

الباب الثاني عشر الكيمياء الكهربائية

الباب الثاني عشر
الكيمياء الكهربائية

:

: (Conductors) -

: (Insulators) -

(Covalent Bonds)

(Macromolecules)

: (Semiconductors) -

: (Electrolytes) -

(Electrovalence)

المواد العازلة الصناعية :

$(10)^{29}$

(High Strength Breaking)

(Strength)

(Flexibility)

(Rigidity)

3×10^6

Impregna-)

(Rheostats)

(Switches)

(Transformers)

(tion

(Diphenyl)

: (Amber) -

(Resin)

: (Mica) -

(Muscovite)

4×10^7

0.012

600

(Flakes)

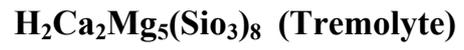
°1200

°1200

°600

Calcium)

(Magnesium Hydrosilicate



30 20

(Soda Glass)

5×10^6

9×10^6

(Glazed)

(Cables)

- : (Plastics)

(PVC)

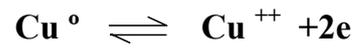
. (Extrusion)

:

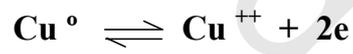
(PVC)

نظرية نيرنست (Nernst Theory) :

Cu^{++}



(1.013)



$$K = \frac{a_{\text{Cu}^{++}}}{a_{\text{Cu}^\circ}}$$

(Activity)

a

= K :

K

$$\Delta F + \Delta F^\circ + RT \ln K$$

(Free Energy)

$$= \Delta F :$$

$$= R$$

$$= \Delta F^\circ$$

$$= T$$

$$\Delta F = -nFE :$$

$$= F$$

$$= n :$$

$$= E$$

$$96496$$

$$-nFE = -nFE^\circ - RT \ln \frac{a_{Cu^{++}}}{a_{Cu^\circ}}$$

$$E = E^\circ - \frac{RT}{nF} \ln \frac{a_{Cu^{++}}}{a_{Cu^\circ}}$$

$$:F R$$

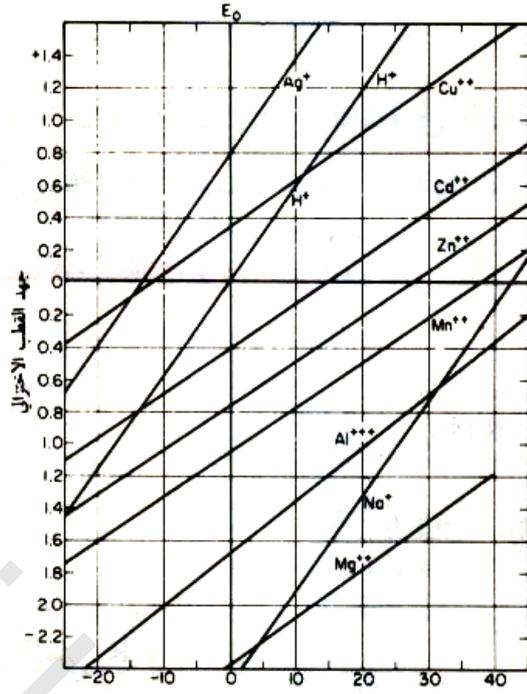
$$E = E^\circ - \frac{(2.3026)(8.3147)T}{(n)(96,496)} \text{Log} \frac{a_{Cu^{++}}}{a_{Cu^\circ}}$$

$$: 298.15 \quad ^\circ 25$$

$$E = E^\circ - \frac{(2.3026)(8.3147)(298.15)}{(n)(96,496)} \text{Log} \frac{a_{Cu^{++}}}{a_{Cu^\circ}}$$

$$E = E^\circ - \frac{0.05916}{n} \text{Log} \frac{a_{Cu^{++}}}{a_{Cu^\circ}}$$

$$E = E^\circ - \frac{0.05916}{n} \text{Log} K$$



الجهد القطبي القياسي (Standard Electrode Potential)

