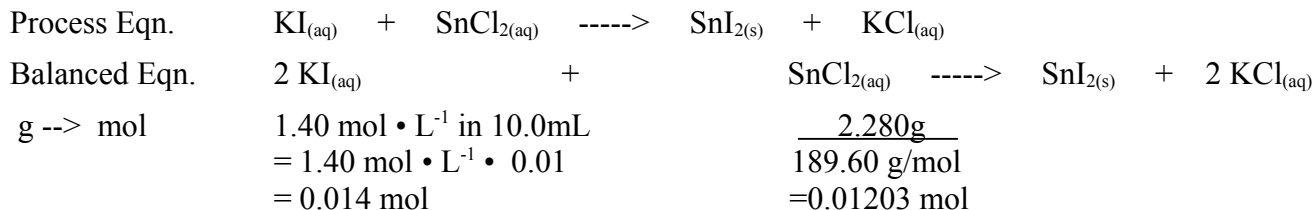
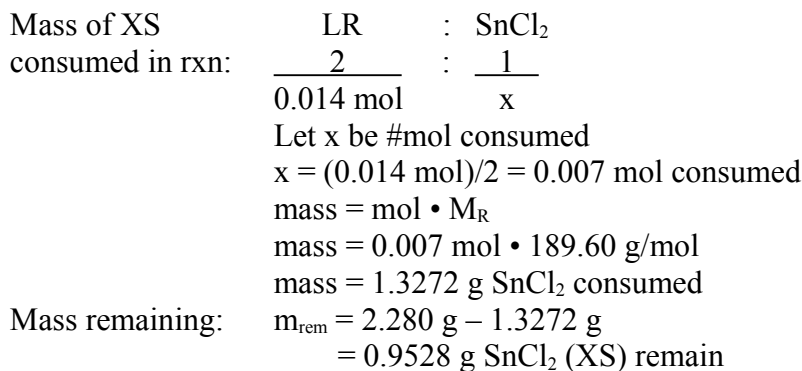


SCH 3UE Unit 1 – Quantitative Chemistry
Unit Review Problems – Answer Key

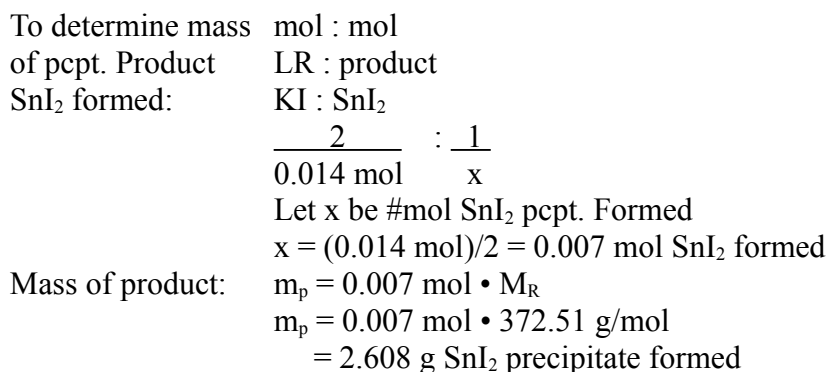
1. a)



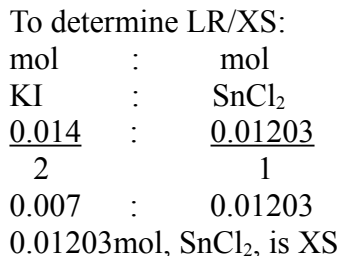
i) Therefore, SnCl_2 is the reagent in excess.



