**Exam 1: Chemistry 1984**

**Fall 2013 Alfred State College**

Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_/100

1. **Really Basic Stuff from Chapter R (6 pts)**
2. The Système International unit system uses what metric measures for:

(write out full name, not just abbreviation)

1. Distance \_\_\_meters\_\_\_\_\_\_\_\_\_\_
2. Mass \_\_\_kilograms\_\_\_\_\_\_\_\_
3. Time \_\_\_\_seconds\_\_\_\_\_\_\_\_
4. What temperature scale features `absolute’ zero = 0 ?

K = Kelvin scale

1. Write 0.00035 in scientific notation \_\_\_3.5\*10-4\_\_\_\_\_\_\_
2. Write 6.02\*10+5 in decimal \_\_\_\_\_\_\_602,000\_\_\_\_\_\_\_\_\_\_\_\_\_

**1.1 Rounding and Significant Figures (11 pts)**

1. How many significant figures are in the numbers below ?
2. 100 \_\_\_1\_\_\_\_ b) 0.00100 \_\_3\_\_\_\_\_ c) 2.00EE23 \_\_\_\_\_3\_\_\_\_\_\_

1. Round the numbers below to the indicated significant figure count
2. 0.001257 to 2 sig figs \_\_\_\_\_\_\_\_**0.0013**\_\_\_\_\_\_\_\_\_\_
3. 4956 to 1 sig fig \_\_\_\_\_\_\_\_**5000**\_\_\_\_\_\_\_\_\_\_\_
4. 9.1915\*10-3 to 3 sig figs \_\_\_\_\_\_\_\_**9.19\*10‑3**\_\_\_\_\_\_\_
5. 53990 to 1 sig fig \_\_\_\_\_\_\_\_**50000**\_\_\_\_\_\_\_\_\_\_
6. Compute the expressions below to the correct significant figure count (2 pts each)
7. 2.01 + 1.111 + 3 = \_\_\_**6**\_\_\_\_\_\_\_\_\_ (1.0 + 6000) = \_\_**\_60**\_\_\_\_\_\_\_\_

(200.0 - 100.00)

**1.2. Metric-English conversion (3 pts)**

 8. Given 1 m =1.094 yd; 12 inches = 1 ft; 1 yd=3 ft

 Convert 5 meters to inches to 3 sig figs using just the data above: (show work)

 **5 ~~m~~\* 1.094 ~~yd~~ \* 3 ~~ft~~ \* 12 in = 197 inches**

 **~~m~~ ~~yd~~  ~~ft~~**

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**1.3. Metric-metric conversions ( 9 pts total/3 pts each)**

5000 kg = \_\_**5**\_\_\_\_\_\_\_\_ Mg 5000 kg/Mg = 5000\*103/106 = 5

0.003 ms = \_\_\_\_\_**3**\_\_\_\_\_\_\_ μs 0.003 ~~ms~~\* 10-3 ~~s~~ \* 1 μs =3 μs

 ~~ms~~ 10-6 ~~s~~

0.500 nm = \_\_**\_500**\_\_\_ pm n🡪p

 -9 -12 x=0.500\*10initial-final =0.500\*10-9-(-12) =500

 120 cm

**1.4. Basic Wave calculations (show work) 2 pts each/4 pts total**

For the wave train shown to the right:



1. Compute the wavelength λ in meters: λ=\_\_0.3\_\_\_ m

120 cm/4 waves = 30 cm/ wave = 0.3 m/wave

1. Given that the wave above is traveling a the speed of light

c=3\*108 m/s, what is the frequency of the wave train above ? f= \_\_\_\_109\_\_\_\_\_\_\_\_\_\_Hz

c/λ =f =3\*108/0.3 =109 Hz

**1.5. Photoelectric Effect and Planck’s Equation (show work or no credit) 10 pts total**

1. What is the chief conclusion drawn from the Photoelectric effect: (1 pt)
2. Energy of light is not connected to its amplitude.
3. Light must be thought of as a series of massless bullets called photons.
4. E/photon=hf.
5. Light is not strictly a wave.
6. **All of the above**
7. Given: c= 3\*108 m/s and h = 6.63\*10-34 J\*s:
8. Compute the frequency, f, of a photon with an energy of 1.326\*10-20 J. (3 pts)

**1.326\*10-20/6.63\*10-34 =2EE+13**

 f= \_\_\_2EE+13\_\_Hz

1. Compute the wavelength, λ, of light associated with a photon energy of 3.978\*10­-19 J.

( 3 pts)

 **3.978\*10-19= E=hc/λ =1.989\*10‑25/λ=> λ=1.989\*10‑25/3.978\*10 -19 meters =5\*10‑7**

λ = \_\_**5\*10-7**\_\_\_\_ m

1. Given a photon wavelength of 1.989\*10-6 m, what is the photon energy, E ?

(3 pts) f=c/λ = 3\*108/1.989\*10‑6=1.5083\*1014

 **E=hf= 6.63\*10-34\*1.5083\*1014=1\*10‑19 J**

E/photon=\_\_\_\_**1\*10-19**\_\_\_\_\_\_\_ J

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 **1.6. The Long, Twisting Evolutionary Path of the Atomic Model (23 pts)**

a) Match the pictures to the atomic models listed below ( 5 pts)

