Exit Exam (Written Portion)

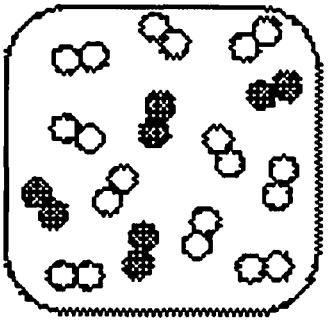
Name _____

Get at least 3/5 correct to pass.

1) What volume of 0.108 M H_2SO_4 is required to neutralize 25.0 mL of 0.145 M KOH ?

2) What is the $[H^+]$ in a solution in which $[HA] = 4.0 \times 10^{-2}$; $[A^-] = 2.0 \times 10^{-2}$, and $K_a = 3.0 \times 10^{-6}$?

3) If Nitrogen atoms are represented as filled circles, and Oxygen atoms as open circles, how much NO_2 can be prepared from this mixture ?



4) What is the specific heat capacity of Mercury (in $J.g^{-1}.{}^{o}C^{-1}$) if a 25.0g sample requires 19.3 J to raise its temperature from 24.5°C to 30.0°C ?

5) A mineral containing iron(II) sulfide but no other sulfides is treated with excess hydrochloric acid to produce hydrogen sulfide. If a 3.15 g sample of the mineral yields 448 mL of hydrogen sulfide gas (measured at 0.0 °C and 760 mmHg), what is the mass percentage of iron(II) sulfide in the sample ?

ABBREVIATIONS AND SYMBOLS					
ampere	A	Faraday constant	F	molal	m
atmosphere	atm	formula molar mass	M	molar	M
atomic mass unit	u	free energy	G	molar mass	M
atomic molar mass	A	frequency	v	mole	mol
Avogadro constant	N_A	gas constant	R	Planck's constant	h
Celsius temperature	°C	gram	g	pressure	P
centi- prefix	c	heat capacity	C_p	rate constant	k
coulomb	C	hour	h	retention factor	R_f
electromotive force	E	joule	J	second	s
energy of activation	E_a	kelvin	K	temperature, K	T
enthalpy	H	kilo- prefix	k	time	t
entropy	S	liter	L	volt	V
equilibrium constant	K	milli- prefix	m		

CONSTANTS
$R = 8.314\ \text{J·mol}^{-1}\text{·K}^{-1}$
$R = 0.0821\ \text{L·atm·mol}^{-1}\text{·K}^{-1}$
$1\ F = 96{,}500\ \text{C·mol}^{-1}$
$1\ F = 96{,}500\ \text{J·V}^{-1}\text{·mol}^{-1}$
$N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$
$h = 6.626 \times 10^{-34}\ \text{J·s}$
$c = 2.998 \times 10^{8}\ \text{m·s}^{-1}$
0 °C = 273.15 K
1 atm = 760 mmHg

EQUATIONS

$$E = E^\circ - \frac{RT}{nF}\ln Q \qquad \ln K = \left(\frac{-\Delta H}{R}\right)\left(\frac{1}{T}\right) + \text{constant} \qquad \ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

PERIODIC TABLE OF THE ELEMENTS

1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H 1.008	2 2A																2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (277)				

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Exit Exam (Written Portion)

Name EXIT EXAM #2

Get at least 3/5 correct to pass.

1) What volume of 0.108 M H_2SO_4 is required to neutralize 25.0 mL of 0.145 M KOH ?

$H_2SO_4 + 2\,KOH \longrightarrow K_2SO_4 + 2H_2O$

Moles of KOH $= \frac{25}{1000} \times 0.145 = 0.0036$ moles

Stoichiometry tells us twice as many KOH as H_2SO_4

So moles of $H_2SO_4 = \frac{1}{2} \times 0.0036 = 0.0018$ moles

$= 0.108\,M \times \frac{\text{Volume in mL}}{1000}$

So Volume $= 16.8$ mL (3 sig figs)

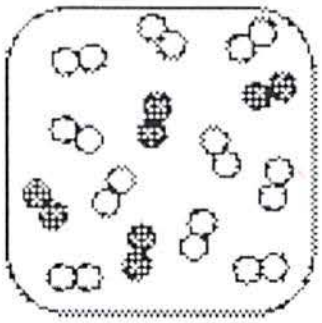
2) What is the $[H^+]$ in a solution in which $[HA] = 4.0\times10^{-2}$; $[A^-] = 2.0\times10^{-2}$, and $K_a = 3.0\times10^{-6}$?

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

So $$3.0\times10^{-6} = \frac{[H^+][2.0\times10^{-2}]}{4.0\times10^{-2}}$$

$\Rightarrow [H^+] = 6.0\times10^{-6}$ moles/L

3) If Nitrogen atoms are represented as filled circles, and Oxygen atoms as open circles, how much NO_2 can be prepared from this mixture ?



$N_2 + 2O_2 \rightleftharpoons 2NO_2$

4 10

Limiting reagent = N_2

So Max NO_2 = twice N_2

= 8 Molecules

4) What is the specific heat capacity of Mercury (in $J.g^{-1}.°C^{-1}$) if a 25.0g sample requires 19.3 J to raise its temperature from 24.5°C to 30.0°C ?

Temperature rise = 30.0 − 24.5

= 5.5 °C

$$SHC = \frac{19.3}{25 \times 5.5} = 0.14\ J.g^{-1}.°C^{-1}$$ (2 sig figs)

5) A mineral containing iron(II) sulfide but no other sulfides is treated with excess hydrochloric acid to produce hydrogen sulfide. If a 3.15 g sample of the mineral yields 448 mL of hydrogen sulfide gas (measured at 0.0 °C and 760 mmHg), what is the mass percentage of iron(II) sulfide in the sample ?

$FeS \rightarrow H_2S$

$PV = nRT$

$\frac{760}{760} \cdot \frac{448}{1000} = n \times 0.082 \times (0.0 + 273.15)$

$\Rightarrow \quad n = 0.02$ moles of FeS.

FeS has FW of $87.91 \frac{g}{mol}$

So 0.02 moles $= 0.02 \times 87.91$

$= 1.76$g of FeS.

$\%$ Mass $= \frac{1.76}{3.15} \times 100 = 56\%$ (2 sig figs)