

## Question bank

2)  $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{right}} - E^{\circ}_{\text{left}}$   
 $0.012 = -0.125 - E^{\circ}_{\text{Sn}}$   
 $E_{\text{Sn}} = -0.125 - 0.012$   
 $= -0.137 \text{ V}$

⑥  $C = 70\%$   
 $O = 8\%$   
 $H = 10\%$   
 $N = 3\%$   
 $S = 2\%$  } Given

formula used,

$$G_{\text{CV}} = \frac{1}{100} \left( 8080 \times C + 34500 \left( H - \frac{O}{8} \right) + 2240 \times S \right)$$

$$G_{\text{CV}} = \frac{1}{100} \left( 8080 \times 70 + 34500 \left( 10 - \frac{8}{8} \right) + 2240 \times 2 \right)$$

$$G_{\text{CV}} = \frac{1}{100} \times 880580$$

$$G_{\text{CV}} = 8805.8 \text{ Kcal/Kg}$$

⑧ Given

$$E^{\circ}_{\text{Ni}} = -0.257 \text{ V (anode)}$$

$$E^{\circ}_{\text{Cu}} = 0.337 \text{ V (cathode)}$$

$$E^{\circ}_{\text{cell}} = 0.337 - (-0.257)$$

$$= 0.594 \text{ V}$$

⑨ Nernst equation

$$E = E^{\circ} - \frac{0.0591}{n} \log_{10} \left( \frac{c_2}{c_1} \right)$$

↓  
 zero (Equation will generate value zero ~~zero~~ when both are same cathode & anode)

$$E = 0 - \frac{0.0591}{1} \log_{10} \left( \frac{0.01}{0.2} \right)$$

$$E = -0.0768909 V_{11}$$

(35) Wt of coal = 3.3 gm  
Wt of ash = 0.252 gm

$$\% \text{ ash} = \frac{\text{Wt of ash} \times 100}{\text{Wt of coal}}$$

$$= \frac{0.252}{3.3} \times 100$$

$$= 7.63\%$$

→ Percentage section

1) Given

$$C = 85\%$$

$$H = 6\%$$

$$H = 6\%$$

$$O = 8\%$$

$$S = 0.5\%$$

$$\text{ash} = 0.5\% \text{ (does not contribute)}$$

→ formula,

$$HCV = \frac{1}{100} (8080C + 34500(H - \frac{O}{8}) + 2240 \times S)$$

$$LCV = HCV - 0.09H \times 587$$

sol  $HCV = \frac{1}{100} (8080 \times 85 + 34500(6 - \frac{8}{8}) + 2240 \times 0.5)$

$$HCV = 8604.2$$

$$LCV = 8604.2 - 0.09 \times 6 \times 587$$

$$LCV = 8287.22$$

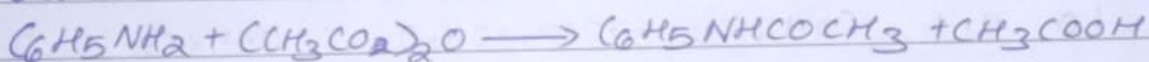
⑥  $E_{\text{cell}}^{\circ} = 0.462 \text{ V}$   
 $E_{\text{Cu}}^{\circ} = 0.337 \text{ V (anode)}$   
 $E_{\text{Ag}}^{\circ} = \text{ (cathode)}$

$E_{\text{cell}}^{\circ} = E_{\text{cathode}} - E_{\text{anode}}$   
 $0.462 + 0.34 = E_{\text{cathode (Ag)}}$   
 $0.802 \text{ V} = E_{\text{cathode (Ag)}}$

⑦ atom economy  

$$\frac{\text{Molecular weight of the product} \times 100}{\text{Total molecular weight}}$$

Given



=  $\frac{\text{Molecular weight of the reactant}}{\text{Molecular weight product}}$   
 $12 \times 6 + 1 \times 5 + 14 \times 1 + 1 \times 2 + (12 \times 1 + 1 \times 3 + 12 \times 1 + 16 \times 1) \times 2 + 16 \times 1$   
 $= 195$

Molecular weight product  
 $12 \times 6 + 5 + 14 \times 1 + 1 + 12 + 16 + 12 + 3 = 133$

atom economy  

$$= \frac{133}{195} \times 100 = 68.20\%$$



⑧ Given

✓ CO = 5%

✓ C<sub>2</sub>H<sub>4</sub> = 10%

✓ CH<sub>4</sub> = 40%

N<sub>2</sub> = 2.5% (No contribution)