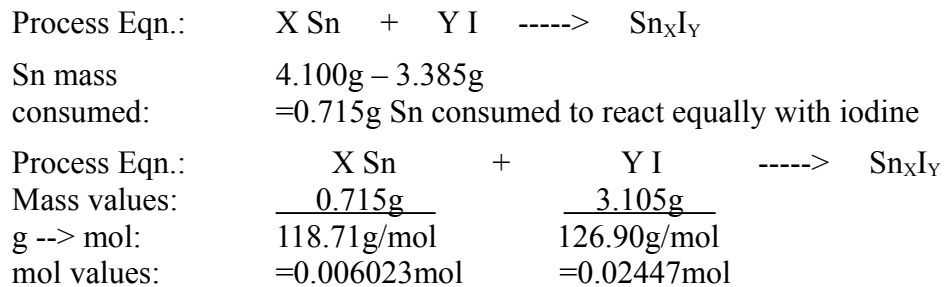
ii) Therefore, 0.9528g of excess SnCl_2 remain.



iii) Therefore, the maximum mass of SnI_2 formed is 2.608g



b)



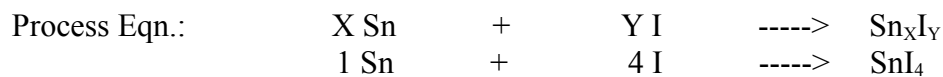
mol : mol ratio Since refluxed until equal proportions, no LR or XS.

mol : mol

Sn : I

$\frac{0.006023\text{mol}}{0.006023\text{mol}} : \frac{0.02447\text{mol}}{0.006023\text{mol}}$

/ by smallest #mol: $1 : 4$



Therefore the formula of the compound formed is SnI_4 , Tin (IV) iodide.

2.

Elements:	C	H	N	O
% composition	40.45%	7.86%	15.73%	35.96%
100% = 100g	<u>40.45g</u>	<u>7.86g</u>	<u>15.73g</u>	<u>35.96g</u>
g --> mol	$\frac{40.45\text{g}}{12.011\text{g/mol}}$	$\frac{7.86\text{g}}{1.0079\text{g/mol}}$	$\frac{15.73\text{g}}{14.007\text{g/mol}}$	$\frac{35.96\text{g}}{15.999\text{g/mol}}$
	$= \frac{3.3677 \text{ mol}}{1.1230}$	$= \frac{7.7984 \text{ mol}}{1.1230}$	$= \frac{1.1230 \text{ mol}}{1.1230}$	$= \frac{2.2476 \text{ mol}}{1.1230}$
/ by smallest #mol	$= 3 \text{ mol}$	$= 7 \text{ mol}$	$= 1 \text{ mol}$	$= 2 \text{ mol}$
Empirical Formula	$3\text{C} + 7\text{H} + 1\text{N} + 2\text{O}$			
	$= \text{C}_3\text{H}_7\text{NO}_2$			
Molecular Formula	#mol = mass / M_R			
	$= 89.0\text{g} / (89.01\text{g/mol})$			
	$= 1$			
	$\therefore = 1(\text{C}_3\text{H}_7\text{NO}_2) = \text{C}_3\text{H}_7\text{NO}_2$			

Therefore the compound is likely Alanine, $\text{C}_3\text{H}_7\text{NO}_2$.

3.

$$\begin{aligned} \text{Produced BaSO}_4 & \frac{0.3550\text{g}}{233.43\text{g/mol}} \\ / \text{ by } M_R & = 1.521 \cdot 10^{-3} \text{ mol} \\ \text{produced SO}_4 & n_{\text{SO}_4} = 1.521 \cdot 10^{-3} \text{ mol} \end{aligned}$$

a) Therefore $1.521 \cdot 10^{-3}$ mol BaSO_4 were precipitated

b) $\text{mass}_T = XM_{R1} + YM_{R2}$

c) #mol SO_4 $n = X + Y$

$$n_{\text{SO}_4} = X + Y$$

$$Y = n_{\text{SO}_4} - X \dots (1)$$

$$m_{\text{mix}} = XM_{R1} + YM_{R2} \dots (2)$$

Sub (1) in (2):

$$= XM_{R1} + (n_{\text{SO}_4} - X)M_{R2}$$

$$= XM_{R1} + n_{\text{SO}_4}M_{R2} - XM_{R2}$$

$$m_{\text{mix}} - n_{\text{SO}_4}M_{R2} = XM_{R1} - XM_{R2}$$

$$m_{\text{mix}} - n_{\text{SO}_4}M_{R2} = X(M_{R1} - M_{R2})$$

$$X = \frac{m_{\text{mix}} - n_{\text{SO}_4}M_{R2}}{M_{R1} - M_{R2}}$$

$$= \frac{(0.3973\text{g}) - (1.521 \cdot 10^{-3}\text{mol})(287.5\text{g/mol})}{(246.5\text{g/mol}) - (287.5\text{g/mol})}$$

