Specimen paper

10ai)

$2NH_3 \longrightarrow (NH_2)_2CO$

FM: 34g $\longrightarrow$ FM = 60g

? $\longleftarrow$ 530 tonnes

$? = \frac{34 \times 530}{60} = \underline{\underline{300.3 \text{ tonnes}}}$

2015 paper

3bi) Cinnamic acid + Methanol $\longrightarrow$ Methyl cinnamate + H_2O

FM = 148g $\longrightarrow$ FM = 32g

6.5g $\longrightarrow$ $\frac{32 \times 6.5}{148} = 1.4g$ (1)

The calculation shows that 6.5g of cinnamic acid would fully react with 1.4g of methanol, however the question states that 2g of methanol is being used so cinnamic acid is limiting the reaction. (1)

3bii) A

Cinnamic acid $\longrightarrow$ Methyl cinnamate

148g $\longrightarrow$ 162g

6.5g $\longrightarrow$ $\frac{162 \times 6.5}{148} = \underline{7.1g}$ theoretical yield

$\frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$

$\frac{3.7}{7.1} \times 100 = 52.1\%$

B

3.7g of methyl cinnamate requires 6.5g of cinnamic acid. 100g of methyl cinnamate requires $\frac{100}{3.7} \times 6.5g$ of cinnamic acid (175.7g).

250g $\longrightarrow$ £35

175.7g $\longrightarrow$ $\frac{£35 \times 175.7g}{250g} = £24.57$

7a) $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$

1 : 1

$n = \frac{M}{FM} = \frac{118}{32} = 3.6875$: $n = 3.6875$

$V = n \times MV = 3.6875 \times 24$

$V = \underline{88.5\ l}$

7cii)

Bonds Broken		Bonds formed	
C-H x3	(+1236)	H-H x3	(-1308)
C-O x1	(+360)	C=O x2	(-1486)
O-H x3	(+1389)		-2794
	+2985		

Enthalpy change = $2985 + (-2794) = +191\ kJ\ mol^{-1}$

12aiii) From Step 2 we can work out the number of moles of iodine from the given information about $Na_2S_2O_3$.

$I_2 \longrightarrow 2Na_2S_2O_3$

1 : 2

$n = V \times C$

$= 0.0124 \times 0.00100$

0.0000062 moles : $= 0.0000124$ moles

Now we can use the number of moles of iodine in the first step to compare I_2 with NaOCl.

$NaOCl \longrightarrow I_2$

1 : 1

0.0000062 : 0.0000062

$C = \frac{n}{V}$

$= \frac{0.0000062}{0.1}$ (from 100cm³ of water sample)

$= 0.000062\ mol\ l^{-1}$

2016 Paper

9b) Reaction equation: $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$

Combustion equations and required action to match the reaction equation:

1) $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$ $\Delta H = -286\ kJ\ mol^{-1}$

2) $Ca(s) + O_2(g) + H_2(g) \longrightarrow Ca(OH)_2(s)$ $\Delta H = -986\ kJ\ mol^{-1}$

For equation 1) – • Flip the value because H_2 needs to be on the right hand side. $+286 kJ\ mol^{-1}$
• x 2 to make sure $H_2O \rightarrow 2H_2O$. $+572\ kJ\ mol^{-1}$

For equation 2) – No action required, Ca(s) is on the correct side. $-986\ kJ\ mol^{-1}$

Enthalpy change = 1) + 2)
$= (+572) + (-986)$
$= -414\ kJ\ mol^{-1}$