Chemistry 115 Name Key

Dr. Cary Willard

Exam 2B October 15, 2008

|  |  |  |
| --- | --- | --- |
|  | Points Earned | Points Possible |
| Page 1 multiple choice |  | 12 |
| Page 2  |  | 25 |
| Page 3 |  | 28 |
| Page 4 |  | 24 |
| Page 5 |  | 12 |
|  |  |  |
| Total |  | 101 |

Note: All work must be shown to receive credit. On calculation problems show answer with the correct number of significant figures using scientific notation if necessary.

Avogadro’s number 6.022 x 1023/mol

 PERIODIC CHART

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  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 | Transition Metals | 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 |  VIIIB | 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**(268) | 110**??**(???) |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 (12 points)

1. Which is not part of Dalton’s atomic model?
	1. Elements are composed of minute, indivisible particles called atoms.
	2. Atoms of the same element are alike in mass.
	3. Atoms of the same element can be different in size.
	4. Chemical compounds are composed of two or more atoms of different elements.
	5. All of the above are part of Dalton’s atomic model
2. What charge does a cation possess?
	1. It is not possible to determine the charge
	2. Positive
	3. Negative
	4. Neutral
3. The nucleus of an atom usually contains
	1. Protons
	2. Neutrons
	3. Electrons
	4. Both choices A and B
	5. Neither, choices A, B, nor C
4. The number of protons in an atom is known as its
	1. Atomic Mass
	2. Atomic number
	3. Mass number
	4. Molecular mass
	5. None of the above
5. Different isotopes of an element are atoms of that element which have
	1. The same atomic number and the same mass number
	2. Different atomic number and the same mass number
	3. The same atomic number and different mass number
	4. Different atomic number and different mass number
	5. None of the above
6. The atomic mass of an element is
	1. The mass of the most abundant isotope of that element
	2. The weighted average of the masses of the naturally occurring isotopes of that element
	3. The arithmetic average of the masses of the isotopes of that element
	4. The ratio of the mass of one atom of an isotope of that element to the mass of hydrogen
	5. None of the above

Part 2 – Nomenclature (8 points) Fill in the following table with the correct IUPAC name or formula

|  |  |
| --- | --- |
| IUPAC Name | Chemical Formula |
| Magnesium nitrate | Mg(NO3)2 |
| Cupric bromide | CuBr2 |
| Trinitrogen pentoxide | N3O5 |
| Ammonium sulfide | (NH4)2S |
| Potassium phosphate | K3PO4 |
| Nickel(III) oxide | Ni2O3 |
| Calcium hydroxide | Ca(OH)2 |
| Pentaphosphorus tetrachloride | P5Cl4 |

Part 3 – Problems (80 points)

1. (6 points) Fill in the chart below

|  |  |  |  |
| --- | --- | --- | --- |
| species | protons | neutrons | electrons |
| 34P | 15 | 19 | 15 |
| 82Br-1 | 35 | 47 | 36 |

1. (5 points) Explain how an empirical and a molecular formula differ.

An empirical formula is the simplest ratio of the atoms in a compound. A molecular formula tells the actual number of each type of atom in a compound.

1. (6 points) Balance the equations below
	1. 2 Al + N2 → 2 AlN
	2. BaCl2 + (NH4)2SO4 → BaSO4 + 2 NH4Cl
2. (8 points) Complete and balance the equations below. (Both reactions will occur.)
	1. Cu + AgNO3 (single replacement reaction)

Cu + 2 AgNO3 🡪 Cu(NO3)2 + 2 Ag

* 1. FeSO4 + KOH (double displacement reaction)

FeSO4 + 2 KOH 🡪 Fe(OH)2 + K2SO4

1. (20 points) Given a 5.96 g sample of the amino acid phenylalanine, C9H10NO2,.calculate the following:
	1. molar mass of phenylalanine

9(C) + 10(H) + N + 2(O)

= 9(12.01 amu) + 10(1.008 amu) + 14.01amu + 2(16.00 amu)

= 108.09 amu + 10.08 amu + 14.01 amu + 32.00 amu

=164.18 amu

* 1. moles of phenylalanine

$$?mol C\_{9}H\_{10}NO\_{2}=5.96 g C\_{9}H\_{10}NO\_{2}×\frac{1 mol C\_{9}H\_{10}NO\_{2}}{164.2 g C\_{9}H\_{10}NO\_{2}}=0.0363 mol C\_{9}H\_{10}NO\_{2}$$

