UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 2005/2006

November 2005

EKC 106 – Kimia Fizik

Masa : 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang bercetak dan EMPAT muka surat Lampiran sebelum anda memulakan peperiksaan ini.

Arahan: Jawab **EMPAT (4)** soalan. Jawab mana-mana **DUA (2)** soalan dari Bahagian A. Jawab mana-mana **DUA (2)** soalan dari Bahagian B.

Pelajar boleh menjawab semua soalan dalam Bahasa Malaysia. Jika pelajar ingin menjawab dalam Bahasa Inggeris, pelajar hendaklah menjawab sekurang-kurangnya SATU soalan dalam Bahasa Malaysia.

...2/-

Bahagian A : Jawab mana-mana DUA soalan.
Section A : Answer any TWO questions.

1. Suatu gas unggul 298 K mengembang secara isoterma daripada 10 bar kepada 1 bar. Apakah nilai-nilai *w* per mol, *q* per mol, $\Delta\overline{U}$, $\Delta\overline{H}$ dan $\Delta\overline{S}$ bagi setiap kes berikut?

   [a] Pengembangan adalah berbalik

   [7 markah]

   [b] Pengembangan adalah tidak berbalik.

   [6 markah]

   [c] Gas dan persekitarannya membentuk suatu sistem berasingan, dan pengembangan adalah berbalik.

   [6 markah]

   [d] Gas dan persekitarannya membentuk suatu sistem berasingan, dan pengembangan adalah bebas.

   [6 markah]

1. An ideal gas at 298 K expands isothermally from a pressure of 10 bar to 1 bar. What are the values of w per mole, q per mole, $\Delta\overline{U}$, $\Delta\overline{H}$ and $\Delta\overline{S}$ in the following cases?

   [a] The expansion is reversible.

   [7 marks]

   [b] The expansion is irreversible.

   [6 marks]

   [c] The gas and its surroundings form an isolated system, and the expansion is reversible.

   [6 marks]

   [d] The gas and its surroundings form an isolated system, and the expansion is free.

   [6 marks]

2. [a] Sepuluh mol H_2 dan dua mol D_2 dicampurkan pada 25°C dan 1 bar. Terbitkan ungkapan bagi $\Delta\overline{S}^{\circ}$ dan kirakan nilainya. Andaikan gas-gas adalah unggul.

   [9 markah]

   [b] 10 gram molekul H_2 pada 1 bar mengembang tiga kali ganda daripada isipadu. Kirakan ΔS_{H_2}, ΔS_{surr} *dan* $\Delta S_{H_2 \text{ dan surr}}$ sekiranya proses adalah:

   [i] Isoterma dan berbalik.

   [8 markah]

   [ii] Adiabatik dan berbalik.

   [8 markah]

...3/-

2. *[a] Ten moles of H_2 and two moles of D_2 are mixed at 25°C and 1 bar. Derive the expression for $\Delta\overline{S}^{\circ}$ and calculate its value. Assume ideal gases.*

[9 marks]

[b] Ten grams of molecular H_2 at 1 bar expands to triple the volume. Find ΔS_{H_2}, ΔS_{surr} and $\Delta S_{H_2 \text{ and surr}}$ if the process is:

[i] Isothermal and reversible.

[8 marks]

[ii] Adiabatically and reversibly.

[8 marks]

3. Toluena diwapkan pada takat didih, 111°C. Haba pengewapan pada suhu ini ialah 361.9 J g^{-1}. Bagi pengewapan toulena, kirakan:

[a] *w* per mol.

[4 markah]

[b] *q* per mol

[4 markah]

[c] $\Delta\overline{H}$

[4 markah]

[d] $\Delta\overline{U}$

[4 markah]

[e] $\Delta\overline{G}$

[5 markah]

[f] $\Delta\overline{S}$

[4 markah]

3. *Toluene is vaporized at its boiling point, 111°C. The heat of vaporization at this temperature is 361.9 J g^{-1}. For the vaporization of toluene, calculate:*

[a] w per mole.

[4 marks]

[b] q per mole

[4 marks]

[c] $\Delta\overline{H}$

[4 marks]

[d] $\Delta\overline{U}$

4 marks]

[e] $\Delta\overline{G}$

[5 marks]

[f] $\Delta\overline{S}$

[4 marks]

...4/-

Bahagian B : Jawab mana-mana DUA soalan.
Section B : Answer any TWO questions.

