The Periodic Table

IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
H 1 1.01	IIA																He 2 4.00
Li 3 6.94	Be 4 9.01											B 5 10.81	C 6 12.01	N 7 14.01	O 8 16.00	F 9 19.00	Ne 10 20.18
Na 11 22.99	Mg 12 24.31	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	Al 13 26.98	Si 14 28.09	P 15 30.97	S 16 32.07	Cl 17 35.45	Ar 18 39.95
K 19 39.10	Ca 20 40.08	Sc 21 44.96	Ti 22 47.88	V 23 50.94	Cr 24 52.00	Mn 25 54.94	Fe 26 55.85	Co 27 58.93	Ni 28 58.69	Cu 29 63.55	Zn 30 65.39	Ga 31 69.72	Ge 32 72.61	As 33 74.92	Se 34 78.96	Br 35 79.90	Kr 36 83.80
Rb 37 85.47	Sr 38 87.62	Y 39 88.91	Zr 40 91.22	Nb 41 92.91	Mo 42 95.94	Tc 43 (97.9)	Ru 44 101.07	Rh 45 102.91	Pd 46 106.42	Ag 47 107.87	Cd 48 112.41	In 49 114.82	Sn 50 118.71	Sb 51 121.76	Te 52 127.60	I 53 126.90	Xe 54 131.29
Cs 55 132.91	Ba 56 137.33	La 57 138.91	Hf 72 178.49	Ta 73 180.95	W 74 183.85	Re 75 186.21	Os 76 190.2	Ir 77 192.22	Pt 78 195.08	Au 79 197.97	Hg 80 200.59	Tl 81 204.38	Pb 82 207.2	Bi 83 208.98	Po 84 (209)	At 85 (210)	Rn 86 (222)
Fr 87 223.02	Ra 88 226.03	Ac 89 227.03	Rf 104 (261)	Db 105 (262)	Sg 106 263)	Bh 107 (262)	Hs 108 (265)	Mt 109 (266)	Ds 110 (271)	Rg 111 (272)	Uub 112 (285)	Uut 113 (284)	Uuq 114 (289)	Uup 115 (288)			

Ce 58 140.12	Pr 59 140.91	Nd 60 144.24	Pm 61 (145)	Sm 62 150.36	Eu 63 152.97	Gd 64 157.25	Tb 65 158.93	Dy 66 162.50	Ho 67 164.93	Er 68 167.26	Tm 69 168.93	Yb 70 173.04	Lu 71 174.97
Th 90 232.04	Pa 91 231.04	U 92 238.03	Np 93 237.05	Pu 94 (240)	Am 95 243.06	Cm 96 (247)	Bk 97 (248)	Cf 98 (251)	Es 99 252.08	Fm 100 257.10	Md 101 (257)	No 102 259.10	Lr 103 262.11

Some Useful Formulae and Constants:

$pH = pK_a + \log_{10}\{[\text{Conjugate base}]/[\text{Conjugate acid}]\}$

$K_w = 1 \times 10^{-14}$ @ 25°C

SID | | | | | | | | | Last _____ First _____

Question 1 **5 Points**

Consider the following system at equilibrium at 500 K:

$PCl_5(g)$ + 21.0 kcal ⇔ $PCl_3(g)$ + $Cl_2(g)$

The production of **$PCl_3(g)$** is favored by:

Indicate **True** or **False** for each of the following:

- ❑ **Increasing** the temperature. _____
- ❑ **Decreasing** the pressure. _____
- ❑ **Decreasing** the volume. _____
- ❑ **Adding PCl_5.** _____
- ❑ **Removing** Cl_2. _____

Question 2 **4 Points**

Consider the following system at equilibrium at 573 K:

2 NOCl(g) ⇔ 2 NO(g) + $Cl_2(g)$

If the **Volume** of the equilibrium system is suddenly decreased at constant temperature:

The reaction must:

- ❑ Run in the forward direction.
- ❑ Run in the reverse direction.
- ❑ Remain the same

The **number of moles of Cl_2** will:

- ❑ Increase.
- ❑ Decrease.
- ❑ Remain the same

Question 3 **4 Points**

Write a net ionic equation to show that **ammonia** behaves as a **base** in **water**.

_____ + $H_2O(l)$ ⇔ _____ + _____

Question 4 **8 Points**

Assign each species on the **left** to a **category** on the **right**.