$$= \underline{-0.03999\text{g}}$$

$$-41.0\text{g/mol}$$

Num. value X: $= 9.75 \cdot 10^{-4} \text{ mol}$

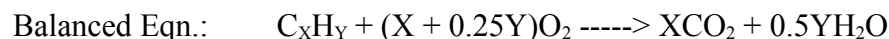
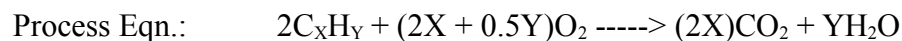
Num. value Y (1): $Y = n_{\text{SO}_4} - X$
 $= 5.46 \cdot 10^{-4} \text{ mol}$

d) Therefore the numerical value of X is $9.75 \cdot 10^{-4}$ mol.

$$\begin{aligned} \% \text{ MgSO}_4 \cdot 7\text{H}_2\text{O} & m_{\text{ms}} = XM_{R1} \\ & = 0.240\text{g} \\ \%m & = m_{\text{ms}} / \text{total mass} \\ & = [(0.240\text{g}) / (0.3973\text{g})] \cdot 100\% \\ & = 60.4 \% \end{aligned}$$

e) Therefore $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ represents 60.4% of total mass.

4. a)



$$\begin{aligned} \# \text{mol CO}_2 (n_{\text{CO}_2}) & n_{\text{CO}_2} = m_{\text{CO}_2} / M_{\text{RCO}_2} \\ & = 1.56\text{g} / (44.095\text{g/mol}) \\ & = 0.0354 \text{ mol} \end{aligned}$$

i) Therefore, 0.0354 mol of CO_2 were produced.

$$\begin{aligned} \# \text{mol H}_2\text{O} (n_{\text{H}_2\text{O}}) & n_{\text{H}_2\text{O}} = m_{\text{H}_2\text{O}} / M_{\text{RH}_2\text{O}} \\ & = 0.638\text{g} / (18.015\text{g/mol}) \\ & = 0.0354 \text{ mol} \end{aligned}$$

ii) Therefore, 0.0354 mol of H_2O were produced.

Empirical Formula	$m_C : m_{CO_2}$	$m_H : m_{H_2O}$
	$X : X$	$Y : 0.5Y$
	$1 : 1, \therefore n_{CO_2} = n_C = 0.0354 \text{ mol}$	$2 : 1, \therefore n_H = 2(0.0354 \text{ mol}) = 0.708 \text{ mol}$

	C	:	H
	$\frac{0.0354 \text{ mol}}{0.0354 \text{ mol}}$:	$\frac{0.708 \text{ mol}}{0.0354 \text{ mol}}$
/ by smallest #mol	1	:	2
	$\therefore 1C2H = CH_2$		

iii) Therefore, the empirical formula of the compound is CH_2 .

b)

Convert to L:	$V_{HC} = 448 \text{ cm}^3$ $= 448 \text{ cm}^3 \cdot L(1000 \text{ cm}^{-3}) = 0.448 \text{ L} \dots (V_1)$
	$\therefore 1.00 \text{ mol of gas is contained in } 22.4 \text{ L at } 0^\circ\text{C, } 101.3 \text{ k Pa:}$
Mols hydrocarbon	$n_{HC} = V \cdot (n/V_1)$ $= 0.448 \text{ L} \cdot (1.00 \text{ mol}/22.4 \text{ L}) = 0.0200 \text{ mol}$

Molecular mass:	$n_{HC} = m_{HC} / M_{RHC}$ $M_{RHC} = (1.12 \text{ g}) / (0.0200 \text{ mol})$ $= 56.0 \text{ g/mol}$
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Mol. Formula	$\frac{M_{RHC}}{M_{REF}} = \frac{(56.0 \text{ g/mol})}{(14.0 \text{ g/mol})}$ $= 4$ $\therefore 4(CH_2) = C_4H_8$
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c) Therefore the molecular formula of the compound is C_4H_8 , butene.