Chemistry 115 Name

Dr. Cary Willard

Exam 3B April 26, 2010

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|  | Points Earned | Points Possible |
| Part 1 multiple choice |  | 30 |
| Page 2  |  | 14 |
| Page 3 |  | 18 |
| Page 4 |  | 14 |
| Page 5 |  | 17 |
| Page 6 |  | 12 |
|  |  |  |
| Total |  | 105 |

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

NA = 6.022 x 1023/mol

PV=nRT

R=0.0821 L atm/mol K= 62.4 L torr.mol K

760 torr = 760 mm Hg = 1.00 atm = 101 kPa = 14.7 psi = 29.9 in Hg

K = oC+273.16

0oC=273.16 K

Part 1 – Multiple Choice (30 points)

1. The characteristic bright line spectrum of an element is produced when electron(s)
	1. Move to higher energy levels
	2. Fall back to lower energy levels
	3. Are emitted as gamma radiation
	4. Are absorbed into the nucleus
2. Which does not exist as an electron sublevel?
	1. 3d
	2. 3p
	3. 3s
	4. 3f
3. What is the maximum number of electrons that can occupy the 4f sublevel?
	1. 2
	2. 6
	3. 14
	4. 10
4. How many valence electrons are present in the element with the following ground state electron configuration?

1s2 2s2 2p3

* 1. 2
	2. 5
	3. 3
	4. 7
1. A Cl-1 ion has an electron configuration similar to that of
	1. Neon
	2. Argon
	3. Krypton
	4. Xenon
2. Which type of chemical bond involves the unequal sharing of electrons?
	1. Polar covalent
	2. Nonpolar covalent
	3. Ionic
3. A bond that is principally ionic will form between
	1. Magnesium and chlorine
	2. Silicon and phosphorus
	3. Selenium and oxygen
	4. Oxygen and nitrogen
4. Which series is ranked in order of increasing electronegativity?
	1. Cl, S, P, Si
	2. Sr, Sn, N, O
	3. C, Si, P, Se
	4. O, S, Se, Te
5. Which can be greatly compressed?
	1. Br2(l)
	2. CaO(s)
	3. Ar(g)
	4. Mg(s)
6. The volume of a gas must always decrease when
	1. Temperature increases and pressure increases
	2. Temperature increases and pressure decreases
	3. Temperature decreases and pressure increases
	4. Temperature decreases and pressure decreases
7. What volume of sulfur dioxide gas will be consumed when 12.0 L of oxygen is consumed in the following equation?

2 SO2 + O2 → 2 SO3

* 1. 6.00 L
	2. 12.0 L
	3. 24.0 L
	4. 60.0 L
1. Which phase change is sublimation?
	1. Solid to gas
	2. Liquid to gas
	3. Gas to liquid
	4. Solid to liquid
2. As the attractive forces between the molecules of a liquid increase, its surface tension
	1. Increases
	2. Decreases
	3. Remains the same
3. At which external pressure will water boil at the highest temperature?
	1. 0.5 atm
	2. 1 atm
	3. 1.5 atm
	4. 2.0 atm
4. The high boiling point of water is due to
	1. Polar covalent bonds
	2. Hydrogen bonds
	3. Nonpolar covalent bonds
	4. Ionic bonds

**Part 2 –Problems and Questions (70 points)**

1. (4 points) Write the complete electron configuration for silicon.

Cl 1s2 2s2 2p6 3s2 3p2

1. (6 points) Write the shorthand electron configuration for technetium (Tc).

Tc [Kr] 5s2 4d5

Write the electron configuration of a Tc+2 ion.

Tc [Kr] 4d5

1. (4 points) What is unique about the noble gases, from an electron point of view?

A nobel gas has a completely filled outer or valence shell. This means that it is not at all reactive

1. (4 points) Which has a larger radius, a calcium atom or a calcium ion? Explain your reasoning.

A calcium ion is smaller than a calcium atom. They both have the same number of protons, but the calcium ion has fewer electrons so it is smaller.

1. (4 points) What are valence electrons?

Valence electrons are the outer most electrons in a atom. They have the highest quantum numbers.

1. (10 points) Draw a Lewis electron dot structure for the following atoms/molecules. Be sure to show all bonds and lone pairs.
	1. N



* 1. OF2 (O is the central atom)



* 1. CO3-2 (C is the central atom. Show all three resonance structures.)