- ❑ **NaOH** _____
- ❑ **HNO_2** _____
- ❑ **HCN** _____
- ❑ **C_9H_7N** _____

1. Strong Acid
2. Weak Acid
3. Strong Base
4. Weak Base

Question 5 **6 Points**

An aqueous solution has a **hydroxide** ion concentration of **1.0×10^{-5} M**.

- ❑ What is the **hydronium** ion concentration in this solution? _____M
- ❑ Is this solution **acidic**, **basic** or **neutral**? _____

Question 6 (9 Points) The pH of an aqueous solution at 25 °C was found to be 7.30.

a. The **hydronium** ion concentration is: _____ M

b. The **hydroxide** ion concentration is: _____ M

c. The **pOH** is: _____

Question 7 (6 Points) Arrange the following solutions in order of decreasing acidity:
1 = most acidic ; 3 = least acidic

1. $[H_3O^+] = 1x10^{-10}M$ _____
2. pOH = 7 _____
3. $[OH^-] = 1x10^{-13}M$ _____

Question 8 (6 Points) In the following **net ionic equation**, identify **each reactant** as either a **Bronsted-Lowry acid** or a **Bronsted-Lowry base**:

$$(C_2H_5)_3N(aq) + H_2O(l) \Leftrightarrow (C_2H_5)_3NH^+ + OH^-$$

Bronsted-Lowry acid: BLA **Bronsted-Lowry base: BLB**

- ❑ **$(C_2H_5)_3N$** _____
- ❑ **H_2O** _____

Question 9 (6 Points) Give the formula for:

1. The **conjugate acid** of **HCO_3^-** _____
2. The **conjugate base** of **HCO_3^-** _____

Question 10 (6 Points) Which of the following aqueous solutions are buffer solutions?

- ❑ 0.24 M HI + 0.18 M NaI
- ❑ 0.34 M NH_4NO_3 + 0.39 M $NaNO_3$
- ❑ 0.10 M CH_3COOH + 0.18 M CH_3COOK
- ❑ 0.10 M HCl + 0.21 M NaF
- ❑ 0.27 M NH_4Br + 0.31 M NH_3

Question 11 (4 Points) A buffer solution is **0.622 M** in **HCN** and **0.373 M** in **KCN**. If **Ka** for HCN is **$4.0x10^{-10}$**, what is the pH of this buffer solution?
Must show work

pH =

Question 12 **8 Points**

A 1L buffer solution solution contains 0.25 mol of NaCN and 0.15 mol of HCN.
(Chose a number from the list on the right that best describes what happens upon –)

- Addition of 0.05 mol of HCl will cause the [HCN] to ____
- Addition of 0.05 mol of HCl will cause the pOH to ____
- Addition of 0.05 mol of NaOH will cause the [HCN] to ____
- Addition of 0.2 mol of NaOH will cause the pH to ____

1. Increase significantly
2. Increase
3. Increase slightly
4. Decrease significantly
5. Decrease
6. Decrease slightly

Question 13 **8 Points**

Write a balanced nuclear equation for the following:

- $^{238}_{92}\mathbf{U}$ undergoing alpha emission: _____ = _____
- $^{137}_{55}\mathbf{Cs}$ undergoing beta decay: _____ = _____
- $^{10}\mathbf{C}$ undergoing positron emission: _____ = _____
- $^{51}_{24}\mathbf{Cr}$ undergoing electron capture: _____ = _____

Question 14 **8 Points**

You need to make an aqueous solution of **0.121** M **ammonium carbonate** for an experiment in lab, using a **125** mL volumetric flask. How much solid **ammonium carbonate** should you add?
Must show work

_____ *g*

Question 15
4 Points

How many **moles** of **hydrochloric acid** will be formed upon the complete reaction of **1.5 moles** of **water** with excess **chlorine gas?**

Chlorine (g) + water (l) = hydrochloric acid (aq) + chloric acid ($HClO_3$)

Must show work and include a balanced chemical equation.

_____ mol

Question 16
8 Points

How many grams of solid **aluminum hydroxide** are required to neutralize **15.5 mL** of a **2.65** M solution of **perchloric acid**.

Must show work and include a balanced chemical equation.

_____ g

Exam III Score _____