Chemistry 115 Name

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Exam 2a October 9, 2013

 Multiple Choice (30 points)

 Nomenclature (12 points)

 Page 5 (18 points)

 Page 6 (23 points)

 Page 7 (18 points)

 Total (101 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 exist in its natural state as a diatomic?
	1. helium
	2. radium
	3. iodine
	4. boron
2. Which of the following represents a tin(II) ion ?
	1. Ti2+
	2. Te2+
	3. Sn2+
	4. Tl2+
3. All chemical compounds must have a net charge of
	1. 0
	2. +1
	3. +2
	4. The charges of compounds can vary.
4. Which is a binary compound?
	1. H2
	2. CaSO4
	3. KClO
	4. H2O
5. Which compound’s name ends in -ide?
	1. KClO2
	2. KClO
	3. KCl
	4. KClO3
6. Which of the following elements will most likely form ions with a –2 charge?
	1. Cr
	2. Sr
	3. Se
	4. N
7. What is the molecular formula of a compound with the empirical formula CH2Cl and molar mass of 98.96 g?
	1. CH2Cl
	2. C2H4Cl2
	3. C3H6Cl3
	4. C4H8Cl4
8. Which statement is **incorrect**?
	1. one mole equals 6.02  1023 g of a compound.
	2. one mole contains 6.02  1023 molecules.
	3. one molar mass equals one mole.
	4. one mole of water contains the same number of molecules as one mole of carbon dioxide.
9. In which pair would both compounds have the same empirical formula?
	1. K2CrO4 and K2Cr2O7
	2. NaHCO3 and Na2CO3
	3. C2H4 and C3H6
	4. FeCl3 and FeCl2
10. In the following reaction: Ba + MgO → Mg + BaO
	1. Mg and MgO are products
	2. Ba and MgO are products
	3. Mg and BaO are products
	4. Ba and Mg are products
11. Reactions which liberate heat are
	1. endothermic.
	2. exothermic.
	3. isothermic.
	4. protothermic.
12. Gamma rays have
	1. a mass of 4 amu.
	2. a charge of +2.
	3. a charge of –1.
	4. neither mass nor charge.
13. A beta particle consists of
	1. one proton.
	2. one neutron.
	3. one electron.
	4. two protons and two neutrons.
14. In a nuclear reaction
	1. energy is converted into mass.
	2. mass is converted into energy.
	3. mass is lost.
	4. mass is gained.
15. Which is true about ionizing radiation?
	1. It dislocates bonding electrons and creates ions.
	2. It can damage DNA molecules.
	3. Both large acute doses and small chronic doses are harmful.
	4. All the above are true.

Part 2 – Nomenclature (12 points) Fill in the following chart with the correct name or formula as appropriate.

|  |  |
| --- | --- |
| IUPAC name | Chemical formula |
| lithium sulfate | Li2SO4 |
| nitric acid | HNO3 |
| chromium(II) phosphide | Cr3P2 |
| potassium hypochlorite | KClO |
| dinitrogen hexaiodide | N2I6 |
| iron(III) hydroxide | Fe(OH)3 |

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. (18 points) Cinnamoldehyde is the primary flavor component in cinnamon. Its IUPAC name is 4,4-dimethylaminocinnamaldehyde and its structure is shown on the right. Its chemical formula is C11H13NO.
	1. Calculate the molar mass of cinnamoldehyde.

$$molar mass=11\left({12.01 g}/{mol}\right)+13\left({1.008 g }/{mol}\right)+14.01 g/mol+{16.00 g}/{mol}$$

$$=132.11+13.104+14.01+16.00$$

$$={175.22 g}/{mol}$$

* 1. Calculate the number of moles cinnamoldehyde in a 527 g sample of cinnamoldehyde.

