Exit Exam (Written Portion)

Name _____

Get at least 3/5 correct to pass.

1) A saturated aqueous solution of sucrose, $C_{12}H_{22}O_{11}$ contains 525g of sucrose (MW = 342) per 100g of water. What is the molecular ratio of $C_{12}H_{22}O_{11}$: H_2O in this solution ?

2) What is the mass of 1 molecule of water in grams ?

3) A 100 mL portion of 0.250 M Calcium Nitrate is mixed with 400 mL of 0.100 M Nitric acid solution. What is the final concentration of the Nitrate ion ?

4) At 20.0°C water has $K_w = 6.807 \times 10^{-15}$. What is the pH of pure water at this temperature ?

5) Calculate the change in enthalpy (in kJ per mole of CO_2) for the decomposition of sodium hydrogen carbonate according to the below equation and provided standard enthalpies of formation.

$$2\ NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$$

	ΔH^0_f (in kJ.mol^{-1})
$NaHCO_{3(s)}$	-947.7
$Na_2CO_{3(s)}$	-1130.9
$H_2O_{(g)}$	-241.8
$CO_{2(g)}$	-393.5

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

EQUATIONS

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

PERIODIC TABLE OF THE ELEMENTS

1 1A																	18 8A
1 H 1.008	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	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 #4

Get at least 3/5 correct to pass.

1) A saturated aqueous solution of sucrose, $C_{12}H_{22}O_{11}$ contains 525g of sucrose (MW = 342) per 100g of water. What is the molecular ratio of $C_{12}H_{22}O_{11}$: H_2O in this solution ?

525g of sucrose = $\frac{525}{342}$ = 1.535 moles

100g of water = $\frac{100}{18}$ = 5.55 moles.

$C_{12}H_{22}O_{11}$: H_2O ratio is 1.535 : 5.55

= 1 : 3.62 (or 0.277 : 1)

2) What is the mass of 1 molecule of water in grams ?

MW of H_2O = 18 g/mol

Avagadro's Number = 6.02×10^{23} per mole

1 mole of H_2O = 18 g = 6.02×10^{23} molecules

So 1 molecule = $\frac{18}{6.02 \times 10^{23}}$ = 3.0×10^{-23} g

3) A 100 mL portion of 0.250 M Calcium Nitrate is mixed with 400 mL of 0.100 M Nitric acid solution. What is the final concentration of the Nitrate ion ?

Moles $Ca(NO_3)_2$: $0.25 \times \frac{100}{1000} = 0.025$

Moles of NO_3^- from above $= 2 \times 0.025 = 0.050$ Moles.

Moles HNO_3 $= 0.1 \times \frac{400}{1000} = 0.04$ Moles.

Total NO_3^- : $0.05 + 0.04 = 0.09$ Moles

Total volume = 100ml + 400ml = 500mL.

$[NO_3^-] = 0.09 \times \frac{1000}{500}$

$= \underline{0.180 \text{ Moles.L}^{-1}}$ (3 sig figs)

4) At 20.0°C water has $K_w = 6.807 \times 10^{-15}$. What is the pH of pure water at this temperature ?

$K_w = [H^+][OH^-]$

$= 6.807 \times 10^{-15} = [H^+]^2$

$\therefore [H^+] = 8.2 \times 10^{-8}$ Moles.L^{-1}

$pH = -\log_{10}[H^+]$

$= 7.08$

5) Calculate the change in enthalpy (in kJ per mole of CO_2) for the decomposition of sodium hydrogen carbonate according to the below equation and provided standard enthalpies of formation.

$$2\ NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$$

	ΔH^0_f (in kJ.mol^{-1})
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$CO_{2(g)}$	-393.5

$\Delta H_{reaction}$ = (ΔH_f° products) − (ΔH_f° reagents)

= (−1130.9 − 241.8 − 393.5) − (2x − 947.7)

= −1766.2 + 1895.4

= 129.2 kJ/mol