



NATIONAL SENIOR CERTIFICATE EXAMINATION  
NOVEMBER 2008

**PHYSICAL SCIENCES: PAPER II**

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**DATA AND FORMULAE FOR PHYSICAL SCIENCES PAPER II (CHEMISTRY)**

**GRAPH PAPER**

**HAND THIS SHEET IN WITH YOUR ANSWER BOOK**

**DATA FOR THE PHYSICAL SCIENCES PAPER 2 (CHEMISTRY)**

**TABLE 1 PHYSICAL CONSTANTS**

Avogadro’s constant	$N_A$ or $L$	$6,02 \times 10^{23} \text{ mol}^{-1}$
Molar gas constant	$R$	$8,31 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$
Standard pressure	$p^\theta$	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP	$V_m$	$22,4 \text{ dm}^3\cdot\text{mol}^{-1}$
Standard temperature	$T^\theta$	273 K

**TABLE 2 FORMULAE**

$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$ $p V = n R T$	$n = \frac{m}{M}$ $c = \frac{n}{V}$ $c = \frac{m}{MV}$	$\frac{n_A}{n_B} = \frac{c_A V_A}{c_B V_B}$ $K_w = [\text{H}^+][\text{OH}^-] = 10^{-14}$ <p style="text-align: center;">at 298 K</p> $\text{pH} = -\log[\text{H}^+]$	$E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta$ $E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta$
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**TABLE 3 PERIODIC TABLE**

**Key**

<b>I</b>	<b>II</b>	<b>Atomic number (Z)</b>										1 2.1	<b>Electronegativity</b>										2				
<b>1</b>	<b>H</b> 1											<b>H</b> 1											<b>He</b> 4				
<b>2</b>	3 1.0 <b>Li</b> 7	4 1.5 <b>Be</b> 9	<b>Relative atomic mass</b>										5 2.0 <b>B</b> 10.8	6 2.5 <b>C</b> 12	7 3.0 <b>N</b> 14	8 3.5 <b>O</b> 16	9 4.0 <b>F</b> 19	10 <b>Ne</b> 20									
<b>3</b>	11 0.9 <b>Na</b> 23	12 1.2 <b>Mg</b> 24.3											13 1.5 <b>Al</b> 27	14 1.8 <b>Si</b> 28	15 2.1 <b>P</b> 31	16 2.5 <b>S</b> 32	17 3.0 <b>Cl</b> 35.5	18 <b>Ar</b> 40									
<b>4</b>	19 0.8 <b>K</b> 39	20 1.0 <b>Ca</b> 40	21 1.3 <b>Sc</b> 45	22 1.5 <b>Ti</b> 48	23 1.6 <b>V</b> 51	24 1.6 <b>Cr</b> 52	25 1.5 <b>Mn</b> 55	26 1.8 <b>Fe</b> 56	27 1.8 <b>Co</b> 59	28 1.8 <b>Ni</b> 59	29 1.9 <b>Cu</b> 63.5	30 1.6 <b>Zn</b> 65.4	31 1.6 <b>Ga</b> 70	32 1.8 <b>Ge</b> 72.6	33 2.0 <b>As</b> 75	34 2.4 <b>Se</b> 79	35 2.8 <b>Br</b> 80	36 <b>Kr</b> 84									
<b>5</b>	37 0.8 <b>Rb</b> 85.5	38 1.0 <b>Sr</b> 88	39 1.2 <b>Y</b> 89	40 1.4 <b>Zr</b> 91	41 1.6 <b>Nb</b> 93	42 1.8 <b>Mo</b> 96	43 1.9 <b>Tc</b> 99	44 2.2 <b>Ru</b> 101	45 2.2 <b>Rh</b> 103	46 2.2 <b>Pd</b> 106	47 1.9 <b>Ag</b> 108	48 1.7 <b>Cd</b> 112	49 1.7 <b>In</b> 115	50 1.8 <b>Sn</b> 119	51 1.9 <b>Sb</b> 121	52 2.1 <b>Te</b> 128	53 2.5 <b>I</b> 127	54 <b>Xe</b> 131									
<b>6</b>	55 <b>Cs</b> 133	56 <b>Ba</b> 137.3											72 <b>Hf</b> 178.5	73 <b>Ta</b> 181	74 <b>W</b> 184	75 <b>Re</b> 186	76 <b>Os</b> 190	77 <b>Ir</b> 192	78 <b>Pt</b> 195	79 <b>Au</b> 197	80 <b>Hg</b> 200.6	81 <b>Tl</b> 204.4	82 <b>Pb</b> 207	83 <b>Bi</b> 209	84 <b>Po</b> -	85 <b>At</b> -	86 <b>Rn</b> -
<b>7</b>	87 <b>Fr</b>	88 <b>Ra</b>																									

