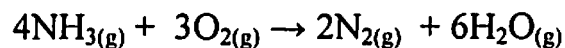


Exit Exam (Written Portion)

Name \_\_\_\_\_

Get at least 3/5 correct to pass.

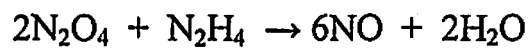
1) The oxidation of ammonia produces nitrogen and water according to the equation:



If the rate of formation of  $\text{N}_2$  at a certain temperature is  $3.0 \text{ mol}\cdot\text{L}^{-1}\cdot\text{s}^{-1}$ , what is the rate of disappearance of  $\text{O}_2$  ?

2) The mineral *Beryl* contains 5.03% Beryllium by mass, and contains three Beryllium atoms per formula unit. What is the formula mass (molecular weight) of *Beryl* ?

3) What is the maximum mass (in grams) of NO that could be obtained from 15.5g of  $\text{N}_2\text{O}_4$  and 4.68g of  $\text{N}_2\text{H}_4$  when they react according to the following equation ?



(MW of  $\text{N}_2\text{O}_4 = 92.0 \text{ g}\cdot\text{mol}^{-1}$ ;  $\text{N}_2\text{H}_4 = 32.0 \text{ g}\cdot\text{mol}^{-1}$ )

4) What is the pH of a 0.0015 M solution of  $\text{HNO}_3$  ?

5) A 2.00 liter evacuated container has a mass of 1050.0g. When the container is filled with an unknown gas at 800 mmHg pressure and 25.0°C, the mass is 1052.4g. What is the molar mass of the gas in  $\text{g}\cdot\text{mol}^{-1}$  ?

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	<i>N<sub>A</sub></i>	gas constant	<i>R</i>
Celsius temperature	°C	gram	g
centi- prefix	c	heat capacity	<i>C<sub>p</sub></i>
coulomb	C	hour	h
electromotive force	<i>E</i>	joule	J
energy of activation	<i>E<sub>a</sub></i>	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	<i>R<sub>f</sub></i>
		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 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)				

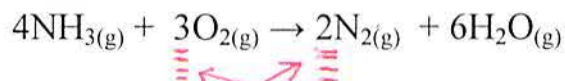
58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101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

Exit Exam (Written Portion)

Name EXIT EXAM #1

Get at least 3/5 correct to pass.

1) The oxidation of ammonia produces nitrogen and water according to the equation:



If the rate of formation of  $\text{N}_2$  at a certain temperature is  $3.0 \text{ mol}\cdot\text{L}^{-1}\cdot\text{s}^{-1}$ , what is the rate of disappearance of  $\text{O}_2$ ?

Stoichiometry of  $\text{N}_2 : \text{O}_2$  is 2:3

$$\text{So rate of disappearance of } \text{O}_2 \text{ is } \frac{3}{2} \times 3.0 = \underline{\underline{4.5 \text{ mol}\cdot\text{L}^{-1}\cdot\text{s}^{-1}}}$$

2) The mineral *Beryl* contains 5.03% Beryllium by mass, and contains three Beryllium atoms per formula unit. What is the formula mass (molecular weight) of *Beryl*?

$$\text{Mass of Be} = 9.012 \frac{\text{g}}{\text{mol}}$$

$$\text{So } 3 \text{ Be atoms} = 3 \times 9.012 = 27.036 \frac{\text{g}}{\text{mol}}$$

$$\text{The } 3\text{Be} \text{ are } 5.03\% \text{ of the total mass, so } \frac{5.03}{100} = \frac{27.036}{\text{MW}}$$

$$\Rightarrow \text{MW} = 538 \frac{\text{g}}{\text{mol}} \quad (3 \text{ sig figs})$$

3) What is the maximum mass (in grams) of NO that could be obtained from 15.5g of  $N_2O_4$  and 4.68g of  $N_2H_4$  when they react according to the following equation?



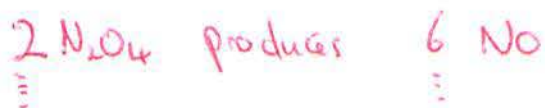
(MW of  $N_2O_4 = 92.0 \text{ g}\cdot\text{mol}^{-1}$ ;  $N_2H_4 = 32.0 \text{ g}\cdot\text{mol}^{-1}$ )

$$\text{Moles of } N_2O_4 = \frac{15.5}{92.0} = 0.168 \text{ moles}$$

$$\text{Moles of } N_2H_4 = \frac{4.68}{32.0} = 0.146 \text{ moles}$$

Stoichiometry is  $\begin{matrix} 2 \\ \vdots \end{matrix} N_2O_4$  reacts with  $\begin{matrix} 1 \\ \vdots \end{matrix} N_2H_4$  so the limiting

reagent is therefore  $N_2O_4$ . (Would need  $2 \times 0.146 = 0.292$  moles of  $N_2O_4$  to fully react with the  $N_2H_4$ ).



So  $0.168 N_2O_4$  produces  $\left(\frac{6}{2} \times 0.168\right) NO = 0.504$  moles.

$$\text{MW of NO} = 30.01, \text{ so } 0.504 \text{ moles} = 30.01 \times 0.504$$

$$= \underline{\underline{15.1 \text{ g of NO}}} \text{ (3 sig figs)}$$

4) What is the pH of a 0.0015 M solution of  $\text{HNO}_3$  ?



(Nitric Acid is a strong acid, which we assume fully dissociates in aqueous solution).

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

$$= -\log_{10} [0.0015]$$

$$= 2.8$$

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5) A 2.00 liter evacuated container has a mass of 1050.0g. When the container is filled with an unknown gas at 800 mmHg pressure and 25.0°C, the mass is 1052.4g. What is the molar mass of the gas in  $\text{g}\cdot\text{mol}^{-1}$ ?

$$\begin{aligned}\text{Mass of gas} &= 1052.4 - 1050.0 \\ &= 2.4\text{g}\end{aligned}$$

$$PV = nRT$$

$$P \text{ in atm} = \frac{800}{760}$$

$$\text{Rearranges to } n = \frac{PV}{RT}$$

$$V \text{ in L} = 2$$

$$R = 0.0821 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$$

$$\begin{aligned}T \text{ in K} &= 25.0 + 273.15 \\ &= 298.15\text{K}\end{aligned}$$

$$\begin{aligned}\text{So } n &= \frac{\left(\frac{800}{760} \times 2\right)}{0.0821 \times 298.15} \\ &= 0.086 \text{ moles}\end{aligned}$$

$$\text{If } 2.4\text{g} = 0.086 \text{ moles, then } \text{MW} = \frac{2.4}{0.086} = \underline{\underline{28 \text{ g/mol}}} \quad (2 \text{ sig figs})$$