4. [a] Suatu analisa menunjukkan campuran N_2 (2.46 atm), H_2 (7.38 atm) dan NH_3 (0.116 atm) pada 472 °C bagi tindakbalas $N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g)$ berada di dalam keseimbangan. Kirakan:

[i] Pemalar keseimbangan

[ii] ΔG^o

[iii] Adakah tindakbalas akan dianjak kesebelah produk dengan menurunkan tekanan? Berikan sebab-sebabnya.

[iv] Adakah penyingkiran NH_3 dari campuran tindakbalas akan menggalakkan pembentukan produk. Terangkan kenapa.

[14 markah]

[b] Kadar lenyapan sukrosa adalah bertertib pertama dengan $k = 0.21\ jam^{-1}$. Jika kepekatan awal sukrosa ialah 0.010 M, berapa tempoh yang diambil untuk kepekatan tersebut menurun sebanyak 90 % dari nilai asal?

[5 markah]

[c] Huraikan dengan ringkas setiap yang berikut:

[i] Apa itu elektrod? Apakah jenis-jenis elektrod?

[ii] Apa itu Hukum Henry?

[iii] Air dan n-heksana tidak boleh bercampur. Kenapa?

[6 markah]

4. *[a] An analysis shows that a mixture of N_2 (2.46 atm), H_2 (7.38 atm) and NH_3 (0.116 atm) at 472°C for the reaction $N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g)$ is in equilibrium state. Calculate:*

[i] Equilibrium constant

[ii] $\Delta G°$

[iii] Will the reaction be pushed to the product side by decreasing the pressure? Give reasons?

[iv] Will the removal of NH_3 from reaction mixture promote the product formation? Explain why.

[14 marks]

...5/-

[b] The rate of disappearance of sucrose is a first order with k = 0.21 hr^{-1}. If initial concentration of sucrose is 0.010 M, how long it takes to drop 90% of its initial value?

[5 marks]

[c] Describe each of the following in brief

[i] What is an electrode? What are the different types of electrodes?

[ii] What is Henry's Law?

[iii] n-Hexane and water are immiscible. Why?

[6 marks]

5. [a] [i] Adakah tindakbalas berikut akan berlaku dengan spontan pada 298K:

$$Co(s) + Fe^{2+}(aq) \rightarrow Co^{2+}(aq) + Fe(s)$$

diberi $[Co^{2+}]$ = 0.15 M dan $[Fe^{2+}]$ = 0.68 M. Sokong jawapan anda dengan mengira keupayaan sel.

[5 markah]

[ii] Berapakah nisbah $[Co^{2+}]$ kepada $[Fe^{2+}]$ yang akan membuatkan tindakbalas menjadi spontan?

[5 markah]

[b] Suatu sebatian HB dibentuk dari H dan B menurut persamaan H + B $\leftrightarrows$ HB. Satu larutan telah disediakan dengan melarutkan 0.100 mol H dan 0.100 mol B di dalam air untuk menghasilkan jumlah isipadu sebanyak satu liter. Selepas keseimbangan dicapai, didapati 20 % H telah bertindakbalas. Apakah kepekatan keseimbangan H, B dan HB? Apakah K_{eq} untuk tindakbalas?

[8 markah]

[c] Tindakbalas ion heksaakuakromium (III) dan ion tiosianat untuk membentuk ion kompleks mengikut hukum:

$$\text{kadar} = \left[Cr(OH_2)_6^{+3}\right]\left[SCN^{-1}\right]$$

Nilai k ialah 2.0 x 10^{-6} L/mol.s pada 14°C dan 2.2 x 10^{-5} L/mol.s pada 30°C. Berapakah nilai tenaga pengaktifan?

[7 markah]

...6/-

5. [a] [i] *Predict whether the following reaction would proceed spontaneously at 298K:*

$$Co(s) + Fe^{2+}(aq) \rightarrow Co^{2+}(aq) + Fe(s)$$

given $[Co^{2+}] = 0.15\ M$ *and* $[Fe^{2+}] = 0.68M$

Support your answer by calculating the cell potential.

