Chemistry 115 Name

Dr. Cary Willard

Exam 3a April 29, 2013

 Multiple Choice (30 points)

 Page 5 (21 points)

 Page 6 (18 points)

 Page 7 (19 points)

 Page 8 (12 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. The lowest possible energy level for an electron is known as
	1. ground state.
	2. low state.
	3. basement state.
	4. excited state.
2. The characteristic bright line spectrum of an element is produced when an electron
	1. moves to higher energy levels.
	2. is emitted as gamma radiation.
	3. falls back to lower energy levels.
	4. is absorbed into the nucleus.
3. Which does not exist as an electron sublevel?
	1. 4*f*
	2. 5*d*
	3. 7*s*
	4. 2*d*
4. How many orbitals are contained in the 2*p* sublevel?
	1. 1
	2. 2
	3. 3
	4. 4
5. How many valence electrons are present in the element with the following ground state electron configuration? 1*s*2 2*s*2 2*p*3
	1. 5
	2. 2
	3. 3
	4. 7
6. Which element is in the *p*-block of the periodic table?
	1. Eu
	2. Li
	3. V
	4. B
7. The maximum number of electrons that can fit into a single *d* orbital is
	1. 2.
	2. 6.
	3. 10.
	4. 14.
8. Choose the correct orbital diagram for arsenic.
	1. 
	2. 
	3. 
	4. 
9. The following figure shows a(an):
	1. *p* orbital
	2. *d* orbital
	3. *s* orbital
	4. *f* orbital
10. Which of the following statements is true for most atoms?
	1. In general, as the atomic radius increases, the first ionization energy increases.
	2. In general, as the first ionization energy decreases, the electronegativity increases.
	3. In general, as the atomic radius increases, the first ionization energy decreases.
	4. No correct answer is given.
11. What is the total number of electrons present in a Ca+2 ion?
	1. 2
	2. 18
	3. 20
	4. 22
12. When potassium fluoride forms from a potassium atom and a fluorine atom
	1. a proton is transferred from the potassium atom to the fluorine atom.
	2. a proton is transferred from the fluorine atom to the potassium atom.
	3. an electron is transferred from the potassium atom to the fluorine atom.
	4. an electron is transferred from the fluorine atom to the potassium atom.
13. Which of the following would require the largest amount of energy to remove the second electron?
	1. Ne
	2. F
	3. Mg
	4. Na
14. The atomic radius generally decreases as we move from left to right across a period because
	1. the sizes of the orbitals in the energy level decreases as we move from left to right.
	2. the number of electrons in the atoms decreases from left to right.
	3. the number of protons in the nucleus increases from left to right.
	4. the number of neutrons in the nucleus remains almost constant as we move from left to right.
15. Carbon dioxide is a nonpolar molecule because
	1. oxygen is more electronegative than carbon.
	2. the two oxygen atoms are bonded to the carbon atom.
	3. the individual dipoles of the carbon-oxygen bonds are oriented 180° to each other.
	4. the carbon-oxygen bonds are polar covalent.

Part 2 – Problems and Short Answer (70 points)

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

1s2 2s2 2p6 3s2 3p4

6 valence electrons

1. (4 points) Write the shorthand electron configuration for an atom of technetium (Tc).

[Kr] 5s2 4d5

1. (8 points) Explain why each of the following electron configurations for a p sublevel is disallowed.
	1. $$

Only 2 electrons are allowed in an orbital.

* 1. $$

Electrons will fill all orbitals before they pair.

1. (5 points) When an atom forms a cation its size changes. Explain how and why its size changes.

Cations form when atoms lose their valence electrons. Cations have one electron shell less than their atoms. In cations, a nucleus must hold fewer electrons than in an atom of the same element. The fewer electrons are held more closely. Both of these properties, fewer electron shells and fewer electrons held both combine to make the cation smaller than its atom.

1. (4 points) Define the term isoelectronic. What are two atoms/ions that are isoelectronic?

Isoelectronic atoms/ions have the same electronic configuration. Na+ and Ne are isoelectronic.

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



* 1. PCl3 (Phosphorous is the central atom)



* 1. HCN (Carbon atom is in the center.)



1. (6 points) Draw Lewis Electron Dot Structures for the carbonate ion (HCO2−). Include reasonable resonance structures. (carbon is the central atom, see skeleton structure at right)



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

Molecular geometry N trigonal pyramidal

Molecular geometry S bent

Orbital geometry P trigonal planar

Molecular geometry C1 tetrahedral

1. (6 points) A disposable helium tank holds 35.0 L of helium with a pressure of 210. psi when the temperature is 20oC.
	1. What is the pressure of helium in the tank in atmospheres?

$$?atm=210. psi×\frac{1 atm}{14.7 psi}=14.3 atm$$

* 1. How many moles of helium are in the tank?

$$PV=nRT\rightarrow \rightarrow n=\frac{PV}{RT}=\frac{\left(14.3 atm\right)\left(35.0L\right) mol K}{\left(0.0821 L atm\right)\left(293 K\right)}=20.8 mol He$$

1. (5 points) Fish contain a collapsible swim bladder containing air which they use to help them maintain buoyancy so they can swim at any level and not sink or float. If a swordfish has a fish bladder with a volume of 42.7 L at sea level where the pressure is 755 torr and the temperature is 28oC, what will the volume of the swim bladder be if the swordfish dives under the water to catch some mackerel where the pressure is 2377 torr and the temperature is 12oC?

$$PV=nRT$$

$$\frac{P\_{1}V\_{1}}{T\_{1}}=\frac{P\_{2}V\_{2}}{T\_{2}}\rightarrow \rightarrow V\_{2}=V\_{1}\left(\frac{P\_{1}}{P\_{2}}\right)\left(\frac{T\_{2}}{T\_{1}}\right)=42.7 L\left(\frac{755 torr}{2377 torr}\right)\left(\frac{285 K}{301 K}\right)=12.8 L$$

1. (4 points) What is the density of nitrogen gas at STP (1 atmosphere and 273K)?

$$density=\frac{g N\_{2}}{L N\_{2}}=\frac{28.02 g N\_{2}}{1 mol N\_{2}}×\frac{1 mol N\_{2}}{22.414 N\_{2}}=1.25 g/L$$

1. (4 points) Propane gas (C3H8) burns in oxygen to produce carbon dioxide and oxygen.

C3H8 (g) + 5 O2(g) 🡪 3 CO2(g) + 4 H2O(g)

How many liters of carbon dioxide will be formed by the complete combustion of 5.23 L of C3H8 with if the pressure and temperature are held constant?

$$?L CO\_{2}=5.23 L C\_{3}H\_{8}×\frac{3 L CO\_{2}}{1 L C\_{3}H\_{8}}=15.7 L CO\_{2}$$

1. (4 points) A gas mixture contains each of the following gases at the indicated partial pressure. N2 (285 torr), O2 (765 torr), and H2(533 torr). What is the total pressure of the mixture in atm?

$$total pressure=285 torr N\_{2}+765 torr O\_{2}+ 533 torr H\_{2}=1583. torr$$

$$?atm=1583 torr×\frac{1 atm}{760 torr}=2.083 atm$$