Chemistry 115 Name

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Exam 2a March 20, 2014

 Multiple Choice (30 points)

 Nomenclature (7 points)

 Page 5 (20 points)

 Page 6 (23 points)

 Page 7 (20 points)

 Total (100 points)

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

$$℉=\left(℃×\frac{180℉}{100℃}\right)+32℉$$

$$℃=\left(℉-32℉\right)\frac{100℃}{180℉}$$

$$K=℃+273$$

454 g = 1 lb

2.54 cm = 1 in

946 mL = 1 qt

Avogadro’s number -- 6.022 x 1023 /mol

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 1 – Multiple Choice (30 points)

1. Which of the following exists in its natural state as a diatomic molecule?
	1. iron
	2. bromine
	3. boron
	4. zirconium
2. Which is the correct name for Mg +2?
	1. magnesium ion
	2. magnesium
	3. manganide
	4. magneside
3. What is the correct name for N3-?
	1. nitrogen(III) ion
	2. nitrogen ion
	3. nitride ion
	4. Iodine (III)nitride(III) ion
4. H2SO3 is named
	1. hydrosulfuric acid.
	2. sulfuric acid.
	3. hydrosulfurous acid.
	4. sulfurous acid.
5. What is the formula for the compound that forms between barium and oxygen?
	1. Ba2O
	2. BaO2
	3. Ba2O3
	4. BaO
6. Which of the following is the formula for sodium chlorite?
	1. NaClO
	2. NaClO2
	3. NaClO3
	4. NaClO4
7. Which of the following compounds is most likely to be ionic?
	1. SO3
	2. BaSO4
	3. H2O
	4. PCl3
8. In which pair would both compounds have the same empirical formula?
	1. H2O and H2O2
	2. BaSO4 and BaSO3
	3. FeO and Fe2O3
	4. C6H12O6 and HC2H3O2
9. In the following reaction:

KOH + CuNO3 → KNO3 + CuOH

* 1. KOH and KNO3 are reactants
	2. KNO3 and CuOH are reactants
	3. CuOH and KOH are products
	4. KOH and CuNO3 are reactants
1. Reactions which liberate heat are
	1. isothermic.
	2. protothermic.
	3. endothermic.
	4. exothermic.
2. Which of the following types of radioactive decay does not produce a new element?
	1. alpha emission
	2. beta emission
	3. electron capture
	4. gamma emission
3. An alpha particle consists of
	1. one proton and one neutron.
	2. one proton and two neutrons.
	3. two protons and one neutron.
	4. two protons and two neutrons.
4. Which form of nuclear emission requires the greatest amount of shielding to provide protection from radiation injury?
	1. alpha
	2. beta
	3. gamma
	4. delta
5. How many protons are in the nucleus of radon-222?
	1. 136
	2. 88
	3. 222
	4. 86
6. In a nuclear reaction
	1. mass is lost.
	2. mass is gained.
	3. mass is converted into energy.
	4. energy is converted into mass.

Part 2 – Nomenclature (7 points) Fill in the following chart with the correct name or formula as appropriate.

|  |  |
| --- | --- |
| IUPAC name | Chemical formula |
| Aluminum nitrite | Al(NO2)3 |
| Sodium hydroxide | NaOH |
| Triphosphorus hexachloride | P3Cl6 |
| Hydrobromic acid | HBr |
| Manganese(III) oxide | Mn2O3 |
| Sodium phosphate | (Na)3PO4 |
| Sulfur trioxide | SO3 |

Part 3 – 58 points Give all answers to the correct number of significant figures and include units where appropriate. Show clear set-up for each problem to receive credit.

1. (20 points) Linalool is one of the components of lavender oil with the chemical formula is C10H18O.
	1. Calculate the molar mass of linalool.

$$molar mass=10\left({12.01 g}/{mol}\right)+18\left({1.008 g }/{mol}\right)+14.01 g/mol+{16.00 g}/{mol}$$

$$=120.1+18.14 +16.00$$

$$={154.2 g}/{mol}$$

* 1. Calculate the mass in grams of 3.62 moles of linalool.

$$?g C\_{10}H\_{18}O=3.62 mol C\_{10}H\_{18}O×\frac{154.2 g C\_{10}H\_{18}O}{1 mol C\_{10}H\_{18}O}=558 g C\_{10}H\_{18}O$$

* 1. Calculate the mass in grams of 3.54 x 1021 molecules of linalool.

$$?gC\_{10}H\_{18}O = 3.54×10^{21}molec C\_{10}H\_{18}O × \frac{1 mol C\_{10}H\_{18}O}{6.022×10^{23}molec C\_{10}H\_{18}O}×\frac{154.2 g C\_{10}H\_{18}O}{1 mol C\_{10}H\_{18}O}=0.905 g C\_{10}H\_{18}O $$

* 1. Calculate the number of moles of hydrogen in a 8.21 mol sample of linalool.