1. (4 points) Rank the following elements in order of increasing atomic radius. As, Cl, Ga, P

\_\_\_\_\_\_\_<\_\_\_\_\_\_\_<\_\_\_\_\_\_\_<\_\_\_\_\_\_\_

\_\_\_\_Cl\_\_\_<\_\_\_P\_\_\_\_<\_\_\_As\_\_\_\_<\_\_\_Ga\_\_\_\_

1. (6 points) Tell the orbital and molecular geometry of the central atom for each of the following structures.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
| Orbital geometryLinear  | Orbital geometryTetrahedral  | Orbital geometryTrigonal planar |
| Molecular geometryLinear  | Molecular geometryTrigonal pyramidal | Molecular geometryBent  |

1. (4 points) If the pressure of air in a tire is 4.15 atm, what is the pressure in psi? In torr?

$$?atm=4.15 atm×\frac{760 torr}{1 atm}=$$

$$?psi=4.15 atm×\frac{14.7 psi}{1 atm}=$$

1. (4 points) A 250.0 L collapsible tank is filled with argon gas at a pressure of 742 torr. The tank is then submerged in the ocean to a depth of 62 meters where the pressure is 5324 torr. What is the new volume of the tank?

$$P\_{1}V\_{1}=P\_{2}V\_{2}\rightarrow \rightarrow V\_{2}=V\_{1}\left(\frac{P\_{1}}{P\_{2}}\right)=250.0 L\left(\frac{742 torr}{5324 torr}\right)=$$

1. (5 points) A tank of ammonia gas is filled with 21.5 moles of ammonia at a pressure of 5.28 atm and 25oC. If some of the ammonia is used to manufacture fertilizer and the new pressure of the ammonia gas is 3.16 atm at a temperature of 36oC, how many moles of ammonia remain in the tank? (Be careful with your algebra! It is easy to make a mistake!)

$$\frac{P\_{1}V\_{1}}{n\_{1}T\_{1}}=\frac{P\_{2}V\_{2}}{n\_{2}T\_{2}}\rightarrow \rightarrow n\_{2}=n\_{1}\left(\frac{P\_{2}}{P\_{1}}\right)\left(\frac{T\_{1}}{T\_{2}}\right)=21.5 mol\left(\frac{3.16 atm}{5.28 atm}\right)\left(\frac{298 K}{309 K}\right)=$$

1. (4 points) Explain using kinetic theory why the pressure of a gas increases when the number of moles of gas increases.

As the number of moles of gas increase, the number of collisions with the wall of the container increase thus increasing the pressure.

1. (4 points) A mixture contains H2 at 600 torr pressure, N2 at 200 torr pressure, and O2 at 300 torr pressure. What is the total pressure of the gases in the system in torr?

$$total pressure=600 torr H\_{2}+ 200 torr N\_{2}+ 300 torr O\_{2}=1100 torr$$

1. (8 points) A sample of methane gas, CH4, occupies a volume of 5.23 L at 37oC and 2.05 atm pressure.
	1. How many moles of methane are in the sample

P = 2.05 atm

V = 5.23 L

T = 37oC + 273 = 310 K

$$PV=nRT$$

$$n=\frac{PV}{RT}=\frac{\left(5.23 L\right)\left(2.05 atm\right)mol K}{\left(0.0821 L atm\right)\left(310 K\right)}=0.421 mol CH\_{4} $$

* 1. What is the mass of the sample of methane gas

$$?g CH\_{4}=0.421 mol CH\_{4}×\frac{16.04 g CH\_{4}}{1 mol CH\_{4}}=6.75 g CH\_{4}$$

* 1. How many molecules of methane are in the sample?

$$?molecules CH\_{4}=0.421 mol CH\_{4}×\frac{6.022×10^{23}molecules CH\_{4}}{1 mol CH\_{4}}=2.53×10^{23}molecules CH\_{4}$$

1. (4 points) Calculate the volume of water, H2O,, that can be produced by the reaction of 6.44 L of ammonia gas (NH3) reacting with excess oxygen gas at 25oC and 470 torr.

5 O2(g) + 4 NH3(g) 🡪 4 NO(g) + 6 H2O(g)

$$?L NH\_{3}=6.44 L NH\_{3}×\frac{6 L H\_{2}O}{4 L NH\_{3}}=$$

Grossmont College

Periodic Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 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) |