[5 marks]

[ii] *At what ratio of* $[Co^{2+}]$ *to* $[Fe^{2+}]$ *will make the reaction spontaneous?*

[5 marks]

[b] *A compound, HB, is formed from H and B according to the equation H+B ⇆ HB A solution was prepared by dissolving 0.100 mole of H and 0.100 mole of B in enough water to make the total volume equal to one liter. After equilibrium had been established, it was found that 20% of H had reacted. What are the equilibrium concentrations of H, B, and HB? What is* K_{eq} *for the reaction?*

[8 marks]

[c] *The reaction of hexaaquochromium ion (III) and thiocyanate ion to form a complex ion, is governed by the law*

$$rate = \left[Cr(OH_2)_6^{+3}\right][SCN^- 1]$$

The value of k is 2.0×10^{-6} *L/mol.s at 14°C and* 2.2×10^{-5} *L/mol.s at 30°C. what is the value of activation energy?*

[7 marks]

6. [a] Apabila nitrogen tetraoksida disimpan di dalam suatu bekas pada T dan P malar, di mana berdekatan suhu bilik atau lebih tinggi, ianya mencapai darjah keseimbangan penguraian ($N_2O_4 \leftrightarrows 2NO_2$) dengan agak pantas. Jika 1.588 g nitrogen memberikan jumlah tekanan keseimbangan sebanyak 1.0133 bar, apakah nilai pemalar keseimbangan apabila ianya terurai secara separa di dalam bekas kaca 500 cm^3 pada 25°C?

[10 markah]

[b] [i] Adakah ion dikromat akan mengoksidakan asid arsenous, H_3AsO_3 untuk menghasilkan asid arsenik, H_3AsO_4 di dalam larutan berasid?

[ii] Adakah ion dirromat akan mengoksidakan hidrogen peroksida (H_2O_2) untuk membebaskan oksigen di dalam larutan berasid? Kenapa? (Berikan persamaan tindakbalas dengan nilai E^o).

[10 markah]

[c] Apakah kemolalan larutan tepu NaCl di dalam air pada 0°C? Kebolehlarutan NaCl ialah 35.7 g / 100 mL pada 0°C.

[5 markah]

...7/-

6. [a] *When nitrogen tetraoxide is held in a container at constant T and P near room temperature or higher, it rather quickly reaches an equilibrium degree of dissociation, $N_2O_4 \rightleftarrows 2NO_2$. If 1.588g of nitrogen tetraoxide gives a total pressure of 1.0133 bar when partially dissociated in a 500 cm^3 glass vessel at 25 °C, what is the value of equilibrium constant?.*

[10 marks]

[b] [i] *Will dichromate ions oxidize arsenous acid, H_3AsO_3, to arsenic acid, H_3AsO_4 in acidic solution?*

[ii] *Will dichromate ions oxidize hydrogen peroxide (H_2O_2) to free oxygen in acidic solution, why? (Write the reaction with E^o value).*

[10 marks]

[c] *What is the molality of a saturated solution of NaCl in water at 0°C? NaCl's solubility of NaCl is 35.7 g/100 mL at 0°C.*

[5 marks]

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Lampiran

Ciri-ciri termodinamik dalam keadaan piawai (25°C dan 1 bar)