(Reactivity)

(Unit Activity)

(1.013)

$$\Delta F^\circ = -RT \ln K$$

$$\Delta F^\circ = -nFE_0$$

$$E_0 = \frac{0.05916}{n} \text{Log } K$$

التفاعل القطبي (من اليسار إلى اليمين) معدن - أيون	الجهد القياسي E ₀ فولت	التفاعل القطبي (من اليسار إلى اليمين) معدن - أيون	الجهد القياسي E ₀ فولت
K/K+	+ 2.92	Cu/Cu++	- 0.345
Ca/Ca++	+ 2.84	Cu/Cu+	- 0.522
Na/Na+	+ 2.71	Hg/Hg+ or Hg/2Hg+	- 0.799
Mg/Mg++	+ 2.37	Ag/Ag+	- 0.800
Al/Al+++	+ 1.67	Hg/Hg++	- 0.854
Mn/Mn++	+ 1.05	Pt/Pt++	- 1.2
Zn/Zn++	+ 0.762	Au/Au+++	- 1.42
Cr/Cr+++	+ 0.71		
Fe/Fe++	+ 0.441	التفاعل القطبي (من اليسار إلى اليمين)	الجهد القياسي E ₀ فولت
Cd/Cd++	+ 0.402	Cr++ / Cr+++	+ 0.40
Co/Co++	+ 0.277	OH/O ₂	- 0.401
Ni/Ni++	+ 0.25	Fe++ / Fe+++	- 0.748
Sn/Sn++	+ 0.136	2Br / Br ₂	- 1.065
Pb/Pb++	+ 0.126	2Cl ⁻ / Cl ₂	- 1.358
H ₂ /2H+	0.000		

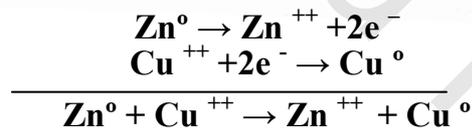
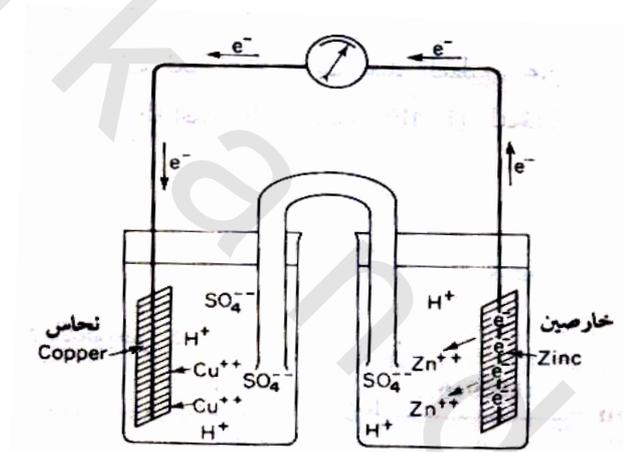
$$2.71+ = E_0$$

$$E_0 = 0.126$$

$$. 0.345-$$

: الخلية الكهربية أو البطارية (Electric cell or Battery)

(Salt Bridge)



:

$$E_0 \text{ cell} = E_01 + E_02$$

$$E_{o2} - E_{o1} = E_{o,cell} :$$

$$1.107 = (0.345 +) + 0.762 = E_{o, cell}$$

$$0.345+$$

$$0.345-$$

(EMF)

$$E_o = \frac{0.05916}{n} \text{Log K}$$

$$E_{Zn} = E_o Zn - \frac{0.05916}{n} \log \frac{a_{Zn^{++}}}{a_{Zn^{\circ}}} :$$

$$E_{Cu} = E_o Cu - \frac{0.05916}{n} \log \frac{a_{Cu^{\circ}}}{a_{Cu^{++}}} :$$