 \_\_\_ \_\_\_ \_\_\_ 3p

 \_\_\_ 3s

 \_\_\_ \_\_ \_\_\_ 2p

 \_\_\_ 2s

\_\_\_ 1s

 **A B C D E**

1. Rutherford’s atom\_\_**B**\_\_\_ (2) Thomson’s atom \_\_**D**\_\_\_\_ (3) Bohr’s atom \_\_\_**C**\_\_\_

 (4) Schrödinger’s atom \_**E**\_\_\_ (5) Spectroscopist’s atom \_**A**\_\_\_\_

b) List the above atomic models in order of their appearance from earliest to latest in development

 Use their assigned numbers in (parentheses) above.

 \_\_\_**2**\_\_\_ then \_\_\_**1**\_\_\_ then \_\_\_**3**\_\_\_ then \_\_\_**5**\_\_\_\_ then \_\_**4**\_\_\_\_\_ 2 pts

**Earliest D B C A E Latest**

1. Each of the atomic models above has one of the flaws listed below.

Match the flaw to the model using their assigned numbers in (parentheses) above. ( 5 pts)

 Flaw model

1. Flunks Gold foil experiment. \_2\_**D**\_
2. Unable to explain why the Earth shouldn’t be the size of a golf ball. \_1\_**B**\_
3. Unable to explain spectral behavior of atoms more complicated than H. \_3\_**C**\_
4. Mathematics becomes too hard for multi-electronic systems. \_4\_**E**\_
5. Not really a model or picture; just the stinking facts. \_5\_**A**\_\_\_
6. DeBroglie’s famous hypothesis: p=mv=h/λ, asserts that: (circle your choice) 2 pts
7. The energy of light is like a massless bullet and is not a wave.
8. The rest mass of matter is convertible to energy and vice versa.
9. **Since light has particle traits, particles can have wave traits.**
10. Atomic scale matter moves via quantum stutter steps or magic popcorn.
11. Electrons will act differently depending on whether you look at them or not.
12. Bohr’s model includes which details? 2 pts
13. EH = -Constant \*n2 , n=± 1,2,3…; assigns nf and ni to solar spectrum transitions
14. **Correct estimate of the atomic radius of H; EH = -Constant/n2, n=1,2,3…**
15. Computes Rydberg’s constant from theory correctly; EH = +Constant/n2, n=0,1,2…
16. An explanation of the effect of magnetic fields on H spectrum;
17. An explanation of the Davisson-Germer electron effects.

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Match each of the items listed to the scientist(s) who employed it: (6 pts)

Scientist(s) item used

Nameless spectroscopists\_\_f\_\_ (a) Alpha particles and a dark, dark, dark room

Bohr \_\_e\_\_ (b) Beam of neutral silver atoms, magnets + cigar smoke

Thomson \_\_d\_\_ (c) Diffraction grating and `spooky’ electrons

Rutherford \_\_a\_\_ (d) Cathode ray tube he didn’t build himself

Davison & Germer \_\_c\_\_ (e) Pencil, paper + a basement room in the Cavendish lab

Stern & Gernlach \_\_b\_\_ (f) Burnt atoms and a surly disposition with theoreticians

**1.7. Electronic Configurations (20 points)**

1. Using the Periodic Tables provided, write down the **complete** electronic configurations for:

**Element Complete electronic configuration (2 pts each)**

S 1s22s22p63s23p4

B 1s22s22p1

Ca 1s22s22p63s23p64s2

Li 1s2 2s1

1. Circle which part(s) of each configuration below is wrong (1 pt each)

N = **1s 2 2s 2 1p 3 Ba = [Ar] 6s 2 Be = 1s 2  2s 1 C= 1s2 2p2**

1. Write down the correct, abbreviated electronic configurations for the transition elements below. (Remember that Mn+ means that the metal in question has lost n electrons.)

**(3 pts each)**

Cu+ [Ar] 3d104s0

Cr+ [Ar]3d5 4s0

Fe2+ [Ar]3d5 4s1

1. What did the atomic orbital designations s, p, d and f originally describe ?? (1 pt)

s=sharp atomic emission line p =principal (strong) atomic emission line

d=weak, diffuse atomic emission line f= fundamental (end of spectral series) atomic emission line

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**1.8** **Quantum Number Predictions for the Atom (2 pts each/10 pts total)**

1. Given n=3, L=2, how many different orbitals are possible ? \_\_\_\_**5**\_\_\_\_\_\_\_
2. Which element(s) can have n= 3, L= 0 ? \_\_\_\_\_\_\_\_\_\_**Na, Mg**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What is the maximum number of electrons which have n=2, L=1 ? \_\_\_**6**\_\_\_\_\_\_\_\_
4. How many orbitals can have the designation: 5p ? \_\_\_\_**3**\_\_\_\_\_\_\_\_
5. How many orbitals have the designation 5dxy ? \_\_**1**\_\_\_\_

**1.9 True/False**

1. Any day doing chemistry is a good day True True

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