Bahan	$\Delta_f H°_{298}$ ($kJmol^{-1}$)	$\Delta_f G°_{298}$ ($kJmol^{-1}$)	$S°_{m,298}$ ($Jmol^{-1}K^{-1}$)	$C_P°_{m,298}$ ($kJmol^{-1}K^{-1}$)
Ag^+ (ak)	105.56	77.09	72.8	-
Br (g)	111.884	82.396	175.022	20.786
Br^+ (aq)	-121.55	-103.97	82.4	-141.8
Br_2 (l)	0	0	152.231	75.689
Br_2 (g)	30.907	3.110	245.463	36.02
C (grafit)	0	0	5.740	8.527
C (berlian)	1.897	2.900	2.377	6.115
C (g)	716.682	671.257	158.096	20.838
CF_4 (g)	-925	-879	261.61	61.09
CH_4 (g)	-74.81	-50.72	186.264	35.309
CO (g)	-110.525	-137.168	197.674	29.116
CO_2 (g)	-393.509	-394.359	213.74	37.11
CO_3^{2-} (aq)	-677.14	-527.81	-56.9	-
COF_2 (g)	-634.7	-619.2	258.60	46.82
C_2H_2 (g)	226.73	209.20	200.94	43.93
C_2H_4 (g)	52.26	68.15	219.56	43.56
C_2H_6 (g)	-84.68	-32.82	229.60	52.63
C_2H_5OH (l)	-277.69	-174.78	160.7	111.46
$(CH_3)_2O$ (g)	-184.05	-112.59	266.38	64.39
C_3H_8 (g)	-103.85	-23.37	270.02	73.51
C_6H_6 (g)	82.93	129.7	269.31	81.67
C_6H_{10} (g)	-5.36	107.0	310.86	105.02
$C_6H_{12}O_6$ (c)	-1274.4	-910.1	212.1	218.8
$C_{12}H_{22}O_{11}$ (c)	-2221.7	-1543.8	360.2	425.5
$CH_3(CH_2)_{14}COOH$ (c)	-890.8	-314.5	455.2	460.7
$CaCO_3$ (kalsit)	-1206.92	-1128.79	92.9	81.88
$CaCO_3$ (arigonit)	-1207.13	-1127.75	88.7	81.25
CaO (c)	-635.09	-604.03	39.75	42.80
Cl (g)	121.679	105.680	165.198	21.840
Cl^- (aq)	-167.159	-131.228	56.5	-136.4
Cl_2 (g)	0	0	223.066	33.907
Cu (c)	0	0	33.150	24.435
Cu^{2+} (aq)	64.77	65.49	-99.6	-
F_2 (g)	0	0	202.78	31.30
Fe (c)	0	0	27.28	25.10
Fe^{3+} (aq)	-48.5	-4.7	-315.9	-
H (g)	217.965	203.247	114.713	20.784
H^+ (aq)	0	0	0	0
H_2 (G)	0	0	130.684	28.824
HD (g)	0.318	-1.464	143.801	29.196

D_2 (g)	0	0	144.960	29.196
HBr (g)	-36.40	-53.45	198.695	29.142
HCl (g)	-92.307	-95.299	186.908	29.12
HF (g)	-271.1	-273.2	173.779	29.133
HN_3 (g)	294.1	328.1	238.97	43.68
H_2O (l)	-285.830	-237.129	69.91	75.291
H_2O (g)	-241.818	-228.572	188.825	33.577
H_2O_2 (l)	-187.78	-120.35	109.6	89.1
H_2S (g)	-20.63	-33.56	205.79	34.23
K^+ (aq)	-252.38	-283.27	102.5	21.8
KCl (c)	-436.747	-409.14	82.59	51.30
Mg (c)	0	0	32.68	24.89
Mg (g)	147.70	113.10	148.650	20.786
MgO (c)	-601.70	-569.44	26.94	37.15
N (g)	472.704	455.563	153.298	20.786
N_2 (g)	0	0	191.61	29.125
NH_3 (g)	-46.11	-16.45	192.45	35.06
NH_2CH_2COOH (c)	-528.10	-368.44	103.51	99.20
NO (g)	90.25	86.55	210.761	29.844
NO_2 (g)	33.18	51.31	240.06	37.20
NO_3^- (aq)	-207.36	-111.25	146.4	-86.6
N_2O_4 (g)	9.16	97.89	304.29	77.28
Na (g)	107.32	76.761	153.712	20.786
Na^+ (aq)	-240.12	-261.905	59.0	46.4
NaCl (c)	-411.153	-384.138	72.13	50.50
O (g)	249.170	231.731	161.055	21.912
O_2 (g)	0	0	205.138	29.355
OH^- (aq)	-229.994	-157.244	-10.75	-148.5
PCl_3 (g)	-287.0	-267.8	311.78	71.84
PCl_5 (g)	-374.9	-305.0	364.58	112.80
SO_2 (g)	-296.830	-300.194	248.22	39.87
Si (g)	455.6	411.3	167.97	22.251
SiC (β, kiub)	-65.3	-62.8	16.61	26.86
SiO_2 (kuartz)	-910.94	-856.64	41.84	44.43
Sn (kelabu)	-2.09	0.13	44.14	25.77
Sn (putih)	0	0	51.55	26.99
SO_4^{2-} (aq)	-909.27	-744.53	20.1	-293

