Chemistry 115 Name

Dr. Cary Willard

Exam 3a May 1, 2014

 Multiple Choice (30 points)

 Page 5 (24 points)

 Page 6 (16 points)

 Page 7 (17 points)

 Page 8 (13 points)

 Total (100 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)

1. How many orbitals are contained in the 2p sublevel?
	1. 1
	2. 3
	3. 4
	4. 2
2. How many valence electrons are present in the element with the following ground state electron configuration?

1s2 2s2 2p3

* 1. 2
	2. 7
	3. 3
	4. 5
1. Which element is a transition element?
	1. Co
	2. K
	3. Ca
	4. Kr
2. What is the number of valence electrons in a halogen?
	1. 2
	2. 7
	3. 8
	4. 5
3. The maximum number of electrons that can fit into a single d orbital is
	1. 10
	2. 5
	3. 2
	4. 6
4. A mixture of gases consists of helium at a partial pressure of 400. torr, neon at a partial pressure of 300. torr, and argon at a partial pressure of 200. torr. What is the total pressure of this mixture of gases?
	1. 760. torr
	2. 300. torr
	3. 900. torr
	4. 1000 torr
5. Atoms of the metallic elements generally form ions by
	1. Losing electrons, forming positive ions
	2. Gaining electrons, forming positive ions
	3. Gaining electrons, forming negative ions
	4. Losing electrons, forming negative ions
6. When potassium fluoride forms from a potassium atom and a fluorine atom
	1. An electron is transferred from the fluorine atom to the potassium atom
	2. A proton is transferred from the potassium atom to the fluorine atom
	3. A proton is transferred from the fluorine atom to the potassium atom
	4. An electron is transferred from the potassium atom to the fluorine atom
7. Which element forms an ion that is larger than its atom?
	1. Lithium
	2. Fluorine
	3. Calcium
	4. Chromium
8. A Cl-1 ion has an electron configuration similar to that of
	1. Neon
	2. Argon
	3. Krypton
	4. Xenon
9. Carbon dioxide is a nonpolar molecule because
	1. The molecule has a linear shape with the carbon in the middle
	2. Oxygen is more electronegative than carbon
	3. The two oxygen atoms are bonded to the carbon atom
	4. The carbon-oxygen bonds are polar covalent
10. Which consists of molecules that are relatively far apart?
	1. Fe(s)
	2. HOH(l)
	3. Ne(g)
	4. Hg(l)
11. As the temperature of a gas sample increases, the number of molecules and volume remaining constant, the pressure exerted by the gas
	1. Decreases
	2. Increases
	3. Remains the same
12. 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 decreases
	4. Temperature decreases and pressure increases
13. At STP, which sample contains twice the number of molecules found in 4.00 L of hydrogen gas?
	1. 1.00 L of He
	2. 2.00 L of He
	3. 4.00 L of He
	4. 8.00 L of He

Part 2 – Problems and Short Answer (70 points)

1. (4 points) Write the complete electron configuration for an atom of chlorine. How many valence electrons does chlorine have?

1s2 2s2 2p6 3s2 3p5

7 valence electrons

1. (4 points) Write the shorthand electron configuration for an atom of molybdenum (Mo) as predicted by the periodic table.

[Kr] 5s2 4d4

1. (4 points) How is the line spectra of an atom produced? (Answer this on an atomic level)

When an electron drops from a higher energy lever to a lower energy lever it releases energy in the form of light. The line spectra represent these light emissions.

1. (4 points) Explain how an ionic bond differs from a covalent bond.

Ionic bonds are formed by the electrostatic attraction between a positively charged cation and a negatively charged anion.

Covalent bonds are formed by the sharing of electrons between two atoms.

1. (8 points) Choose the element/ion for each of the following:
	1. Which element has the higher ionization energy, K or Se?

Se

* 1. Which element has the larger radius, O or Sr?

Sr

* 1. Which element is more electronegative, Ca or N?

N

* 1. Which is larger, a beryllium atom (Be) or a beryllium ion (Be+2)?