$$E_{Zn} + E_{Cu} = (E_o Zn - \frac{0.05916}{n} \log \frac{a_{Zn^{++}}}{a_{Zn^{\circ}}}) + (E_o Cu - \frac{0.05916}{n} \log \frac{a_{Cu^{\circ}}}{a_{Cu^{++}}})$$

$$E_{Zn} + E_{Cu} = E_{cell} \quad E_o Zn + E_o Cu = E_o cell$$

$$E_{cell} = E_o cell - \frac{0.05916}{n} \log \frac{(a_{Zn^{++}})(a_{Cu^{\circ}})}{(a_{Zn^{\circ}})(a_{Cu^{++}})}$$

$$E_{cell} = E_o cell - \frac{0.05916}{n} \log K :$$

$$0.001 = Cu^{++}$$

$$1.107 = E_0 \quad 0.1 = \text{Zn}^{++}$$

:

$$\log K = \frac{(a_{\text{Zn}^{++}})(a_{\text{Cu}^{\circ}})}{(a_{\text{Cu}^{++}})(a_{\text{Zn}^{\circ}})}$$



1

$$\frac{(0.1)}{(0.001)} \quad \frac{0.05916}{2} - 1.107 = E_{\text{cell}} \quad \therefore \quad 1.047 = E_{\text{cell}}$$

(Daniel Cell)

(Anode)

(Cathode)

: (Concentration Cells) الخلايا التركيبية

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.05916}{n} \log K$$

$$0 = E_{\text{cell}}^{\circ} + E_{\text{cell}}^{\circ}$$

$$E_{\text{cell}} = - \frac{0.05916}{n} \log \frac{a_2}{a_1}$$

$$a_2 = a_1$$

$$E_{\text{cell}} = - \frac{0.05916}{n} \log \frac{C_2}{C_1}$$

$$(C_2) = C_1$$

$$0.1 = 0.05916 - 0.05916$$

$$0.02958$$



$$E_{\text{mf}} = E_{\text{Zn}} + E_{\text{Cu}} = 0$$

$$E_{\text{Zn}} = - E_{\text{Cu}}$$

:

$$E_o \text{ Zn} - \frac{0.05916}{2} \text{ Log } (\text{Zn}^{++}) = - [E_o \text{ Cu} - \frac{0.05916}{2} \text{ Log } (\text{Cu}^{++})]$$

$$[\text{Cu}^{++}) \quad 0.0296 - 0.345] - = (\text{Zn}^{++}) \quad 0.0296 - 0.762$$

$$\frac{(\text{Zn}^{++})}{(\text{Cu}^{++})} \quad 0.0296 = 1.107$$

$$\frac{(\text{Zn}^{++})}{(\text{Cu}^{++})} = 37.4$$

$$K = \frac{(\text{Zn}^{++})}{(\text{Cu}^{++})} = 2.5 \times 10^{37}$$

: (Reverse Cell) **خلية عاكسة**

Cus

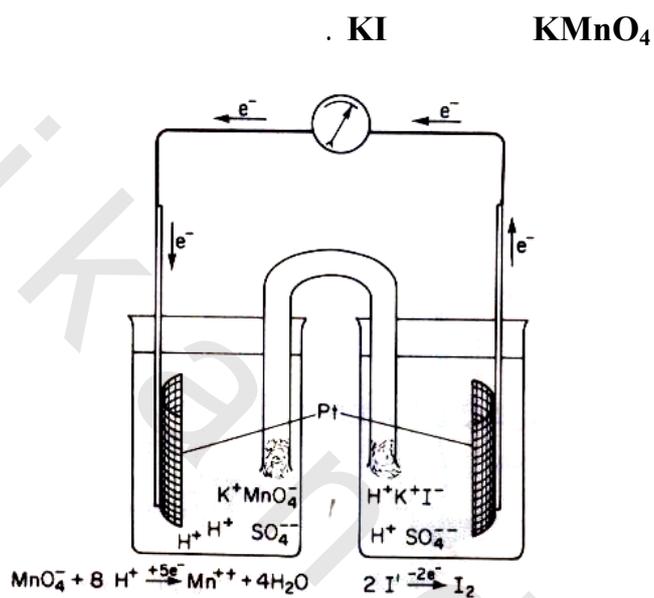
Emf

KCN

KCN

Cu(CN)₄

خلایا تاكسد - اختزال آخري :



