Problem Set 3 pt 2 #16-20 KEY

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67. Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This causes sodium azide (NaN_3) to decompose explosively according to the following reaction: $$2NaN_3(s) \longrightarrow 2Na(s) + 3N_2(g)$$ What mass of $NaN_3(s)$ must be reacted to inflate an air bag to 70.0 L at STP?	$\frac{70L}{22.4\frac{l}{mol}}$ = 3.125 mol N_2 3.125 mol ($\frac{2}{3}$) = 2.083 mol NaN_3 2.083 mol NaN_3 x 65.0$\frac{g}{mol}$ = 135 g NaN_3
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10.55 The metabolic oxidation of glucose, $C_6H_{12}O_6$, in our bodies produces CO_2, which is expelled from our lungs as a gas: $$C_6H_{12}O_6(aq) + 6\,O_2(g) \longrightarrow 6\,CO_2(g) + 6\,H_2O(l)$$ a) Calculate the volume of dry CO_2 produced at body temperature (37 °C) and 0.970 atm when 24.5 g of glucose is consumed in this reaction. b) Calcaulte the volume of oxygen at 1 atm and 298 K gas needed to completely oxidize 50.0 g of glucose.	a) $\frac{24.5g}{180\frac{g}{mol}}$ = 0.136 mol $C_6H_{12}O_6$ 0.136 mol $C_6H_{12}O_6$ $\left(\frac{6}{1}\right)$ = 0.817 mol CO_2 $V = \frac{nRT}{P} = \frac{(0.817mol)(0.0821\frac{Latm}{molK})(310K)}{0.970atm}$ = 21.4 L CO_2 b) $\frac{50.0g}{180\frac{g}{mol}}$ = 0.278 mol $C_6H_{12}O_6$ 0.278 mol $C_6H_{12}O_6$ $\left(\frac{6}{1}\right)$ = 1.67 mol O_2 $V = \frac{nRT}{P} = \frac{(1.67mol)(0.0821\frac{Latm}{molK})(298K)}{1.00atm}$ = 40.8 L CO_2
18	
Ethanol (C_2H_5OH) burns in air: __C_2H_5OH (l) + __O_2 (g) → __ CO_2 (g) + __ H_2O (g) Balance the equation and determine the volume of air in Liters at 35.0ºC and 790. mm Hg required to burn 227 grams of ethanol. Assume that air is 21.0 percent O_2 by volume.	C_2H_5OH (l) + 3 O_2 (g) → 2 CO_2 (g) + 3 H_2O (g) $\frac{227g}{46.0\frac{g}{mol}}$ = 4.93 mol C_2H_5OH 4.93 mol $C_2H_5OH$$\left(\frac{3}{1}\right)$ = 14.8 mol O_2 $V = \frac{nRT}{P} = \frac{(14.8mol)(62.4\frac{LmmHg}{molK})(308K)}{790.\,mmHg}$ = 360. L O_2 360. L O_2 = 0.21x where x = volume of air x = $\frac{360L}{0.21}$ = 1714 L ~ 1710 L air

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In alcoholic fermentation, yeast converts glucose to ethanol and carbon dioxide: $C_6H_{12}O_6$ (s) → 2 C_2H_5OH (l) + 2 CO_2 (g) If 5.97 g of glucose are reacted and 1.44 L of CO_2 gas are collected at 293 K and 0.984 atm, what is the percent yield of the reaction?	$\frac{5.97g}{180\frac{g}{mol}}$= 0.0332 mol $C_6H_{12}O_6$ 0.0332 mol $C_6H_{12}O_6$ $\left(\frac{2}{1}\right)$= 0.0664 mol CO_2 $V = \frac{nRT}{P} = \frac{(0.0664mol)(0.0821\frac{Latm}{molK})(293K)}{0.984atm}$= 1.62 L CO_2 $\frac{1.44L}{1.62L}x100$ = 88.9%
20	
10.113 Consider the combustion reaction between 25.0 mL of liquid methanol (density = 0.850 g/mL) and 12.5 L of oxygen gas measured at STP. The products of the reaction are $CO_2(g)$ and $H_2O(g)$. Calculate the number of moles of H_2O formed if the reaction goes to completion.	$2CH_3OH + 3O_2 \Rightarrow 2CO_2 + 4H_2O$ $25.0mL(0.850\frac{g}{mL}) = 21.25g$ CH_3OH $\frac{21.25g}{32\frac{g}{mol}}$= 0.664 mol CH_3OH $\frac{12.5\ L}{22.4\frac{L}{mol}}$ = 0.558 mol O_2 LR 0.558 mol O_2 $\left(\frac{4}{3}\right)$ = 0.744 mol H_2O