Be

1. (8 points) Draw Lewis Electron Dot Structures for the following atoms/molecules.
	1. P



* 1. C2H4 (Carbons are joined together and 2 hydrogens are attached to each carbon atom.)



* 1. CH2O (Carbon is the central atom.)



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

Orbital geometry Ca  trigonal planar

Orbital geometry Cb tetrahedral

Molecular geometry Sc  bent

Molecular geometry Nd  trigonal pyramid

1. (5 points) Draw Lewis Electron Dot Structures for the nitrite ion (NO3−). Include reasonable resonance structures. (nitrogen is the central atom)



1. (8 points) A 35.0 L flask is filled with methane gas (CH4) at a pressure of 8.64 atm and a temperature of 42oC.
	1. How many moles of methane are contained in the flask?

$$PV=nRT\rightarrow \rightarrow n=\frac{PV}{RT}=\frac{\left(8.64 atm\right)\left(35.0 L\right)mol K}{\left(0.0821 L atm\right)\left(315 K\right)}=11.7 mol CH\_{4}$$

* 1. What is the pressure (in torr) of methane in the flask?

$$?torr=8.64 atm×\frac{760 torr}{1 atm}=6570 torr$$

* 1. If the temperature of the methane were raised to 79oC, what would the new pressure of the methane be?

$$PV=nRT\rightarrow \rightarrow R=\frac{PV}{nT}\rightarrow \rightarrow \frac{P\_{1}}{T\_{1}}=\frac{P\_{2}}{T\_{2}}$$

$$P\_{2}=P\_{1}\left(\frac{T\_{2}}{T\_{1}}\right)=8.64 atm\left(\frac{352 K }{315 K}\right)=9.65 atm (7340 torr)$$

1. (4 points) Hexane gas burns in the presence of oxygen gas to produce water and carbon dioxide.

2 C6H14 (g) + 19 O2(g) 🡪 14 H2O(g) + 12 CO2(g)

How many L of water will be produced if 7.00 L of hexane are burned in the presence of excess oxygen gas if the pressure and temperature are held constant?

$$?L H\_{2}O=7.00 L C\_{6}H\_{14}×\frac{14 L H\_{2}O}{2 L C\_{6}H\_{14}}=49.0 L H\_{2}O$$

1. (5 points) What is the density of a sample of carbon tetrabromide gas (CBr4) at a pressure of 3.88 atm and a temperature of 55oC?

$$density=\frac{g CBr\_{4}}{L CBr\_{4}}=\frac{331.6 g CBr\_{4}}{1 mol CBr\_{4}}×\frac{1 mol}{6.94 L}=47.8 g CBr\_{4}/L$$

Find n/V or V/n

$$PV=nRT\rightarrow \rightarrow \frac{V}{n}=\frac{RT}{P}=\frac{\left(0.0821 L atm\right)\left(328 K\right) }{\left(3.88 atm\right)mol K}=\frac{6.94 L}{1 mol}$$

$$PV=nRT\rightarrow \rightarrow \frac{n}{V}=\frac{P}{RT}=\frac{\left(3.88 atm\right)mol K}{\left(0.0821 L atm\right)\left(328 K\right)}=\frac{0.144 mol}{1 L}$$

1. (8 points) Given the following data

A sample of manganese is placed into a solution of lead(II) chloride and the manganese dissolves. A precipitate of elemental lead is observed to form. Another sample of manganese is placed into a solution of barium chloride and no reaction occurs.

* 1. Write the equation for the reaction that takes place between lead(II) chloride and manganese. (manganese will form an ion with a +2 charge)

PbCl2(aq) + Mn(s) 🡪 MnCl2(aq) + Pb(s)

* 1. Which element is more active, lead or manganese?

Mn

* 1. Which element is more active, manganese or barium?

Ba

* 1. Would you expect a reaction to occur if you placed a sample of lead metal into a solution of barium chloride? Why or why not? (Hint: include the overall activity series in your answer)

No, because Pb<Mn and Mn<Ba so Pb<Ba meaning that lead is less active than barium and cannot replace it as an ion.