K₂CrO₄

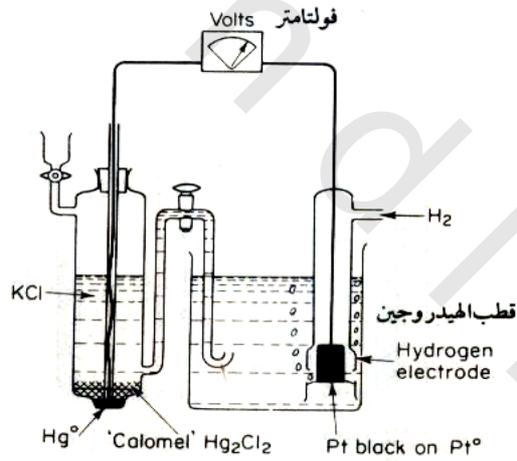


أقطاب قياسية أخرى أو أنصاف خلايا :

KCl

(Calomel)

KCl Hg_2Cl_2 ()



الجهد ، فولت		تركيز كلوريد البوتاسيوم
25 ° م	20 ° م	
0.2446	0.2492	مشبع 1 مولارية 0.1 عيارية 1 عيارية
0.2816	-	
0.3334	0.3379	
0.2809	0.2860	

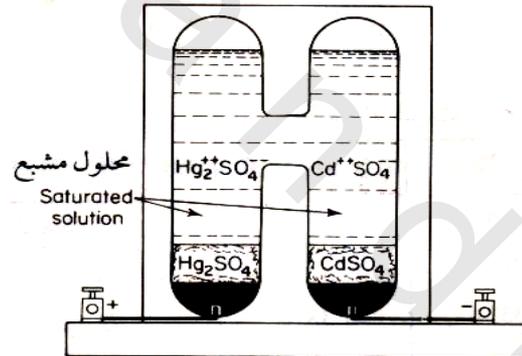
Ag⁰ - AgCl :

. Pb-PbSO₄

: خلية وستن القياسية (The Standard Weston Cell)

(Reference Cell)

. (Potentiometer)



H

Hg₂SO₄

10-13%

- 321 -

$$4.06 \times 10^{-5} \quad \text{CdSO}_4 \cdot \frac{8}{3} \text{H}_2\text{O} \quad \text{° 20} \quad 1.01816$$

قياس الرقم الهيدروجيني (pH) :

$$0.2816$$

° 25

$$E_{\text{cell}} = E_{\text{H}_2} + E_{\text{calomel}}$$

$$E_{\text{H}_2} = E_{\text{cell}} - E_{\text{calomel}}$$

$$E_{\text{H}_2} = E^\circ(\text{H}_2) - \frac{0.05916}{1} \text{Log} \frac{a_{\text{H}^+}}{a_{\text{H}_2}}$$