57 <b>La</b>	58 <b>Ce</b>	59 <b>Pr</b>	60 <b>Nd</b>	61 <b>Pm</b>	62 <b>Sm</b>	63 <b>Eu</b>	64 <b>Gd</b>	65 <b>Tb</b>	66 <b>Dy</b>	67 <b>Ho</b>	68 <b>Er</b>	69 <b>Tm</b>	70 <b>Yb</b>	71 <b>Lu</b>
89 <b>Ac</b>	90 <b>Th</b>	91 <b>Pa</b>	92 <b>U</b>	93 <b>Np</b>	94 <b>Pu</b>	95 <b>Am</b>	96 <b>Cm</b>	97 <b>Bk</b>	98 <b>Cf</b>	99 <b>Es</b>	100 <b>Fm</b>	101 <b>Md</b>	102 <b>No</b>	103 <b>Lw</b>

**TABLE 4      STANDARD ELECTRODE POTENTIALS**

Half –reaction		E°/ volt
$\text{Li}^+ + \text{e}^-$	$\rightleftharpoons$ Li	-3.05
$\text{K}^+ + \text{e}^-$	$\rightleftharpoons$ K	-2.93
$\text{Cs}^+ + \text{e}^-$	$\rightleftharpoons$ Cs	-2.92
$\text{Ba}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Ba	-2.90
$\text{Sr}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Sr	-2.89
$\text{Ca}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Ca	-2.87
$\text{Na}^+ + \text{e}^-$	$\rightleftharpoons$ Na	-2.71
$\text{Mg}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Mg	-2.37
$\text{Al}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ Al	-1.66
$\text{Mn}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Mn	-1.18
$2\text{H}_2\text{O} + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2(\text{g}) + 2\text{OH}^-$	-0.83
$\text{Zn}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Zn	-0.76
$\text{Cr}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Cr	-0.74
$\text{Fe}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Fe	-0.44
$\text{Cd}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Cd	-0.40
$\text{Co}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Co	-0.28
$\text{Ni}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Ni	-0.25
$\text{Sn}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Sn	-0.14
$\text{Pb}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Pb	-0.13
$\text{Fe}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ Fe	-0.04
$2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2(\text{g})$	0.00
$\text{S} + 2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2\text{S}(\text{g})$	+0.14
$\text{Sn}^{4+} + 2\text{e}^-$	$\rightleftharpoons$ $\text{Sn}^{2+}$	+0.15
$\text{Cu}^{2+} + \text{e}^-$	$\rightleftharpoons$ $\text{Cu}^+$	+0.16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0.17
$\text{Cu}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Cu	+0.34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$\rightleftharpoons$ $4\text{OH}^-$	+0.40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^-$	$\rightleftharpoons$ $\text{S} + 2\text{H}_2\text{O}$	+0.45
$\text{I}_2 + 2\text{e}^-$	$\rightleftharpoons$ $2\text{I}^-$	+0.54
$\text{O}_2(\text{g}) + 2\text{H}^+ + \text{e}^-$	$\rightleftharpoons$ $\text{H}_2\text{O}_2$	+0.68
$\text{Fe}^{3+} + \text{e}^-$	$\rightleftharpoons$ $\text{Fe}^{2+}$	+0.77
$\text{Hg}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Hg	+0.79
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^-$	$\rightleftharpoons$ $\text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0.80
$\text{Ag}^+ + \text{e}^-$	$\rightleftharpoons$ Ag	+0.80
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^-$	$\rightleftharpoons$ $\text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0.96
$\text{Br}_2 + 2\text{e}^-$	$\rightleftharpoons$ $2\text{Br}^-$	+1.09
$\text{Pt}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Pt	+1.20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1.21
$\text{O}_2 + 4\text{H}^+ + 4\text{e}^-$	$\rightleftharpoons$ $2\text{H}_2\text{O}$	+1.23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^-$	$\rightleftharpoons$ $2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1.33
$\text{Cl}_2 + 2\text{e}^-$	$\rightleftharpoons$ $2\text{Cl}^-$	+1.36
$\text{Au}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ Au	+1.42
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^-$	$\rightleftharpoons$ $\text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1.51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + \text{e}^-$	$\rightleftharpoons$ $2\text{H}_2\text{O}$	+1.77
$\text{F}_2(\text{g}) + 2\text{e}^-$	$\rightleftharpoons$ $2\text{F}^-$	+2.87

Increasing oxidising ability

Increasing reducing ability

**Question 2.5 – Graph Paper**

**EXAMINATION NUMBER**

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