$$?mol H=8.21 mol C\_{10}H\_{18}O×\frac{18 mol H}{1 mol C\_{10}H\_{18}O}=148 mol H$$

* 1. Calculate the mass of carbon in a 15.5 g sample of linalool.

$$?g C=15.5 g C\_{10}H\_{18}O×\frac{1 mol C\_{10}H\_{18}O}{154.2 g C\_{10}H\_{18}O}×\frac{10 mol C}{1 mol C\_{10}H\_{18}O}×\frac{12.01 g C}{1 mol C}=12.1 g C$$

1. (6 points) Determine the empirical formula of vanillin. It is composed of 63.15% C, 5.30% H, and 31.55% O.

$$63.15 g C×\frac{1 mol C}{12.01 g C}=5.258 mol C$$

$$5.30 g H×\frac{1 mol H}{1.008 g H}=5.26 mol H$$

$$31.55 g O×\frac{1 mol O}{16.00 g O}=1.972 mol O$$

$$C\_{\frac{5.258}{1.972}}H\_{\frac{5.26}{1.972}}O\_{\frac{1.972}{1.972}}$$

$$C\_{2.67}H\_{2.67}O\_{1} or C\_{8}H\_{8}O\_{3} $$

1. (8 points) Balance the following chemical equations. Include state labels.
	1. Gaseous ammonia(NH3) reacts with gaseous oxygen(O2) to form gaseous nitrogen monoxide(NO) and liquid water(H2O).

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

* 1. Co(NO3)3(aq) + K2S(aq) 🡪 Co2S3(s) + KNO3(aq)

2 Co(NO3)3(aq) + 3 K2S(aq) 🡪 Co2S3(s) + 6 KNO3(aq)

1. (3 points) Write a balanced equation for the decay of californium-252 ($$) by alpha emission. This isotope is used to inspect luggage for explosives

$$\rightarrow + $$

1. (3 points) Write a balanced nuclear equation for the decay of sodium-24 ($$) by beta emission. This isotope is used to locate leaks in industrial pipelines.

$$\rightarrow +$$

1. (3 points) An 800 mg sample of a radioactive isotope decays for 28 days. At the end of the 28 days, 50 mg of the sample remain. What is the half-life of the isotope?

$$800 mg\overset{1}{\overbrace{\rightarrow \rightarrow }}400mg\overset{2}{\overbrace{\rightarrow \rightarrow }}200mg\overset{3}{\overbrace{\rightarrow \rightarrow }}100mg\overset{4}{\overbrace{\rightarrow \rightarrow }}50mg$$

The sample decays for 4 half lives so 28 days/4 = 7 days/half-life

1. (20 points) Nitric acid, HNO3, is manufactured by the Ostwald process, in which nitrogen dioxide, NO2, reacts with water:

nitrogen dioxide water nitric acid nitrogen monoxide

3 NO2(g) + H2O(l) 🡪 2 HNO3 + NO + 396 kJ

46.01 g/mol 18.02 g/mol 63.02 g/mol 30.01 g/mol

* 1. How many molecules of nitric acid can be formed by the complete reaction 57 molecules of nitrogen dioxide?

$$?molec HNO\_{3}=57 molec NO\_{2}×\frac{2 molec HNO\_{3}}{3 molec NO\_{2} }=38 molec HNO\_{3}$$

* 1. How many moles of water will react with 93.3 g of nitrogen dioxide?

$$?g H\_{2}O=93.3 g NO\_{2} ×\frac{1 mol NO\_{2}}{46.01 g NO\_{2}}×\frac{1 mol H\_{2}O}{3 mol NO\_{2}}=0.676 g H\_{2}O$$

* 1. How many grams of nitric acid will be produced by the reaction of 72.3 g of nitrogen dioxide with excess water?

$$?g HNO\_{3}=72.3 g NO\_{2}×\frac{1 mol NO\_{2}}{46.01 g NO\_{2} }×\frac{2 mol HNO\_{3}}{3 mol NO\_{2} }×\frac{63.02 g HNO\_{3}}{1 mol HNO\_{3}}=66.0 g HNO\_{3}?$$

* 1. If 58.2 g of HNO3 are produced from the reaction in part d, what is the percent yield of the reaction?

$$\% yield=\left(\frac{actual yield}{theoretical yield}\right)×100=\left(\frac{58.2 g}{66.0 g}\right)×100=88.2\% yield$$

* 1. If 17.6 mol of nitrogen dioxide react with 12.3 mol of water, how many grams of nitrogen monoxide will result?

$$?g NO=19.6 mol NO\_{2} ×\frac{1 mol NO}{3 mol NO\_{2} }×\frac{30.01 g NO}{1 mol NO}=$$

$$?g NO=14.3 mol H\_{2}O ×\frac{1 mol NO}{1 mol H\_{2}O }×\frac{30.01 g NO}{1 mol NO}=429 g NO$$

$$ $$

Nitrogen dioxide is limiting and only 196 g of NO will be produced.