$$a_{\text{H}_2} = 1 \quad (1.013)$$

$$E^\circ = E^\circ(\text{H}_2)$$

$$E_{\text{H}_2} = -0.05916 \log a_{\text{H}^+}$$

$$\text{pH} = -\log a_{\text{H}^+}$$

$$E_{\text{H}_2} = +0.05916 \text{pH}$$

$$E_{\text{cell}} = E_{\text{H}_2} + E_{\text{ref}}$$

$$E_{\text{cell}} = 0.05916 \text{pH} + E_{\text{ref}}$$

$$\text{pH} = \frac{E_{\text{cell}} - E_{\text{ref}}}{0.05916}$$

$$0.694$$

$$6.97 = \frac{0.2816 - 0.694}{0.05916} \text{ pH}$$

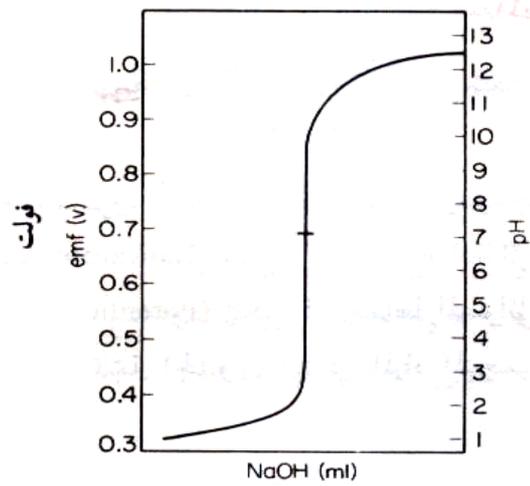
(Indicators)
(Potentiometric Method)

قطب الزجاج (Glass Electrode) :

(pH Meter)

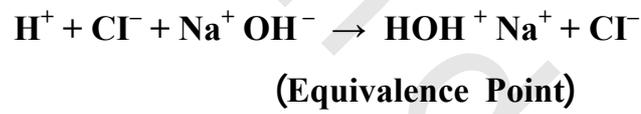
(Buffer Solution)

الحمضية الكلية (Total Acidity) :



NaOH
(Conductance Method)

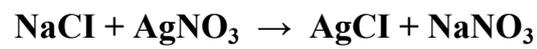
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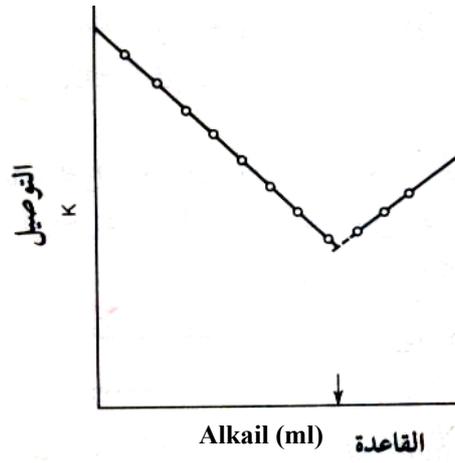


(Mobility)

End)

(Point

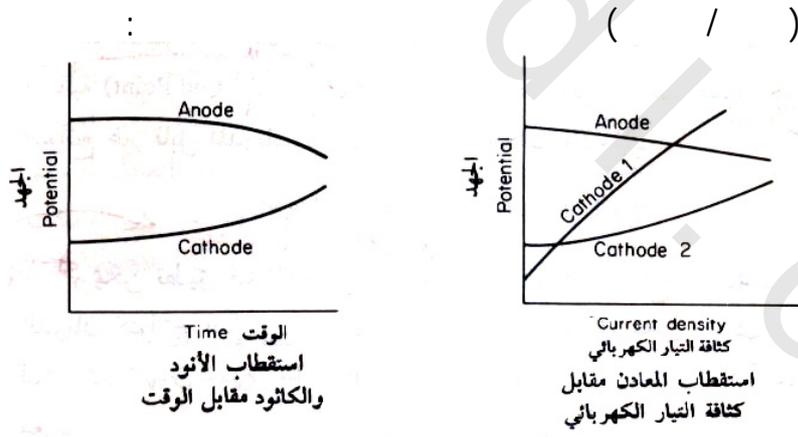




3

الاستقطاب (Polarization) :

(Concentration Polarization)





()

الجهود الزائدة : (Overvoltage) :

1.36

(Decomposition Voltage)
(Electrolysis)

(Passive Films)

H₂SO₄ :

K₂SO₄ NaOH KOH H₃PO₄ HNO₃

1.23 ()

