CH1011 Tutorial 1 Answers

1. How many significant figures in the following numbers:

2.304e-6	0.0010	2.0010
4	2	5

- remember that all digits to the RHS of the decimal point have been measured unless it is *0.xxxx* in which case it is all digits to the RHS of the first non-zero digit that are significant.

2. What is the alkaline metal in the 3rd period and how many protons does it have?
Write down the atomic symbol for this element and include the atomic number.

Sodium. Na_{11} this element has 11 protons

3. Balance the following equation:

	$C_2H_6(g)$	+	$O_2(g)$	$\rightarrow$	$H_2O(l)$	+	$CO_2(g)$	
Step 1	C_2H_6			$\rightarrow$			$2CO_2$	- heavy atoms
Step2	C_2H_6			$\rightarrow$	$3H_2O$			- hydrogens
Step3			$7O_2$	$\rightarrow$	$6H_2O$	+	$4CO_2$	- oxygens
Step4	$2C_2H_6$	+	$7O_2$	$\rightarrow$	$6H_2O$	+	$4CO_2$	- summate
Step5	4C 12H	+	14O	=	12H 6O	+	4C 8O	- check

Balanced equation $2C_2H_6(g) + 7O_2(g) \rightarrow 6H_2O(l) + 4CO_2(g)$

4. The above equation is a combustion reaction between ethane and oxgen that is responsible for the formation of CO_2 which is one of the major green house gases. If 300 g of ethane were combusted in a reaction vessel with 900g of oxygen how much carbon dioxide would be formed in kilograms (kg)?

M C_2H_6 = (2 x 12.0) + (6 x 1.0) = 30.0 g mol^{-1}
M O_2 = (2 x 16.0) = 32.0 g mol^{-1}
M CO_2 = (1 x 12.0) + (2 x 16.0) = 44.0 g mol^{-1}

nC_2H_6 = 300 g / 30.0 g mol^{-1} = 10.0 mol nO_2 = 900 g / 32.0 g mol^{-1} = 28.1 mol

For 100 mol of C_2H_6 we would need (7/2 x 10.0) mol of O_2 which is 35 mol of O_2.
As we have 28.1 mol of O_2 available the **limiting reagent is oxygen**.

What has been done here is to convert the reaction stoichiometry by dividing all the stoichiometric coefficients by the coefficient of the reactant we are looking at, here 2 for C_2H_6, so that we have the reaction in terms of 1 mol of C_2H_6. Therefore if 1 mol of C_2H_6 reacts with 7/2 mols of O_2 then 10.0mol will react with 7/2 x 10.0 mol of O_2 - this is the **ideal amount** predicted which must be compared with the actual amount we have (28.1 mol).

From 28.1 mol of O_2 we get (4/7 x 28.1) mol of CO_2 that is 16.1 mol of CO_2

Here we have converted the reaction stoichiometry again, now by dividing the balanced equation through by 7, the coefficient of the limiting reagent, so that for 1 mol of O_2 we get 4/7 mol of CO_2. Therefore if we have 28.1 mol of O_2 we get 4/7 mol of CO_2.

$mCO_2 = nCO_2 \times MCO_2$ = 16.1 mol x 44.0 g mol-1 = 707 g = **0.71 kg of carbon dioxide**
707 x 10^{-3} =0.707 - this is the conversion g to kg

The significant figures are based on H 1.0 (2 sig. fig.)

5. Name the following compounds:

P_4O_6	V_2O_5	H_2SO_3
tetraphosphorous hexoxide	vanadium(V) oxide	sulphurous acid