Question bank

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2) $E^\circ_{cell} = E^\circ_{right} - E^\circ_{left}$

$0.012 = -0.125 - E^\circ_{Sn}$

$E_{Sn} = -0.125 - 0.012$

$= -0.137\,V$

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

formula used,

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

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

$GCV = \frac{1}{100} \times 880580$

$GCV = 8805.8$ Kcal/kg //

8) Given

$E^\circ_{Ni} = -0.257\,V$ (anode)

$E^\circ_{Cu} = 0.337\,V$ // (cathode)

$E^\circ_{cell} = 0.337 - (-0.257)$

$= 0.594\,V$

27) Nrsb equation

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

zero (Equation will generate value zero [redacted] recoming 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 = 3.3gm
Wt of ash = 0.252gm

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

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

$$= 7.63\%$$

a) Descriptive section

b) Given
C = 85%
H = 6%
H = 6%
O = 8%
S = 0.5%
Ash = 0.5% (does not contribute)

c) formula,

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

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

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

$$HCV = 8604.2$$

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

$$LCV = 8287.22_{11}$$

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(6) $E^\circ_{cell} = 0.462\,V$

$E^\circ_{Cu} = 0.337\,V$ (anode)

$E^\circ_{Ag} =$ (cathode)

$E^\circ_{cell} = E_{cathode} - E_{anode}$

$0.462 + 0.34 = E_{cathode(Ag)}$

$0.802V = E_{cathode(Ag)}$

(7) Atom economy =

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

Given

$C_6H_5NH_2 + (CH_3CO_2)_2O \longrightarrow C_6H_5NHCOCH_3 + CH_3COOH$

= Molecular weight of the reactant

$12\times6 + 1\times5 + 14\times1 + 1\times2 + (12\times1 + 1\times3 + 12\times1 + 16\times1)\times2 + 16\times1$

$= 195$

Molecular weight product

$12\times6 + 5 + 14\times1 + 1 + 12 + 16 + 12 + 3 = 133$

Atom economy

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

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(8) Given

✓ $CO = 5\%$

✓ $C_2H_4 = 10\%$

✓ $CH_4 = 40\%$

$N_2 = 2.5\%$ (No contribution)

✓ $H_2 = 35\%$

$CO_2 = 2\%$ (No contribution)

✓ $O_2 = 2.5\%$

Const.	Volumne %	m^3	Reaction	Oxygen
H	35	0.35	$H_2 + \frac{1}{2}O_2 \Rightarrow H_2O$	$0.35 \times 0.5 = 0.175$
C_2H_4	10	0.1	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$	$0.1 \times 3 = 0.3$
CH_4	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		$- 0.025$

Weight of oxygen $= (0.175 + 0.3 + 0.8 + 0.1 - 0.025)$

$= 1.35_{//}$

Volum of air $= \frac{1.35}{21} \times 100 = 6.42\%_{//}$

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(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 = [redacted] 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

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

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

—

$$\%S = \frac{0.67}{2.45} \times \frac{32}{238} \times 100 = 3.755$$

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

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

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

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24) Given

$CO = 10\%$

$C_3H_8 = 12\%$

$CH_4 = 30\%$

$N_2 = 3\%$ (No contribution)

$H_2 = 40\%$

$CO_2 = 3\%$ (No contribution)

$O_2 = 2\%$.

Const	Volumne m^3	%	Reaction	Oxygen
CO	0.1	10	$CO + 1/2O_2 \rightarrow CO_2$	$0.5 \times 0.1 = 0.05$
C_3H_8	0.12	12	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$	$0.12 \times 5 = 0.6$
CH_4	0.3	30	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	$0.3 \times 2 = 0.6$
H_2	0.4	40%	$H_2 + 1/2O_2 \rightarrow H_2O$	$0.4 \times 1/2 = 0.2$
O_2	0.02	2%	-0.02	$-0.02 = -0.02$

Weight of oxygen = 1.43

Since air contain 23% oxygen

$$\frac{100}{21} \times 1.43 = 6.8 \text{ kg/kg of coal}$$

28.949 kg of air occupies 22.4 m^3

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

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Q30 C = 80%
H = 6%
O = 8%
S = 1.5%
H_2O = 1.0%
N = 1.5%

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

Weight of oxygen / kg of coal
$= (2.13 + 0.48 - 0.08 + 0.015)$
$= \underline{2.545}$

air contain 23% oxygen
$\frac{100\%}{21} \times 2.545 = 12.119$ kg/kg of coal

28.949 kg of air 22.4 m^3
$\frac{12.119}{28.949} \times 22.4 = 9.337\ m^3$,

(33) $E^\circ_{cell} = E^\circ_{cat} - E^\circ_{anode}$

$E^\circ_{cat} = Ni$

$E^\circ_{anode} = Cd$

$E^\circ_{cell} = E^\circ_{cat} - E^\circ_{anode})$

$E^\circ_{cell} = 0.25 - (-0.40)$

$= 0.25 + 0.40$

$E^\circ_{cell} = 0.65V$ //

(34) Nernst formula

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

Given

$E^\circ_{Cu} = 0.34V$

$E^\circ_{Mg} = -2.37$

$E^\circ_{cell} = E^\circ_{cat} - E^\circ_{anode}$ //

$E^\circ_{cell} = 0.34 - (-2.37)$

$E^\circ_{cell} = 2.71$

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

$E_{cell} = 2.0804V$ //

(40)

Const	Weight %	Weight kg	Reaction	Weight of O_2
C	80	0.80	$C + O_2 = CO_2$ (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 = $(2.133 + 0.4 - 0.01) = 2.523$ kg //

Since air contain 23% oxygen by weight

$$\frac{100}{21} \times 2.523 = 12.014 \text{ kg/kg of coal}$$

28.949 of air occupies = 22.4 m^3

$$\frac{12.014}{28.949} \times 22.4 = 9.29\ m^3 //$$

(42) $E_{cell} = E_{cat} - E_{anode}$ $E_{cat} = Ag$

$= 0.8 - (-0.76)$ $E_{anode} = Zn$

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

(47) Zn = anode

(62) Cu = cathode

$E_{cell} = E_{cat} - E_{anode}$

$= 0.337 - (-0.763)$

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

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60,50 are almost same 40 and 30 pl. respectively

(48) $C_6H_6 + CH_3COCl \longrightarrow C_6H_5COCH_3 + HCl$

Total molecular weight of reactant

$C_6H_6 + CH_3COCl_2 \longrightarrow [12\times6+1\times6] + [12\times1+1\times3+12+16+35.5\times2]$

$= 192$

Molecular weigh product.

$C_6H_5COCH_3$

$12\times6+5+12\times1+16\times1+12\times1+1\times3$

$= 120_{11}$

Atom economy $\frac{120}{192} \times 100 = 62.5\%_{11}$