1) $E = 1.5 \times 100 \times \dfrac{100}{30}$ MJ

$= 500$ MJ

$P = 700$ bar

Lower heating value of $H_2 = 120$ mJ/kg

$\therefore$ mass of $H_2 = \dfrac{500}{120}$ kg $= \dfrac{25}{6}$ kg
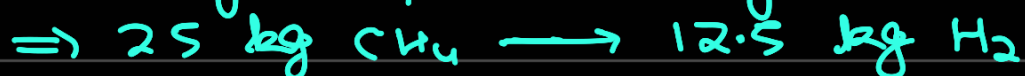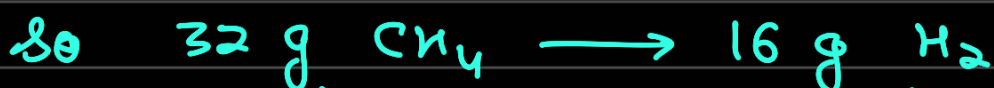
≈ 4.167 kg

$n = \dfrac{25/6}{2} \times 1000 = \dfrac{25}{12} \times 1000$

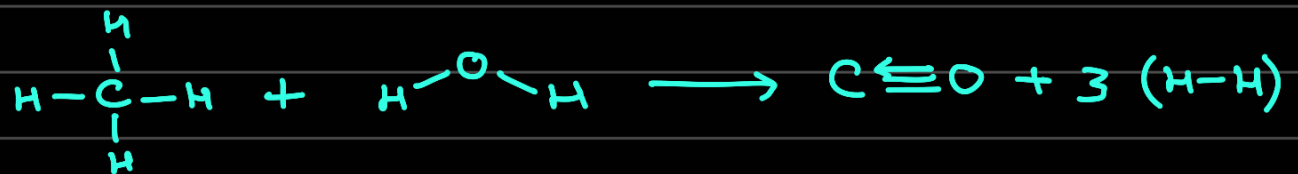$V = \dfrac{nRT}{P} = \dfrac{25/12 \times 8.314 \times 298}{700 \times 10^5} \times 1000$ m^3

$= \dfrac{8.314 \times 298}{12 \times 7 \times 4} \times 10^{-2}$ m^3

$\approx 7.3737 \times 10^{-2}$ m^3

$= 73.737$ L

2) $2CH_4 + 3H_2O \longrightarrow CO_2 + CO + 7H_2$

2×16 g CH_4 gives 28 g $CO + 7 \times 2$ g H_2

$CO + H_2O \longrightarrow CO_2 + H_2$

28 g CO gives 2 g H_2

So 32 g $CH_4 \longrightarrow 16$ g H_2

$\Rightarrow 25$ kg $CH_4 \longrightarrow 12.5$ kg H_2

3)

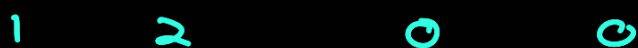$$H-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-H \;+\; H{\sim}O{\sim}H \longrightarrow C\equiv O + 3\,(H-H)$$

$$\Delta B.E = 4\times413 + 2\times467 - (1072 + 3\times436)$$

$$= 1652 + 934 - 1072 - 1308$$

$$= 206 \;\; kJ$$

4)
$$CO + H_2O \longrightarrow CO_2 + H_2$$

1	2	0	0
$1-x$	$2-x$	x	x

Now, $\quad 1 = \dfrac{x \times x}{(1-x)(2-x)}$

$$\Rightarrow x^2 - 3x + 2 = x^2$$
$$\Rightarrow x = 0.67$$