Chemistry 115 Name

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Exam 2b 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. boron
	2. zirconium
	3. iron
	4. bromine
2. Which is the correct name for Mg +2?
	1. magnesium
	2. magnesium ion
	3. manganide
	4. magneside
3. What is the correct name for N3-?
	1. nitride ion
	2. nitrogen(III) ion
	3. nitrogen ion
	4. Iodine (III)nitride(III) ion
4. H2SO3 is named
	1. sulfurous acid.
	2. hydrosulfuric acid.
	3. sulfuric acid.
	4. hydrosulfurous acid.
5. What is the formula for the compound that forms between barium and oxygen?
	1. BaO
	2. Ba2O
	3. BaO2
	4. Ba2O3
6. Which of the following is the formula for sodium chlorite?
	1. NaClO4
	2. NaClO3
	3. NaClO2
	4. NaClO
7. Which of the following compounds is most likely to be ionic?
	1. BaSO4
	2. SO3
	3. H2O
	4. PCl3
8. In which pair would both compounds have the same empirical formula?
	1. H2O and H2O2
	2. C6H12O6 and HC2H3O2
	3. BaSO4 and BaSO3
	4. FeO and Fe2O3
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. endothermic.
	2. exothermic.
	3. isothermic.
	4. protothermic.
2. Which of the following types of radioactive decay does not produce a new element?
	1. electron capture
	2. gamma emission
	3. alpha emission
	4. beta emission
3. An alpha particle consists of
	1. one proton and one neutron.
	2. one proton and two neutrons.
	3. two protons and two neutrons.
	4. two protons and one neutron.
4. Which form of nuclear emission requires the greatest amount of shielding to provide protection from radiation injury?
	1. gamma
	2. alpha
	3. beta
	4. delta
5. How many protons are in the nucleus of radon-222?
	1. 222
	2. 86
	3. 136
	4. 88
6. In a nuclear reaction
	1. mass is lost.
	2. mass is gained.
	3. energy is converted into mass.
	4. mass is converted into energy.

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

|  |  |
| --- | --- |
| IUPAC name | Chemical formula |
| Aluminum nitrate | Al(NO3)3 |
| Potassium hydroxide | KOH |
| Dinitrogen tetrafluoride | N2F4 |
| Hydrofluoric acid | HF |
| Vanadium(II) phosphide | V3P2 |
| Sodium phosphite | (Na)3PO3 |
| 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 5.87 moles of linalool.

$$?g C\_{10}H\_{18}O=5.87 mol C\_{10}H\_{18}O×\frac{154.2 g C\_{10}H\_{18}O}{1 mol C\_{10}H\_{18}O}=905 g C\_{10}H\_{18}O$$

* 1. Calculate the mass in grams of 8.11 x 1021 molecules of linalool.

$$?gC\_{10}H\_{18}O = 8.11×10^{21}molec C\_{10}H\_{18}O × \frac{1 mol C\_{10}H\_{18}O}{6.022×10^{23}molec C\_{10}H\_{18}O}×\frac{154.2 g C\_{10}H\_{18}O}{1 mol C\_{10}H\_{18}O}=2.08 g C\_{10}H\_{18}O $$

* 1. Calculate the number of moles of hydrogen in a 3.59 mol sample of linalool.

$$?mol H=3.59 mol C\_{10}H\_{18}O×\frac{18 mol H}{1 mol C\_{10}H\_{18}O}=64.6 mol H$$

* 1. Calculate the mass of carbon in a 11.5 g sample of linalool.

$$?g C=11.5 g C\_{10}H\_{18}O×\frac{1 mol C\_{10}H\_{18}O}{154.2 g C\_{10}H\_{18}O}×\frac{10 mol C}{1 mol C\_{10}H\_{18}O}×\frac{12.01 g C}{1 mol C}=8.96 g C$$

1. (6 points) Determine the empirical formula of hexazole, a fungicide used to prevent mildew in rice and other crops. It is composed of 66.99% C, 9.56% H, and 23.44% N.

$$66.99 g C×\frac{1 mol C}{12.01 g C}=5.578 mol C$$

$$9.56 g H×\frac{1 mol H}{1.008 g H}=9.48 mol H$$

$$23.44 g N×\frac{1 mol N}{14.01 g N}=1.673 mol N$$

$$C\_{\frac{5.578}{1.673}}H\_{\frac{9.48}{1.673}}N\_{\frac{1.673}{1.673}}$$

$$C\_{3.33}H\_{5.67}N\_{1} or C\_{10}H\_{17}N\_{3} $$

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 radium-226 ($$) by alpha emission. This isotope is used to make lightning rods more effective.

$$\rightarrow + $$

1. (3 points) Write a balanced nuclear equation for the decay of strontium-90 ($$) by beta emission. This isotope is used as a power source for weather satellites.

$$\rightarrow +$$

1. (3 points) An 800 mg sample of a radioactive isotope decays for 20 days. At the end of the 20 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 20 days/4 = 5 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 78 molecules of nitrogen dioxide?

$$?molec HNO\_{3}=78 molec NO\_{2}×\frac{2 molec HNO\_{3}}{3 molec NO\_{2} }=52 molec HNO\_{3}$$

* 1. How many moles of water will react with 71.5 g of nitrogen dioxide?

$$?g H\_{2}O=71.5 g NO\_{2} ×\frac{1 mol NO\_{2}}{46.01 g NO\_{2}}×\frac{1 mol H\_{2}O}{3 mol NO\_{2}}=0.518 g H\_{2}O$$

* 1. How many grams of nitric acid will be produced by the reaction of 84.1 g of nitrogen dioxide with excess water?

$$?g HNO\_{3}=84.1 g NO\_{2}×\frac{1 mol NO\_{2}}{46.01 g NO\_{2} }×\frac{2 mol HNO\_{3}}{3 mol NO\_{2} }×\frac{63.02 g HNO\_{3}}{1 mol HNO\_{3}}=76.8 g HNO\_{3}?$$

* 1. If 68.2 g of HNO3 are produced from the reaction in part d, what is the percent yield of the reaction?

$$\% yield=\left(\frac{actual yield}{theoretical yield}\right)×100=\left(\frac{68.2 g}{76.8 g}\right)×100=88.8\% yield$$

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

$$?g NO=17.6 mol NO\_{2} ×\frac{1 mol NO}{3 mol NO\_{2} }×\frac{30.01 g NO}{1 mol NO}=$$

$$?g NO=12.3 mol H\_{2}O ×\frac{1 mol NO}{1 mol H\_{2}O }×\frac{30.01 g NO}{1 mol NO}=369 g NO$$

$$ $$

Nitrogen dioxide is limiting and only 176 g of NO will be produced.