The Periodic Table

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
H 1 1.01																	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											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:

$$pH = pKa + \log_{10} \frac{[Base]}{[Acid]}$$

$25^{0}C = 298K$

$K_w = 1 \times 10^{-14}$ @ $25^{\circ}C$

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

Question 1 (7 Points)

a) Write a **net ionic equation** to show that **hydrocyanic** acid, behaves as an acid in water.

$HCN(aq) + H_2O(l)$ _____ _____ + _____

(= or ⇔)

b) Write a **net ionic equation** to show how **barium hydroxide** behaves as a base in water.

_____ _____ _____ + _____

(= or ⇔)

Question 2 (8 Points)

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

a) HF _____

b) $Ba(OH)_2$ _____

c) $(CH_3)_2NH$ _____

d) HNO_3 _____

1. Strong Acid

2. Weak Acid

3. Strong Base

4. Weak Base

Question 3 (6 Points)

An aqueous solution has a **hydroxide ion** concentration of **1.0×10^{-2} M**.

a) What is the **hydronium ion** concentration in this solution? _____ M

b) Is this solution **acidic**, **basic** or **neutral**? _____

Question 4 (6 Points)

An aqueous solution has a **pH** of **8.30**

a) What is the **pOH** of this solution? _____

b) What is the **hydronium ion** concentration in this solution? _____ M

c) What is the **hydroxide ion** concentration in this solution? _____ M

Question 5 (6 Points)

Arrange the following solutions in order of **increasing acidity**:
1 = **least acidic** ; 3 = **most acidic**

a) Solution with a **pOH = 8** _____

b) Solution with a **hydroxide ion** concentration = **1×10^{-10} M** _____

c) Solution with a **hydronium ion** concentration = **1×10^{-13} M** _____

Question 6 (3 Points)

Hydrocyanic acid (HCN) has a Ka = **4.0×10^{-10}** @ 25°C. Which of the following **amino acids** has an **acid strength closest** to that of **HCN**?

☐ Arginine pKa = 12.0

☐ Lysine pKa = 9.0

☐ Cysteine pKa = 8.3

☐ Histidine pKa = 6.1

Question 7 — **9 Points**

In the following net ionic equation:

$$CH_3NH_2(aq) + H_2O(l) \rightleftharpoons CH_3NH_3^+ + OH^-$$

a) CH_3NH_2 is a Bronsted-Lowry _____

b) H_2O is a Bronsted-Lowry _____

c) The formula of the **product** that acts as a **proton acceptor**: _____

Question 8 — **6 Points**

a) The formula for the **conjugate acid** of **HSO_3^-** is: _____

b) The formula for the **conjugate base** of **HSO_3^-** is: _____

Question 9 — **4 Points**

Which of the following aqueous solutions are **buffer solutions?**

- ☐ 0.21M HI + 0.17M KI
- ☐ 0.13M NaOH + 0.24M NaCl
- ☐ 0.16M CH_3COOH + 0.21M CH_3COOK
- ☐ 0.31M HClO + 0.28M KClO
- ☐ 0.26M NH_4NO_3 + 0.37M KNO_3

Question 10 — **8 Points**

A buffer solution is made that is **0.432M** in **H_2S** and **0.432M** in **NaHS**

(2 Points)

a) If Ka for H_2S is 1.0×10^{-7}, what is the **pH of the buffer solution?** _____

(4 Points)

b) Write the **net ionic equation** for the reaction that occurs when 0.088mol **HBr** is **added** to 1.00 L of the buffer solution.

_____ + _____ = _____ + _____

(2 Points)

c) The **Buffer capacity** for removal of added **OH^-** is: _____ M

Question 11 — **5 Points**

A buffer solution is **0.398M** in **HCN** and **0.324M** in **NaCN**. If **Ka** for **HCN** is 4.0×10^{-10}, what is the **pH of this buffer** solution?

For full credit you must show work

pH = _____

Question 12 (6 Points)

The pKa value for HNO_2 is **3.35**.

(3 Points) a) Would a buffer prepared from **HNO_2** and **KNO_2** with a **pH of 3.00** be considered to be an effective buffer? (Yes or No) _____

(3 Points) b) A buffer in which the mole ratio of **KNO_2** to **HNO_2** is **0.46**.

Would this buffer solution have a greater capacity for added acid (**H_3O^+**) or added base (**OH^-**)? _____

Question 13 (4 Points)

A small amount of **strong base** is added to a **buffer** made from **HCN** and **NaCN**. What changes if any will occur to the following.

Choose from the following choices:

Increase significantly	**Increase**	**Increase slightly**
Decrease significantly	**Decrease**	**Decrease slightly**

a) **pOH** _____

b) **[HCN]** _____

Question 14 (6 Points)

Whether or not the process is observed in nature, which of the following could account for the following transformations: (Choose all that apply)

a) $^{234}U \rightarrow {}^{230}Th$

- ☐ alpha decay
- ☐ beta decay
- ☐ electron capture
- ☐ positron emission

b) $^{210}Pb \rightarrow {}^{210}Bi$

- ☐ alpha decay
- ☐ beta decay
- ☐ electron capture
- ☐ positron emission

c) $^{51}Cr \rightarrow {}^{51}V$

- ☐ alpha decay
- ☐ beta decay
- ☐ electron capture
- ☐ positron emission

Question 15 (4 Points)

You need to make an aqueous solution of **0.145M iron(III) sulfate** for an experiment in lab, using a **500mL** volumetric flask. How many **grams** of **iron(III) sulfate** should you add?:

For full credit you must show work.

_____ **g**

Question 16 **6 Points**	An aqueous solution of **barium hydroxide** is standardized by titration with a **0.199M** solution of **hydrochloric acid**. If **21.0mL** of base are required to neutralize **18.9mL** of the acid, what is the **molarity** of the **barium hydroxide** solution? *For full credit you must show work and give a balanced chemical equation.* _____ **M**
Question 17 **6 Points**	According to the following reaction, **how many grams of water** will be formed upon the complete reaction of **29.0 grams of oxygen gas** with **excess hydrochloric acid?** hydrochloric acid (aq) + oxygen (g) ⟶ water (l) + chlorine (g) *For full credit you must show work and give a balanced chemical equation.* _____ **g**

Do Not Write Below This

Exam III Score