✓ H<sub>2</sub> = 35%

CO<sub>2</sub> = 2% (No contribution)

✓ O<sub>2</sub> = 2.5%

Const.	Volume % m <sup>3</sup>	Reaction	Oxygen
H	35 0.35	$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$	$0.35 \times 0.5 = 0.175$
<del>C<sub>2</sub>H<sub>2</sub></del> C <sub>2</sub> H <sub>4</sub>	10 0.1	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$	$0.1 \times 3 = 0.3$
CH <sub>4</sub>	40 0.4	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	$0.4 \times 2 = 0.8$
CO	5 0.05	$CO + \frac{1}{2}O_2 \rightarrow CO_2$	$0.5 \times 0.2 = 0.1$
O	25 0.025		- 0.025

$$\text{Weight of oxygen} = (0.175 + 0.3 + 0.8 + 0.1 - 0.025) = 1.35\%$$

$$\text{Volume of air} = \frac{1.35}{21} \times 100 = 6.42\%$$

(15) Mass of coal = 3gm  
 Volatile  $H_2SO_4$  = 40ml  
 Normality = 0.5N  
 after absorption

18.5ml Volatile  $H_2SO_4$

0.5N =  $H_2SO_4$

$BaSO_4$  = 0.67

Coal = ~~2.45~~ 2.45g

(55) Mass of coal = 3.2  
 Volatile  $H_2SO_4$  = 40ml  
 Normality 0.5

16ml volatile  $H_2SO_4$

0.5 =  $H_2SO_4$

$BaSO_4$  = 0.42

Coal = 2.5

formula used

$\%N = \frac{\text{Volatile} \times \text{Normality} \times 1.4}{\text{Weight of coal}}$

$\%S = \frac{\text{Weight of } BaSO_4}{\text{Weight of coal}}$

$$\%S = \frac{0.67}{2.45} \times \frac{32}{233} \times 100 = 3.755$$

$$\frac{0.42}{2.5} \times \frac{32}{233} \times 100 = 2.307$$

$$\%N = \frac{(40 - 18.5) \times 5 \times 1.4}{3} = 50.16$$

$$\frac{(40 - 16) \times 5 \times 1.4}{3.2} = 52.5$$

24) Given

$$\text{CO} = 10\%$$

$$\text{C}_3\text{H}_8 = 12\%$$

$$\text{CH}_4 = 30\%$$

$$\text{N}_2 = 3\% \text{ (No contribution)}$$

$$\text{H}_2 = 40\%$$

$$\text{CO}_2 = 3\% \text{ (No comb.)}$$

$$\text{O}_2 = 2\%$$

Const	Volume		Reaction	Oxygen
	$\text{m}^3$	%		
CO	0.1	10	$\text{CO} + \frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2$	$0.5 \times 0.1 = 0.05$
$\text{C}_3\text{H}_8$	0.12	12	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$	$0.12 \times 5 = 0.6$
$\text{CH}_4$	0.3	30	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$	$0.3 \times 2 = 0.6$
$\text{H}_2$	0.4	40%	$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	$0.4 \times \frac{1}{2} = 0.2$
$\text{O}_2$	0.02	2%	- 0.02	- 0.02 = - 0.02

$$\text{Weight of oxygen} = 1.43$$

Since air contain 23% oxygen

$$\frac{100}{23} \times 1.43 = 6.8 \text{ kg/kg of coal}$$

28.949 kg of air occupies  $22.4 \text{ m}^3$

$$\frac{6.8}{28.949} \times 22.4 = 5.269 \text{ m}^3$$

(30)  $\longleftrightarrow$



030 C = 80%

H = 6%

O = 8%

S = 1.5%

H<sub>2</sub>O = 1.0%

N = 1.5%

Moisture	Weight %	kg	Reaction	O <sub>2</sub> (Weight)
C	80	0.80	$C + O_2 = CO_2$	$0.80 \times \frac{32}{12} = 2.13$
H	6	0.06	$H_2 + \frac{1}{2}O_2 = H_2O$	$0.06 \times \frac{16}{2} = 0.48$
O	8	0.08		$- 0.08 = -0.08$
S	1.5	0.015	$S + O_2 = SO_2$	$0.015 \times \frac{32}{32} = 0.015$

