

Exit Exam (Written Portion)

Name _____

Get at least 3/5 correct to pass.

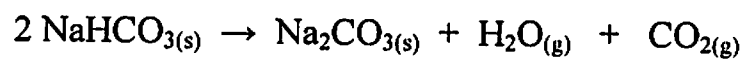
1) A saturated aqueous solution of sucrose, $C_{12}H_{22}O_{11}$ contains 525g of sucrose (MW = 342) per 100g of water. What is the molecular ratio of $C_{12}H_{22}O_{11} : H_2O$ in this solution ?

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 CO₂) for the decomposition of sodium hydrogen carbonate according to the below equation and provided standard enthalpies of formation.



	<u>ΔH_f^0 (in kJ.mol⁻¹)</u>
NaHCO _{3(s)}	-947.7
Na ₂ CO _{3(s)}	-1130.9
H ₂ O _(g)	-241.8
CO _{2(g)}	-393.5

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

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

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

PERIODIC TABLE OF THE ELEMENTS

1	PERIODIC TABLE OF THE ELEMENTS																18				
1A															3A	4A	5A	6A	7A	8A	
1 H 1.008	2 He 4.003															13 B 10.81	14 C 12.01	15 N 14.01	16 O 16.00	17 F 19.00	18 Ne 20.18
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 B 10.81	4 C 12.01	5 N 14.01	6 O 16.00	7 F 19.00	8 Ne 20.18	9 Na 22.99	10 Mg 24.31	11 Al 26.98	12 Si 28.09	13 P 30.97	14 S 32.07	15 Cl 35.45	16 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?

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

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

$$C_{12}H_{22}O_{11} : H_2O \text{ ratio is } 1.535 : 5.55 \\ = \underline{\underline{1 : 3.62}} \text{ (or } \underline{\underline{0.277 : 1}})$$

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

$$\text{MW of } H_2O = 18 \text{ g/mol}$$

$$\text{Avogadro's Number} = 6.02 \times 10^{23} \text{ per mole}$$

$$1 \text{ mole of } H_2O = 18 \text{ g} = 6.02 \times 10^{23} \text{ molecules}$$

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

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?

$$\text{Moles } \text{Ca}(\text{NO}_3)_2 = 0.25 \times \frac{100}{1000} = 0.025$$

$$\text{Moles of } \text{NO}_3^- \text{ from above} = 2 \times 0.025 = 0.050 \text{ moles.}$$

$$\text{Moles } \text{HNO}_3 = 0.1 \times \frac{400}{1000} = 0.04 \text{ moles.}$$

$$\text{Total } \text{NO}_3^- : 0.05 + 0.04 = 0.09 \text{ moles}$$

$$\text{Total volume} = 100 \text{ mL} + 400 \text{ mL} = 500 \text{ mL.}$$

$$[\text{NO}_3^-] = 0.09 \times \frac{1000}{500}$$

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

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

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

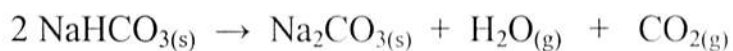
$$= 6.807 \times 10^{-15} = [H^+]^2$$

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

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

$$= \underline{\underline{7.08}}$$

5) Calculate the change in enthalpy (in kJ per mole of CO₂) for the decomposition of sodium hydrogen carbonate according to the below equation and provided standard enthalpies of formation.



	ΔH_f° (in kJ.mol ⁻¹)
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$$\begin{aligned}\Delta H_{\text{reaction}} &= (\Delta H_f^\circ \text{ products}) - (\Delta H_f^\circ \text{ reagents}) \\ &= (-1130.9 - 241.8 - 393.5) - (2 \times -947.7) \\ &= -1766.2 \quad + 1895.4 \\ &= \underline{\underline{129.2 \text{ kJ/mol}}}\end{aligned}$$