_\_\_.
	1. ionic bonds
	2. hydrogen bonds
	3. dispersion forces
	4. dipole-dipole attractions
	5. none of the above
9. Of the five elements Na, Al, S, Cl, F, the most electronegative is \_\_\_\_\_\_\_\_.
	1. F
	2. Na
	3. Al
	4. S
	5. Cl
10. The force of gas particles against the walls of a container is called \_\_\_\_\_\_\_\_.
	1. pressure
	2. volume
	3. temperature
	4. quantity of gas
	5. density
11. According to the kinetic molecular theory of gases, a gas can be compressed much more than a liquid or solid because
	1. a gas is composed of very small particles.
	2. the particles of a gas are very far apart.
	3. gas particles move rapidly.
	4. gas particles do not attract or repel one another.
	5. gas particles move faster when the temperature increases.
12. The boiling point of water at sea level is 100 °C. At higher altitudes, the boiling point of water will be
	1. lower, because temperatures are lower.
	2. higher, because there are fewer water molecules in the air.
	3. lower, because the atmospheric pressure is lower.
	4. higher, because the altitude is greater.
	5. the same, because water always boils at 100 °C.
13. What unit of temperature is used in gas law calculations?
	1. Fahrenheit
	2. Kelvin
	3. Celsius
	4. either Celsius or Fahrenheit
	5. either Celsius or Kelvin
14. In Gay-Lussac's law, the pressure of a gas increases due to an increase in temperature because
	1. the molecules strike the walls of the container less often.
	2. the molecules get bigger.
	3. there is a decrease in the volume of the container.
	4. the molecules strike the walls of the container harder and more often.
	5. there is an increase in the number of gas particles.
15. The pressure exerted by a gas on its container is directly proportional to
	1. the volume of the container.
	2. the number of molecules of gas in the sample.
	3. the mass of the individual gas molecules.
	4. the Celsius temperature of the gas.
	5. the Fahrenheit temperature of the gas.

Part 2 – Problems and Short Answer (70 points)

1. (17 points) Given the following balanced equation, answer the questions below:

4 Al*(s)* + 3 O2*(g)* 🡪 2 Al2O3*(s)*

* 1. How many formula units of Al2O3 will be produced by the reaction of 18 molecules of O2 with excess Al?

$$?units Al\_{2}O\_{3}=18 molec O\_{2}×\frac{2 units Al\_{2}O\_{3} }{3 molec O\_{2}}=12 units Al\_{2}O\_{3}$$

* 1. How many moles of O2 are required to react with 8.36 moles of aluminum?

$$?mol O\_{2}=8.36 mol Al×\frac{3 mol O\_{2}}{4 mol Al}=6.27 mol O\_{2} $$

* 1. How many grams of aluminum oxide will be formed by the reaction of 5.99 g of Al with excess O2?

$$?g Al\_{2}O\_{3}=5.99 g Al×\frac{1 mol Al}{26.98 g Al}×\frac{2 mol Al\_{2}O\_{3}}{4 mol Al}×\frac{101.96 g Al\_{2}O\_{3}}{1 mol Al\_{2}O\_{3}}=11.3 g Al\_{2}O\_{3} $$

* 1. How many molecules of oxygen gas (O2) are required to make 24.8 grams of Al2O3?

$$?molec O\_{2}=24.8 g Al\_{2}O\_{3}×\frac{1 mol Al\_{2}O\_{3}}{101.96 g Al\_{2}O\_{3}}×\frac{3 mol O\_{2} }{2 mol Al\_{2}O\_{3}}×\frac{6.02×10^{23}molec O\_{2}}{1 mol O\_{2}}=2.20×10^{23}molec O\_{2} $$

* 1. If 70.0 grams of aluminum oxide are formed from the reaction of 40.0 grams of aluminum and 40.0 grams of oxygen gas, what is the percent yield?