Weight of oxygen / kg of coal

$(2.13 + 0.48 - 0.08 + 0.015)$

$= 2.545$

air contain 23% oxygen

$\frac{100\%}{21} \times 2.545 = 12.119 \text{ kg/kg of coal}$

28.949 kg of air 22.4 m<sup>3</sup>

$\frac{12.119}{28.949} \times 22.4 = 9.337 \text{ m}^3$

$$(38) E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cat}} - E^{\circ}_{\text{anode}}$$

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$$E^{\circ}_{\text{cat}} = \text{Ni}$$

$$E^{\circ}_{\text{anode}} = \text{Cd}$$

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cat}} - E^{\circ}_{\text{anode}}$$

$$E^{\circ}_{\text{cell}} = 0.25 - (-0.40)$$

$$= 0.25 + 0.40$$

$$E^{\circ}_{\text{cell}} = 0.65 \text{ V}$$

$$(39) \text{Nernst formula}$$

Given

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{2.303RT}{nF} \log_{10} \left[ \frac{M_1}{M_2} \right]$$

$$E^{\circ}_{\text{Cu}} = 0.34 \text{ V}$$

$$E^{\circ}_{\text{Zn}} = -2.37$$

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cat}} - E^{\circ}_{\text{anode}}$$

$$E^{\circ}_{\text{cell}} = 0.34 - (-2.37)$$

$$E^{\circ}_{\text{cell}} = 2.71$$

$$E_{\text{cell}} = 2.71 - \frac{2.303 \times 8.314 \times 298}{2 \times 96500} \log_{10} \left[ \frac{0.001}{0.0001} \right]$$

$$E_{\text{cell}} = 2.6804 \text{ V}$$



④①	Const	Weight % kg	Reaction	Weight of $O_2$
	C	80 0.80	$CO_2 = CO_2$ 12 32	$0.80 \times \frac{32}{12} = 2.133$
	H	5 0.05	$H_2 + \frac{1}{2}O_2 = H_2O$ 2 16	$0.05 \times \frac{16}{2} = 0.4$
	O	1 0.01	-	$-0.01 = -0.01$
	N	2 0.02	(No contribution)	

Weight of oxygen =  $(2.133 + 0.4 - 0.01) = 2.523 \text{ kg}$

Since air contain 23% oxygen by weight

$$\frac{100}{23} \times 2.523 = 12.014 \text{ kg / kg of coal}$$

28.9249 of air occupies = 22.4 m<sup>3</sup>

$$\frac{12.014}{28.9249} \times 22.4 = 9.29 \text{ m}^3$$

④②  $E_{\text{cell}} = E_{\text{cat}} - E_{\text{anode}}$   
 $= 0.8 - (-0.76)$

$E_{\text{cat}} = \text{Ag}$   
 $E_{\text{anode}} = \text{Zn}$

$E_{\text{cell}} = 1.56 \text{ V}$

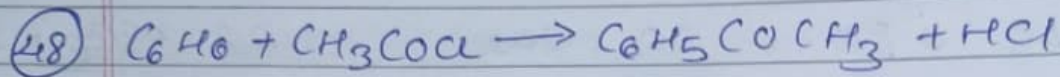
④⑦ Zn = anode

⑥② Cu = Cathode

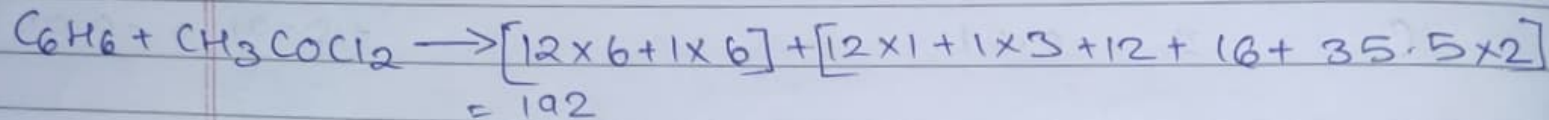
$E_{\text{cell}} = E_{\text{cat}} - E_{\text{anode}}$   
 $= 0.337 - (-0.763)$

$E_{\text{cell}} = 1.1 \text{ V}$

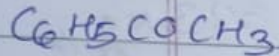
60,50 are ~~quite~~ almost same 40 and 30 pl. refer



Total molecular weight of reactant



Molecular weight product.



$$12 \times 6 + 5 + 12 \times 1 + 16 \times 1 + 12 \times 1 + 1 \times 3$$

$$= 120$$

Atom economy

$$\frac{120}{192} \times 100 = 62.5\%$$