$$?mol C\_{11}H\_{13}NO=527 g C\_{11}H\_{13}NO×\frac{1 mol C\_{11}H\_{13}NO}{175.22 g C\_{11}H\_{13}NO}=3.01 mol C\_{11}H\_{13}NO$$

* 1. Calculate the mass in grams of one molecule of cinnamoldehyde.

$$?gC\_{11}H\_{13}NO=1 molec C\_{11}H\_{13}NO×\frac{1 mol C\_{11}H\_{13}NO}{6.022×10^{23}molec C\_{11}H\_{13}NO}×\frac{175.22 g C\_{11}H\_{13}NO}{1 mol C\_{11}H\_{13}NO}=2.91×10^{-22}g C\_{11}H\_{13}NO $$

* 1. Calculate the number of moles of carbon in a 5.99 mol sample of cinnamoldehyde.

$$?mol C=5.99 mol C\_{11}H\_{13}NO×\frac{11 mol C}{1 mol C\_{11}H\_{13}NO}=65.9 mol C$$

* 1. Calculate the mass of hydrogen in a 12.8 g sample of cinnamoldehyde.

$$?g O=12.8 g C\_{11}H\_{13}NO×\frac{1 mol C\_{11}H\_{13}NO}{175.22 g C\_{11}H\_{13}NO}×\frac{13 mol H}{1 mol C\_{11}H\_{13}NO}×\frac{1.008 g H}{1 mol H}=0.957 g H$$

* 1. Calculate the mass of a sample of cinnamoldehyde that contains 8.94 x 1019 atoms of carbon.

$$?g C\_{11}H\_{13}NO=8.94×10^{19}atoms C×\frac{1 mol C}{6.022×10^{23} atom C}×\frac{1 mol C\_{11}H\_{13}NO}{11 mol C}×\frac{175.22 g C\_{11}H\_{13}NO}{1 mol C\_{11}H\_{13}NO}=2.36×10^{-3} g C\_{11}H\_{13}NO$$

1. (6 points) Determine the empirical formula of a nickel compound used to prepare surfaces for plating with different metals. It is composed of 48.11% Ni, 34.97% O, and 16.92% P.

$$48.11 g Ni×\frac{1 mol Ni}{58.69 g Ni}=0.8197 mol Ni$$

$$34.97 g O×\frac{1 mol O}{16.00 g O}=2.186 mol O$$

$$16.92 g P×\frac{1 mol P}{30.97 g P}=0.5463 mol P$$

$$Ni\_{\frac{0.8197}{0.5463}}O\_{\frac{2.186}{0.5463}}P\_{\frac{0.5463}{0.5463}}$$

$$Ni\_{1.50}O\_{4}P\_{1} or Ni\_{3}O\_{8}P\_{2} $$

1. (8 points) Balance the following chemical equations. Include state labels.
	1. Aqueous solutions of silver nitrate (AgNO3) and aluminum iodide (AlI3) are mixed together forming solid silver iodide (AgI) and aqueous aluminum nitrate(Al(NO3)3).

3 AgNO3(aq) + AlI3(aq) 🡪 3 AgI(s) + Al(NO3)3(aq)

* 1. Bi2S3(s) + HCl(aq) 🡪 BiCl3(aq) + H2S(g)

Bi2S3(s) + 6 HCl(aq) 🡪 2 BiCl3(aq) + 3 H2S(g)

1. (3 points) Write a balanced equation for the decay of polonium-210 ($$) by alpha emission.

$$\rightarrow + $$

1. (3 points) Write a balanced nuclear equation for the decay of cesium-137 ($$) by beta emission.

$$\rightarrow +$$

1. (3 points) The half life of I-123 is 13 hours. If a 40 mg sample of I-123 is administered to a patient, how many mg remain after 2 days and 4 hours (52 hours)?

$$40 mg\overset{13 hr}{\overbrace{\rightarrow \rightarrow }}20mg\overset{26 hr}{\overbrace{\rightarrow \rightarrow }}10mg\overset{39 hr}{\overbrace{\rightarrow \rightarrow }}5.0mg\overset{52 hr}{\overbrace{\rightarrow \rightarrow }}2.5mg$$

1. (18 points) Matches contain tetraphosphorous trisulfide which when combined with an oxidizing agent such as potassium chlorate will ignite when shocked. The balanced equation for the reaction which takes place when a match is lit is shown below. Answer the following questions using this balanced chemical equation.

