**Exam 3: Introduction to Chemistry Spring 2015**

Monday 4 May 2015

Your name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_answers\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1) Write the complete molecular reaction for the compounds below assuming that AgCl is the only species formed as a final precipitate. (2 pts)

Ag(HSO3)(aq) + LiCl(aq)-🡪 LiHSO3(aq) + AgCl(s)

2) Write the equivalent complete ionic reaction for the reaction above: (note: Ag is +1

HSO3 is -1, Li is +1 and Cl is -1) (2 pts)

Ag+ + HSO3- + Li+ + Cl- AgCl(s) + HSO3- + Li+

3) Write the equivalent net ionic reaction for the reaction above: (2 pts)

Ag+ + Cl- AgCl(s)

4) Balance and write the complete molecular reaction occurring between CaCl2 and K2SO4.

The charges on the various ions are: Ca2+, Cl-1, K+1 andf (SO4)2-. The final Calcium salt formed

can be presumed to be a solid. (2 pts)

CaCl2(aq) + K2SO4(aq) CaSO4(s) + 2KCl(aq)

5) Using the solubility rules provided, decide whether the following compounds are soluble (aq) or insoluble (s) in water: (1 pt each)

a) Ag2S aq s

b) Ca(C2H3O2)2 aq s

c) Na2O aq s

d) PbCO3  aq s

e) KCl aq s

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6) Complete and balance the acid-base reactions below: 2 pts each

H(NO3)(aq) + LiOH(aq) 🡪 H2O + LiNO3(aq)

H2SO4(aq) + Mg(OH)2(aq) 🡪 2H2O + MgSO4(aq)

\_2\_HNO3(aq) + Ca(OH)2(aq) 🡪 2H2O + Ca(NO3)2(aq)

(needs a coefficient)

7) A Brnsted base is a(n) \_\_\_\_\_\_\_proton acceptor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8) An Arrhenius base is a(n) \_\_\_\_\_\_OH- donor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9) What are the acid(A), base(B) , conjugate acid (CA) and conjugate base (CB) in the reactions below? (Write A, B, CB and CB above appropriate species below)

A B CB CA

HPO42- + CO32- -🡪 PO42- + HCO3- (2 pts)

A B CB CA

HClO4 + H(SO4)- 🡪 ClO4- + H2(SO4) (2 pts)

B A CA CB

H(CrO4)‑ + H2PO3- 🡪 H2CrO4 +HPO32- (2 pts)

10) Complete the water-splitting hydrolysis reaction proposed by Brnsted below: (2 pts)

CO32- + H-OH 🡪 HCO3- + OH-

11) Which species in the list below are Brnsted bases ? ( 2 pts) [circle your choice(s)]

**HCl OH- Na PO43- K+**

12a) gaining electrons means \_\_\_\_\_reduction\_\_\_\_\_\_\_\_\_\_\_

12b) oxidation means\_\_\_\_losing\_\_\_\_\_\_\_\_\_\_\_\_ electrons

13) What is the oxidation number for each element (per element) in the compounds below:

H2O CO2 H3PO4

H=+1\_\_ C=\_\_+4\_ H=\_+1\_\_ O=\_-2\_\_\_

O=\_-2\_\_ O=\_-2\_\_ P= \_+5\_\_

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14) Who is oxidized in the reaction below ?

C + O2 -🡪 CO2 \_\_\_C\_\_\_\_ is oxidized (2 pts)

15) What is reduced in the reaction below ?

Mgo + 2HCl 🡪 H2 + MgCl2 \_\_\_\_H\_\_\_\_ is reduced (2 pts)

15) Name two problems with the Rutherford atom model

problem 1:\_\_\_\_\_\_\_\_\_\_can’t explain why + nucleus doesn’t suck in - electrons\_\_\_\_\_\_

problem 2:\_\_\_\_\_\_\_\_\_\_\_can’t explain why the sun shows only discrete wavelength emissions\_\_\_\_

For the next 5 problems assume:

**The speed of light, c=3\*108 m/s. Planck’s constant, h=6.63\*10-34 J\*s**

**(3 pts each)**

16) If a wave has a frequency of 6\*105 cycles per second, what is the wavelength, λ in meters (m):

c=3\*108= fλ=6\*105\*λ

3\*108/6\*105 =5\*102 m=500 m λ= \_\_\_500\_\_\_ m

17) If a wave has a wavelength of 1.5\*10-3 m, what is its frequency f in cycles pers second (1/s)?

c=3\*108= fλ=f\*1.5\*10-3

3\*108/1.5\*10-3 =2\*1011

f= \_\_2\*1011\_\_\_\_\_ cps

18) What is the energy of light with a frequency f= 6.032\*1034 ?

E=hf=6.63\*10-34\*6.032\*1034~ 40 J

E= \_\_40\_\_\_\_\_\_\_\_\_\_ J

19) What is the energy of light with a wavelength of 9.945 meters (m) ?

Find f first: c=3\*108= fλ=f\*9.945

3\*108/9.945=f=0.301659\*108

E=hf=6.63\*10-34\*0.301659\*108=2\*10-26 E= \_\_\_2\*10--26\_\_\_\_\_\_\_\_ J

20) A photon has an energy of 1.989\*10-21 J. What is the wavelength of the photon in m ?

E=1.989\*10\_21= hf=6.63\*10-34f

1.989\*10-21/6.63\*10-34 =f=3\*1012

c=3\*108= fλ=3\*1012\*λ

3\*108/3\*1012=λ=10-4 m λ= \_\_\_\_\_10‑4\_\_\_\_\_\_\_\_ m

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21) Use the Periodic Table provided to describe the complete electronic configuration of:

(3 pts each)

O 1s22s22p4

Mg 1s22s22p63s2

S 1s22s22p63s23p4

22) Use the Periodic Table provide to describe the abbreviated electronic configuration of:

(2 pts each)

Al [Ne]3s23p1

Ca [Ar]4s2

Cl [Ne]3s23p5

Zn [Ar]3d10 4s2

(remember to d-s switch)

23) Draw the correct pigeonhole configurations for the various species below. (Make sure to correct for

charges; a (+1) means the element has lost 1 electron from its usual count.) (2 pts each)

**Fe2+  [Ar]**

**Cu [Ar]**

**Cu1+ [Ar]**

**Ru3+ [Kr]**

**Mn2+ [Ar]**

24) Provide the correct Lewis dot structures for: (1 pt each)

. ..

:N: :Ca :Ar:

..

25) Provide the correct Lewis structures for the compounds below. Include lone pairs ! ( 2 pt each)







**H2O CO2 N2**

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