Sistem unit penukaran

Kuantiti	Nilai kesamaan
Jisim	1 kg = 1000 g = 0.001 tan metrik = 2.20462 lb_m = 35.27392 aun 1 lb_m = 16 aun = 5×10^{-4} tan = 453.593 g = 0.453593 kg
Panjang	1 m = 100 sm = 1000 mm = 10^6 μm = 10^{10} angstrom = 39.37 in = 3.2808 ka = 1.0936 ela = 0.0006214 batu.
Isipadu	1 m^3 = 1000 L = 10^6 sm^3 = 10^6 ml = 35.3145 ka^3 = 264.17 gal 1 ka^3 = 1728 in^3 = 7.4805 gal = 0.028317 m^3 = 28.317 L = 28317 sm^3
Daya	1 N = 1 kg.m.s^{-2} = 10^5 dyne = 10^5 g.sm.s^{-2} = 0.22481 lb_f 1 lb_f = 32.174 lb_m ft.s^{-2} = 4.4482 N
Tekanan	1 atm = 1.01325×10^5 N/m^2 (Pa) = 1.01325×10^5 kg/(m.s^2) = 760 torr = 760 mmHg = 14.696 psi
Tenaga	1 J = 1 N.m = 10^7 dyne.sm = 2.778×10^{-7} kW.h = 0.23901 kal = 0.7376 ka-lb_f = 9.486×10^{-4} Btu
Kuasa	1 W = 1 J/s = 0.23901 kal/s = 0.7376 ka-lb_f/s = 9.486×10^{-4} Btu/s = 1.341×10^{-3} hp

Pemalar Gas	Pemalar Faraday	Persamaan-persamaan
8.314 m^3.Pa/mol.K 0.08314 liter. bar/mol.K 0.08206 liter.atm/mol.K 62.36 liter.mmHg/mol.K 0.7302 ft^3.atm/lb-mole.°R 10.73 ft^3.psia/lb-mole.°R 8.314 J/mol.K 1.987 kal/mol.K 1.987 Btu/lb-mole.°R	96485 C/mol	$\zeta = \zeta^\circ - \frac{RT}{nF}\ln\left[\prod_i (a_i)^{\nu_i}\right]$ $= \zeta^\circ - \frac{RT}{nF}\ln Q$ Tindakbalas tertib ke-n $\left(\frac{[A]}{[A]_\circ}\right)^{1-n} = 1 + [A]_\circ^{n-1}(n-1)k_a t$ untuk $n \neq 1$.

Keupayaan elektrod piawai

Tindakbalas separuh	ζ, Volt	Tindakbalas separuh	ζ, Volt
$K^+ + e^- \rightarrow K$	-2.936	$2D^+ + 2e^- \rightarrow D_2$	-0.01
$Ca^{2+} + 2e^- \rightarrow Ca$	-2.868	$2H^+ + 2e^- \rightarrow H_2$	0
$Na^+ + e^- \rightarrow Na$	-2.714	$AgBr(c) + e^- \rightarrow Ag + Br^-$	0.073
$Mg^{2+} + 2e^- \rightarrow Mg$	-2.360	$AgCl(c) + e^- \rightarrow Ag + Cl^-$	0.222
$Al^{3+} + 3e^- \rightarrow Al$	-1.677	$Hg_2Cl_2(c) + 2e^- \rightarrow 2Hg + 2Cl^-$	0.268
$2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-$	-0.828	$Cu^{2+} + 2e^- \rightarrow Cu$	0.339
$Zn^{2+} + 2e^- \rightarrow Zn$	-0.762	$Cu^+ + e^- \rightarrow Cu$	0.518
$Ga^{3+} + 3e^- \rightarrow Ga$	-0.549	$I_2(c) + 2e^- \rightarrow 2I^-$	0.535
$Fe^{2+} + 2e^- \rightarrow Fe$	-0.44	$Hg_2SO_4(c) + 2e^- \rightarrow 2Hg + SO_4^{2-}$	0.615
$Cd^{2+} + 2e^- \rightarrow Cd$	-0.402	$Fe^+ + e^- \rightarrow Fe^{2+}$	0.771
$PbI_2(c) + 2e^- \rightarrow Pb + 2I^-$	-0.365	$Ag^+ + e^- \rightarrow Ag$	0.799
$PbSO_4(c) + 2e^- \rightarrow Pb + SO_4^{2-}$	-0.356	$Br_2(l) + 2e^- \rightarrow 2Br^-$	1.078
$Sn^{2+} + 2e^- \rightarrow Sn$	-0.141	$O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O$	1.229
$Pb^{2+} + 2e^- \rightarrow Pb$	-0.126	$Cl_2(g) + 2e^- \rightarrow 2Cl^-$	1.360
$Fe^{3+} + 3e^- \rightarrow Fe$	-0.04	$Au^+ + e^- \rightarrow Au$	1.69