$$?g Al\_{2}O\_{3}=40.0 g Al×\frac{1 mol Al}{26.98 g Al}×\frac{2 mol Al\_{2}O\_{3}}{4 mol Al}×\frac{101.96 g Al\_{2}O\_{3}}{1 mol Al\_{2}O\_{3}}=75.6 g Al\_{2}O\_{3}$$

$$?g Al\_{2}O\_{3}=40.0 g O\_{2}×\frac{1 mol O\_{2}}{16.00 g O\_{2}}×\frac{2 mol Al\_{2}O\_{3}}{3 mol O\_{2}}×\frac{101.96 g Al\_{2}O\_{3}}{1 mol Al\_{2}O\_{3}}=85.0 g Al\_{2}O\_{3}$$

$$\% yield=\left(\frac{70.0 g Al\_{2}O\_{3} }{75.6 g Al\_{2}O\_{3}}\right)×100=92.6\% Al\_{2}O\_{3}$$

1. (6 points) Draw Lewis Electron Dot Structures for the following molecules.
	1. OF2

* 1. C2H2

1. (5 points) Draw Lewis Electron Dot Structures for the nitrite ion (NO2-1). Include resonance structures as necessary.

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

molecular geometry S1 bent

Orbital geometry C2 tetrahedral

Orbital geometry C3 linear

Molecular geometry N4 trigonal pyramidal

1. (7 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. 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. Give an example of a molecule that can form hydrogen bonds and draw a structure to show the hydrogen bonding.

Water will hydrogen bond

1. (4 points) Formaldehyde boils at a lower temperature than ethylene glycol. What can you say about the relative strength of the intermolecular forces in the two compounds? Which is more volatile?

Ethylene glycol must have stronger intermolecular forces because it is harder to evaporate. The formaldehyde is more volatile because it evaporates more easily.

1. (4 points) Explain why scuba divers should not hold their breath as they ascend to the surface.

As a diver ascends to the surface, the pressure decreases and the volume of air in the lungs increases. If the diver holds their breath, their lungs will burst.

1. (4 points) A 0.533 mol sample of helium gas occupies a volume of 7.39 L. What is the volume of 0.381 mol of helium under the same conditions?

$$PV=nRT$$

$$\frac{V\_{1}}{n\_{1}}=\frac{V\_{2}}{n\_{2}} \rightarrow \rightarrow V\_{2}=V\_{1}\left(\frac{n\_{2}}{n\_{1}}\right)=7.39 L\left(\frac{0.381 mol}{0.533 mol}\right)=5.28 L He$$

1. (4 points) A balloon will burst if the volume exceeds 3.40 L. If 2.96 L of helium are put into the balloon at a temperature of 15oC, how high can the temperature go (oC) before it will burst?

$$PV=nRT$$

$$\frac{V\_{1}}{T\_{1}}=\frac{V\_{2}}{T\_{2}}\rightarrow \rightarrow T\_{2}=T\_{1}\left(\frac{V\_{2}}{V\_{1}}\right)=288K\left(\frac{3.40}{2.96}\right)=331K or 58℃$$

1. (4 points) A sample of a gas with an initial volume of 37.2 L at a pressure of 6.44 atm and a temperature of 41oC is compressed to a new volume of 23.6 L at a temperature of 28oC. What is the new pressure of the gas?

$$PV=nRT$$

$$\frac{P\_{1}V\_{1}}{T\_{1}}=\frac{P\_{2}V\_{2}}{T\_{2}}\rightarrow \rightarrow P\_{2}=P\_{1}\left(\frac{V\_{1}}{V\_{2}}\right)\left(\frac{T\_{2}}{T\_{1}}\right)=6.44 atm\left(\frac{37.2 L}{23.6 L}\right)\left(\frac{301 K}{314 K}\right)=9.73 atm$$

1. (4 points) What is the pressure in atmospheres of a 3.66 L sample of methane gas containing 18.7 grams of methane at a temperature of 27oC?

$$?mol CH\_{4}=18.7 g CH\_{4}×\frac{1 mol CH\_{4}}{16.04 g CH\_{4}}=1.17 mol CH\_{4} $$

$$PV=nRT\rightarrow \rightarrow P=\frac{nRT}{V}=\frac{\left(1.17 mol\right)\left(0.0821 L atm\right)\left(295 K\right)}{\left(3.66 L\right)mol K}=7.85 atm$$

1. (3 points) A gas mixture contains each of the following gases at the indicated partial pressure. N2 (714 torr), O2 (261 torr), and H2(386 torr). What is the total pressure of the mixture?

$$total pressure=285 torr N\_{2}+539 torr O\_{2}+ 377 torr H\_{2}=1361 torr$$