:

$$E_{\text{cell}} = E_{\text{H}_2} + E_{\text{O}_2}$$

$$(E_{\text{cell}} = 0 + E_{\text{O}_2} - \frac{0.05916}{1} \text{Log} (\text{OH}^-))$$

$$1.229 = 14 - (10) \quad 0.05916 - 0.401 + 0 = E_{\text{cell}}$$

$$0.401 - = (E_{\text{O}_2}) \quad :$$

$$0 = E_{\text{H}_2}$$

1.7

0.47

$$/ \quad 10.0 \quad ^2 \quad / \quad 1.0$$

.

$$1.24 \quad 1.29 \quad 1.23 \quad ^2 \quad / \quad 1.0$$

$$1.07 \quad 0.80$$

$$1.12 \quad 1.09$$

(298) ° 25

10.0 ² /	1.0 ² /	
0.01	0.01	Pt,black
0.03	0.02	Pt,smooth
0.39	0.24	Au
0.56	0.40	Fe
0.76	0.48	Ag
0.58	0.48	Cu
1.09	0.52	Pb
....	0.56	Ni
0.83	0.57	Al
....	0.60	C(graphite)
0.75	0.72	Zn
....	0.78	Bi
1.08	0.86	Sn
1.04	0.88	Hg
1.13	0.98	Cd

ZnSO₄

H₂SO₄

0.76

0.76

)

(**1.04-**)

(² / 10

0.28

0.76-

خلايا انعكاسية أو بطاريات خزن :

PbO₂

1.28

37%

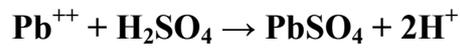


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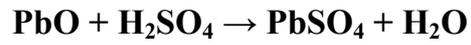
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- 329 -



1.16

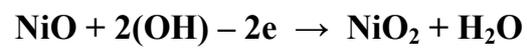
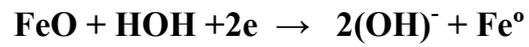
2.0

1.8

2.3

بطارية أديسون (Edison Cell) :

304



KOH

-

°-9.5

(Shorts)

بطارية خزن نيكل - كادميوم :

-

: (Miniature)

(Flashlights)

-

NiO Cd°

CdO

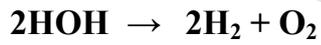
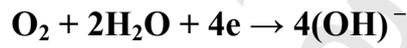
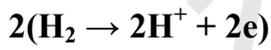
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12

NiO.OH

الإنتاج أمبير - ساعة عند 15 أمبير والحد الأدنى 1.0 فولت للخلية		درجة حرارة الشحن والتفريغ
-	-	° 25
45	34	م ° 25
22	26	م ° 17.8
10	20	م ° 28.9-
0	9	م ° 40.0-
0	5 - 2	م ° 53.9-

خلايا وقود (Fuel Cells) :



(Bacon)