Potassium tetraphosphorus potassium tetraphosphorus sulfur

 chlorate trisulfide chloride decoxide dioxide

16 KClO3 + 3 P4S3 🡪 16KCl + 3 P4O10 + 9 SO2 + 8954 kJ

 122.6 g/mol 220.1 g/mol 74.55 g/mo 283.9 g/mol 64.07 g/mol

* 1. How many moles of potassium chlorate can react with 8.44 moles of tetraphosphorus trisulfide?

$$?mol KClO\_{3}=8.44 mol P\_{4}S\_{3}×\frac{16 mol KClO\_{3}}{3 mol P\_{4}S\_{3} }=45.0 mol KClO\_{3}$$

* 1. How many grams of tetraphosphorus decoxide can be formed from the reaction of 28.7 g of tetraphosphorus trisulfide with excess potassium chlorate?

$$?g P\_{4}O\_{10}=28.7 g P\_{4}S\_{3} ×\frac{1 mol P\_{4}S\_{3}}{220.1 g P\_{4}S\_{3}}×\frac{3 mol P\_{4}O\_{10}}{3 mol P\_{4}S\_{3}}×\frac{283.9 g P\_{4}O\_{10}}{1 mol P\_{4}O\_{10}}=37.0 g P\_{4}O\_{10}$$

* 1. How much energy will be produced if 800.0 grams of potassium chlorate react with excess P4S3?

$$?kJ=800.0 g KClO\_{3}×\frac{1 mol KClO\_{3}}{122.6 g KClO\_{3}}×\frac{8954 kJ}{16 mol KClO\_{3}}=3652 kJ$$

* 1. If 155 grams of tetraphosphorus trisulfide react with excess potassium chlorate to produce 127 grams of sulfur dioxide, what is the percent yield of the reaction?

$$?g SO\_{2}=155 g P\_{4}S\_{3} ×\frac{1 mol P\_{4}S\_{3}}{220.1 g P\_{4}S\_{3}}×\frac{9 mol SO\_{2}}{3 mol P\_{4}S\_{3}}×\frac{64.07 g SO\_{2}}{1 mol SO\_{2}}=135 g SO\_{2} $$

$$?\% yield=\left(\frac{actual yield}{theoretical yield}\right)×100=\left(\frac{127 g}{135 g}\right)×100=94.1\% yield$$

* 1. If 25.0 grams of tetraphosphorous trisulfide react with 80.0 g potassium chlorate, how many g of tetraphosphorus decoxide should be produced?

$$?g P\_{4}O\_{10}=30.0 g P\_{4}S\_{3} ×\frac{1 mol P\_{4}S\_{3}}{220.1 g P\_{4}S\_{3}}×\frac{3 mol P\_{4}O\_{10}}{3 mol P\_{4}S\_{3}}×\frac{283.9 g P\_{4}O\_{10}}{1 mol P\_{4}O\_{10}}=38.7 g P\_{4}O\_{10}$$

$$?g P\_{4}O\_{10}=80.0 g KClO\_{3}×\frac{1 mol KClO\_{3}}{122.6 g KClO\_{3}}×\frac{3 mol P\_{4}O\_{10}}{16 mol KClO\_{3}}×\frac{283.9 g P\_{4}O\_{10}}{1 mol P\_{4}O\_{10}}=34.7 g P\_{4}O\_{10}$$

$$ $$

Potassium chlorate is limiting and only 34.7 g of tetraphosphorus decoxide will be produced.