Exit Exam (Written Portion)

Name _____

Get at least 3/5 correct to pass.

1) For the below reaction, the rate of disappearance of $N_2O_{5(g)}$ at a certain temperature is 0.016 $mol.L^{-1}.min^{-1}$. What is the rate of formation of $NO_{2(g)}$ in $mol.L^{-1}.min^{-1}$ at the same temperature ?

$$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$$

2) The standard enthalpy of formation of $NH_{3(g)}$ is -46.1 $kJ.mol^{-1}$. Calculate ΔH^0 for the following reaction.

$$2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$$

3) According to the below equation, how many moles of $NH_{3(g)}$ could be formed from the reaction of 0.22 moles of $N_2O_{3(g)}$ with 0.87 moles of $H_{2(g)}$?

$$N_2O_{3(g)} + 6H_{2(g)} \rightarrow 2NH_{3(g)} + 3H_2O_{(g)}$$

4) In a solution of formic acid ($K_a = 1.7x10^{-4}$), the $[H^+] = 2.3x10^{-3}$. What is the concentration of formic acid in $mol.L^{-1}$?

5) A sample of C_2H_6 gas initially at 50.0°C and 720mmHg is heated to 100°C in a container at constant volume. What is the new pressure (in mmHg) ?

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																	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 (???)				

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 #3

Get at least 3/5 correct to pass.

1) For the below reaction, the rate of disappearance of $N_2O_{5(g)}$ at a certain temperature is 0.016 $mol.L^{-1}.min^{-1}$. What is the rate of formation of $NO_{2(g)}$ in $mol.L^{-1}.min^{-1}$ at the same temperature ?

$$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$$

Disappears at 0.016, from stoichiometry, ratio of $N_2O_5 : NO_2$ = 2 : 4

So rate of formation of NO_2 = $0.016 \times \frac{4}{2}$ = $0.032\ mol.L^{-1}.min^{-1}$

(2 sig figs)

2) The standard enthalpy of formation of $NH_{3(g)}$ is -46.1 $kJ.mol^{-1}$. Calculate ΔH^0 for the following reaction.

$$2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$$

$\Delta H^\circ = (\Delta H_f^\circ \text{ PRODUCTS}) - (\Delta H_f^\circ \text{ REACTANTS})$

$= 0 - (2 \times -46.1)$

$= 92.2\ kJ/mol$

(3 sig figs)

3) According to the below equation, how many moles of $NH_{3(g)}$ could be formed from the reaction of 0.22 mol of $N_2O_{3(g)}$ with 0.87 mol of $H_{2(g)}$?

$$N_2O_{3(g)} + 6H_{2(g)} \rightarrow 2NH_{3(g)} + 3H_2O_{(g)}$$

Moles of N_2O_3 = 0.22

Moles of H_2 = 0.87

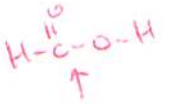
Stoichiometry of $N_2O_3 : H_2$ = 1 : 6

∴ limiting reagent is H_2 ($0.22 \times 6 = 1.32$)

Ratio of $NH_3 : H_2$ = 2 : 6

= 1 : 3

∴ Moles of NH_3 = $\frac{0.87}{3}$ = 0.29 moles



4) In a solution of formic acid ($K_a = 1.7 \times 10^{-4}$), the $[H^+] = 2.3 \times 10^{-3}$. What is the concentration of formic acid in $mol.L^{-1}$?

$$K_a = \frac{[H^+][HCO_2^-]}{[HCO_2H]} \qquad HCO_2H \rightleftharpoons H^+ + HCO_2^-$$

$$= 1.7 \times 10^{-4} = \frac{2.3 \times 10^{-3} \cdot 2.3 \times 10^{-3}}{[HCO_2H]}$$

$$\therefore [HCO_2H] = 0.031 \ mol.L^{-1}$$

5) A sample of C_2H_6 gas initially at 50.0°C and 720mmHg is heated to 100°C in a container at constant volume. What is the new pressure (in mmHg) ?

$V_1 = V_2$

$P_1V_1 = nRT_1$

$\frac{720}{760} \cdot V_1 = n \cdot R \cdot (50.0 + 273.15)$

So $\frac{V_1}{n \cdot R} = 341.102$

$P_2V_2 = nRT_2$ and $V_1 = V_2$ and $\frac{V_1}{n \cdot R} = 341.102$

So $\frac{V_2}{nR} = \frac{T_2}{P_2} = \frac{(100 + 273.15)}{P_2} = 341.102$

So $P_2 = 1.09 \text{ atm}$

$= 831 \text{ mm Hg}$ (3 sig figs).