Standard Reduction Potentials

Reaction	E° (V)	Reaction	E° (V)
$F_2 + 2e^- \rightarrow 2F^-$	2.866	$AgCl + e^- \rightarrow Ag + Cl^-$	0.22233
$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$	1.776	$Cu^{2+} + e^- \rightarrow Cu^+$	0.153
$N_2O + 2H^+ + 2e^- \rightarrow N_2 + H_2O$	1.766	$Sn^{4+} + 2e^- \rightarrow Sn^{2+}$	0.151
$Au^3 + e^- \rightarrow Au$	1.692	$AgBr + e^- \rightarrow Ag + Br^-$	0.07133
$MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$	1.679	$2H^+ + 2e^- \rightarrow H_2$	0.0000
$HClO_2 + H^+ + 3e^- \rightarrow \frac{1}{2}Cl_2 + 2H_2O$	1.63	$Fe^{3+} + 3e^- \rightarrow Fe$	−0.037
$Mn^{3+} + e^- \rightarrow Mn^{2+}$	1.5415	$2D^+ + 2e^- \rightarrow D_2$	−0.044
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$	1.507	$Pb^{2+} + 2e^- \rightarrow Pb$	−0.1262
$Au^{3+} + 3e^- \rightarrow Au$	1.498	$Sn^{2+} + 2e^- \rightarrow Sn$	−0.1375
$Cl_2 + 2e^- \rightarrow 2Cl^-$	1.358	$Ni^{2+} + 2e^- \rightarrow Ni$	−0.257
$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$	1.229	$Co^{2+} + 2e^- \rightarrow Co$	−0.28
$Br_2 + 2e^- \rightarrow 2Br^-$	1.087	$PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$	−0.3588
$2Hg^{2+} + 2e^- \rightarrow Hg_2^{2+}$	0.920	$Cr^{3+} + e^- \rightarrow Cr^{2+}$	−0.407
$Hg^{2+} + 2e^- \rightarrow Hg$	0.851	$Fe^{2+} + 2e^- \rightarrow Fe$	−0.447
$Ag^+ + e^- \rightarrow Ag$	0.7996	$Cr^{3+} + 3e^- \rightarrow Cr$	−0.744
$Hg_2^{2+} + 2e^- \rightarrow 2Hg$	0.7973	$Zn^{2+} + 2e^- \rightarrow Zn$	−0.7618
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.771	$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$	−0.8277
$MnO_4^- + e^- \rightarrow MnO_4^{2-}$	0.558	$Cr^{2+} + 2e^- \rightarrow Cr$	−0.913
$I_3^- + 2e^- \rightarrow 3I^-$	0.536	$Al^{3+} + 3e^- \rightarrow Al$	−1.662
$I_2 + 2e^- \rightarrow 2I^-$	0.5355	$Be^{2+} + 2e^- \rightarrow Be$	−1.847
$Cu^+ + e^- \rightarrow Cu$	0.521	$H_2 + 2e^- \rightarrow 2H^-$	−2.23
$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$	0.401	$Mg^{2+} + 2e^- \rightarrow Mg$	−2.372
$Cu^{2+} + 2e^- \rightarrow Cu$	0.3419	$Na^+ + e^- \rightarrow Na$	−2.71
$Hg_2Cl_2 + 2e^- \rightarrow 2Hg + 2Cl^-$	0.26828	$Ca^{2+} + 2e^- \rightarrow Ca$	−2.868
		$Li^+ + e^- \rightarrow Li$	−3.04