The Periodic Table

IA																	VIIIA
H 1 1.01	IIA											IIIA	IVA	VA	VIA	VIIA	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 Formula and Constants:

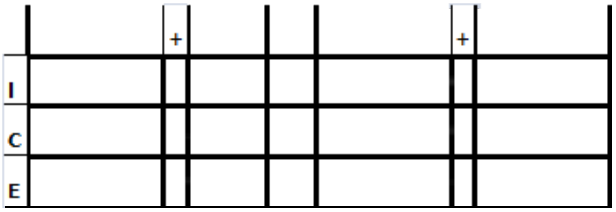
K_w @25°C = 1.00×10^{-14}

$K_a K_b = K_w$

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

Question 1
9 Points

The substance **hydrocyanic acid** (**HCN**) is a weak acid (**Ka = 4.90x10^{-10}**).
What is the **pH** of a **0.322 M** aqueous solution of **sodium cyanide**?



pH = _____

Question 2
9 Points

With respect to the following acid base reactions, indicate whether the resulting solution will be **acidic**, **basic**, or **neutral**:

1. When **35** mL of **0.40 M HClO** and **35** mL of **0.40 M sodium hydroxide** are combined: _____
2. When **35** mL of **0.400 M nitric acid** and **35** mL of **0.400 M sodium nitrite** are combined: _____
3. When **50** mL of **0.20 M ammonium iodide** and **50** mL of **0.20 M potassium hydroxide** are combined: _____

Question 3
9 Points

The following questions pertain to a buffer solution that is **0.102** M in **NH_3** (**ammonia**) and **0.131** M in **NH_4Br**. **$K_b(NH_3) = 1.8x10^{-5}$ @25°C**

1. Write the net ionic equation for the removal of added H_3O^+ to this buffer:
   _____ + **H_3O^+** = _____ + _____
2. What is the **buffer capacity** for **addition** of **strong base**: _____
3. The choice of **NH_4^+** suggests that the **desired pH** is close to: _____

Question 4
9 Points

Identify buffer solutions from the following list.
Choose all that apply.

- ☐ 0.30M $HNO_2(aq)$ + 0.25M $KNO_2(aq)$
- ☐ 0.15M NaOH(aq) + 0.30M ammonium chloride(aq)
- ☐ 0.40M Ammonium chloride + 0.30M Ammonia
- ☐ 0.30M HCl(aq) + 0.30M KF(aq)
- ☐ 0.20M $HNO_3(aq)$ + 0.15M $NaNO_2(aq)$

Question 5
9 Points

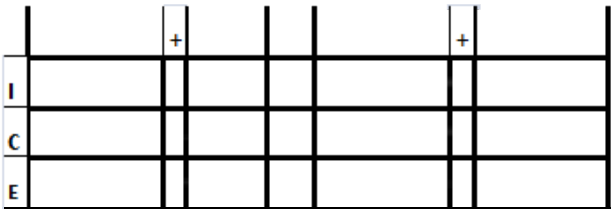
Rank the following salts from **1-3** in order of **increasing solubility** with **1 being the most soluble** and **3 being the least soluble**.

- **AgCN** $K_{sp} = 1.2 \times 10^{-16}$ _____
- **CaF_2** $K_{sp} = 3.9 \times 10^{-11}$ _____
- **$Zn_3(PO_4)_2$** $K_{sp} = 9.1 \times 10^{-33}$ _____

Question 6
9 Points

The **maximum** amount of **chromium(III) hydroxide** that will dissolve in a **0.255M chromium(III) nitrate** solution is:

Chromium(III) hydroxide: Ksp = 6.70×10^{-31}



_____ **M**

Question 7
10 Points
(4+6)

Write a balanced net ionic equation to show why the solubility of **$Mn(OH)_2(s)$ increases** in the **presence of a strong acid** and **calculate the equilibrium constant** for the reaction **of this sparingly soluble salt with acid**.

Must show work when calculating K – Ksp $Mn(OH)_2 = 4.6 \times 10^{-14}$

_____ + _____ = _____ + _____

K = _____

Question 8
12 Points

Rank the following substances from **1-4** in order of **increasing entropy** with **1 being the lowest entropy** and **4 being the highest entropy**.

- **$CH_3CHO(g)$** _____
- **$CH_3OH(g)$** _____
- **$(CH_3)_2CO(g)$** _____
- **$HCHO(g)$** _____

Question 9
6 Points

Consider the reaction: $2\ H_2O_2(l) \longrightarrow 2\ H_2O(l) + O_2(g)$

Using standard absolute entropies at 298K, calculate the entropy change for the **system** when **2.38** moles of **$H_2O_2(l)$** react at standard conditions?

S° (J/K.mol): $H_2O_2(l)$: 109.6 $O_2(g)$: 205.1 $H_2O(l)$: 69.9

_____ **J/K**

Question 10
6 Points

Consider the reaction: $2\ CO(g) + 2\ NO(g) \longrightarrow 2\ CO_2(g) + N_2(g)$

for which ΔH° = **-746.6 kJ** and ΔS° = **-198 J/K** at **298 K**.

Calculate **the entropy change** of the **UNIVERSE when 1.57 moles of NO(g)** react under standard conditions at **298 K**.

$\Delta S^\circ_{Universe}$ = _____ **J/K**

- Is this reaction **reactant** or **product** favored? _____

Question 11
6 Points

Without doing any calculations, **match** the following **thermodynamic properties** with their appropriate numerical value given on the right for the following **endothermic reaction**.

$2\ H_2O(g) + 2\ Cl_2(g) \longrightarrow 4\ HCl(g) + O_2(g)$

- ΔS_{rxn} _____
- ΔG_{rxn} _____
- $\Delta S_{universe}$ _____

1. **> 0**
2. **< 0**
3. **= 0**
4. **> 0 at low T, < 0 at high T**
5. **< 0 at low T, > 0 at high T**

Question 12
6 Points

For the reaction

$Fe(s) + 2HCl(aq) = FeCl_2(s) + H_2(g)$ ΔH° = **-7.4 kJ and** ΔS° = **107.9 J/K**

a) The **standard free energy change** for the reaction of 1.63 moles of Fe(s) at 291 K, 1 atm would be kJ.

_____kJ

b) The reaction is (**reactant, product**) **favored** under these conditions. _____

Assume that ΔH° and ΔS° are independent of temperature.

Do Not Write Below This Line

Exam III Score