* 1. moles of carbon atoms

$$0.0363 mol C\_{9}H\_{10}NO\_{2}×\frac{9 mol C}{1 mol C\_{9}H\_{10}NO\_{2}}=0.327 mol C$$

* 1. molecules of phenylalanine

$$0.0363 mol C\_{9}H\_{10}NO\_{2}×\frac{6.022×10^{23}molec C\_{9}H\_{10}NO\_{2}}{1 mol C\_{9}H\_{10}NO\_{2}}=2.18×10^{22} molec C\_{9}H\_{10}NO\_{2}$$

* 1. number of oxygen atoms

$$2.18×10^{22} molec C\_{9}H\_{10}NO\_{2}×\frac{2 oxygen atoms}{molec C\_{9}H\_{10}NO\_{2}}=4.36×10^{22} oxygen atoms$$

1. (24 points) Butane, C4H10, is a common fuel for heating homes in areas not serviced by natural gas. The equation for its combustion is

2 C4H10 + 13 O2 ⎯⎯→ 8 CO2 + 10 H2O

* 1. How many moles of oxygen are required to react with 7.44 mol C4H10?

$$?mol O\_{2}=7.44 mol C\_{4}H\_{10}×\frac{13 mol O\_{2}}{2 mol C\_{4}H\_{10}}=48.4 mol O\_{2}$$

* 1. How many grams of carbon dioxide will be produced when 5.19 mol of C4H10 are burned?

$$?g CO\_{2}=5.19 mol C\_{4}H\_{10}×\frac{8 mol CO\_{2}}{2 mol C\_{4}H\_{10}}×\frac{44.01 g CO\_{2}}{1 mol CO\_{2}}=913 g CO\_{2}$$

* 1. If 855 grams of CO2 are produced in part b, what is the percent yield of the reaction?

$$?\% yield=\left(\frac{actual }{expected}\right)×100\left(\%\right)=\left(\frac{855}{913}\right)×100\left(\%\right)=93.6\% yield$$

* 1. How many molecules of butane will react with 39 molecules of oxygen gas?

$$?molec C\_{4}H\_{10}=39 molec O\_{2}×\frac{2 molec C\_{4}H\_{10}}{13 molec O\_{2}}=6 molec C\_{4}H\_{10}$$

* 1. How many molecules of water will be produced by the combustion of 5.00 g of butane?

$$?molec H\_{2}O=5.00 g C\_{4}H\_{10}×\frac{1 mol C\_{4}H\_{10}}{58.12g C\_{4}H\_{10}}×\frac{10 mol H\_{2}O}{2 mol C\_{4}H\_{10}}×\frac{6.022×10^{23}molec H\_{2}O}{1 mol H\_{2}O}=2.59×10^{23}molec H\_{2}O$$

* 1. How many moles of CO2 will be produced by the reaction of 5.00 moles of butane with 40.0 moles of oxygen gas?

$$?mol CO\_{2}=5.00 mol C\_{4}H\_{10}×\frac{8 mol CO\_{2}}{2 mol C\_{4}H\_{10}}=$$

$$?mol CO\_{2}=40.0 mol O\_{2}×\frac{8 mol CO\_{2}}{13 mol O\_{2}}=24.6 mol CO\_{2}$$

1. (7 points) Calculate the empirical formula of a compound which is composed of 38.76% Cl and 61.24% O

$$38.76 g Cl×\frac{1 mol Cl}{35.45 g Cl}=1.093 mol Cl$$

$$61.24 g O×\frac{1 mol O}{16.00 g O}=3.828 mol O$$

$$Cl\_{\frac{1.093}{1.093}}O\_{\frac{3.828}{1.093}}=Cl\_{1}O\_{3.50}=Cl\_{2}O\_{7}$$

1. (5 points) A compound with empirical formula SO2F2 has a molar mass of 306 g. Determine the molecular formula for the compound.

SO2F2 -- Molar mass = 32 + 2(16) + 2 (19) = 102

You need 3 units of SO2F2 to get a molar mass of 306

So the molecular formula is S3O6F6