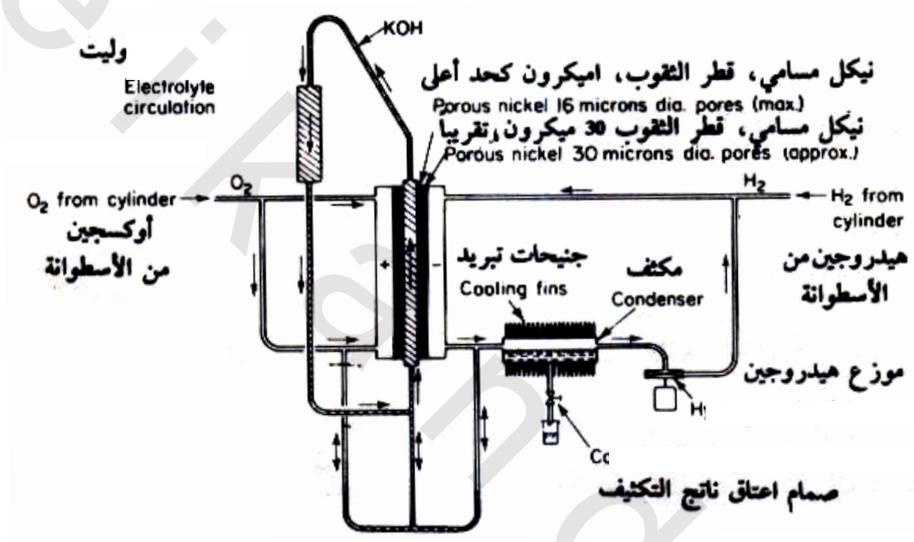
16
(50%
° 200

37)

KOH

27.2

30

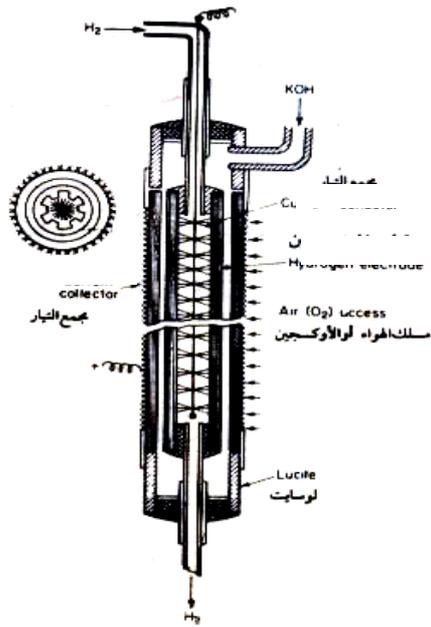


(Union Carbide)

KOH

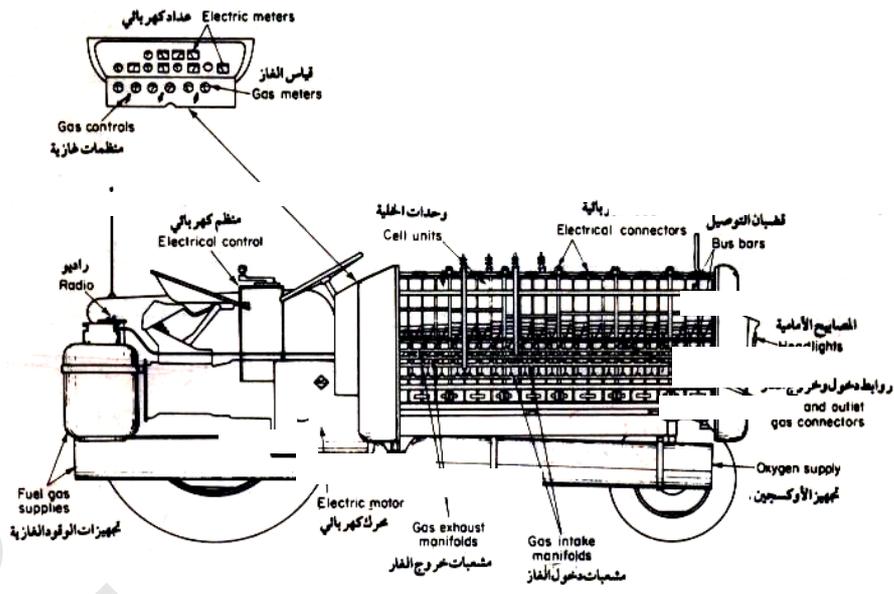
30%

()



° 800

(Eutectic)



الأسئلة

- 1
- 2
- 3
- 0.345-
0.001 Cu^{++} 0.762 + E . -4
- 0.1 Zn^{++}
(Cable) Cu^{++} -5
- 0.001
0.1
° 20 0.281+ -6
- 3 1000 / 1.5×10^{-3} H_2 -
Ag° . 5 -7
- (0.800 - = E_o)
0.860 Cd-H₂ -8
- 0.402+ E_o .
Cds -9
