

**EXAMINATION DATA BOOKLET FOR THE PHYSICAL SCIENCES  
(PHYSICS & CHEMISTRY)**

**TABLE 1 PHYSICAL CONSTANTS**

NAME	SYMBOL	VALUE
Approximate magnitude of acceleration due to gravity	g	10 m·s <sup>-2</sup>
Speed of light in a vacuum	c	3,0 × 10 <sup>8</sup> m·s <sup>-1</sup>
Magnitude of charge on electron	e	1,6 × 10 <sup>-19</sup> C
Mass of an electron	m <sub>e</sub>	9,1 × 10 <sup>-31</sup> kg
Planck's constant	h	6,6 × 10 <sup>-34</sup> J·s
1 electron volt	1 eV	1,6 × 10 <sup>-19</sup> J
Standard pressure	p <sup>θ</sup>	1,013 × 10 <sup>5</sup> Pa
Molar gas volume at STP	V <sub>m</sub>	22,4 dm <sup>3</sup> ·mol <sup>-1</sup>
Standard temperature	T <sup>θ</sup>	273 K

**TABLE 2 PHYSICS FORMULAE**

**MOTION**

$v_f = v_i + a\Delta t$ <b>or</b> $v = u + a\Delta t$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ <b>or</b> $s = \left(\frac{v + u}{2}\right)\Delta t$
$v_f^2 = v_i^2 + 2a\Delta x$ <b>or</b> $v^2 = u^2 + 2as$	$\Delta x = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$ <b>or</b> $s = u\Delta t + \frac{1}{2}a(\Delta t)^2$

**FORCE**

$p = mv$	$F_{net} = \frac{\Delta p}{\Delta t}$	$F_{net}\Delta t = m\Delta v$
$F_{net} = ma$	$F_g = mg$	

**WORK, ENERGY AND POWER**

$W = F\Delta x$ <b>or</b> $W = Fs$	$P = Fv$	$P = \frac{W}{t}$
$E_p = mgh$	$E_k = \frac{1}{2}mv^2$	

**WAVES, LIGHT AND SOUND**

$v = f \lambda$		$T = \frac{1}{f}$
$E = hf$	$E = \frac{hc}{\lambda}$	$E = W_f + \frac{1}{2}mv^2$
$f_o = \left( \frac{v}{v - v_s} \right) f_s$ or $f_o = \left( \frac{v}{v + v_s} \right) f_s$		

**ELECTROMAGNETISM**

$emf = -N \frac{\Delta\Phi}{\Delta t}$
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**ELECTRIC CIRCUITS**

$Q = I\Delta t$	$R = \frac{V}{I}$
$P = VI = I^2R = \frac{V^2}{R}$	$V = \frac{W}{Q}$
$R = R_1 + R_2 + \dots$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
$C = \frac{Q}{V}$ $C = \frac{\epsilon_0 A}{d}$	$emf = I(R + r)$

**TABLE 3      CHEMISTRY FORMULAE**

$n = \frac{m}{M}$ $c = \frac{n}{V}$	$E_{\text{cell}}^{\theta} = E_{\text{oxidising agent}}^{\theta} - E_{\text{reducing agent}}^{\theta}$ $E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta}$
$W = VQ$ $Q = I\Delta t$	$K_w = [H^+][OH^-] = 10^{-14}$ at 298 K

**TABLE 4 PERIODIC TABLE**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>		
	Atomic number (Z)												Electronegativity							
<b>1</b>	1 2.1 <b>H</b> 1													1 2.1 <b>H</b> 1						2 <b>He</b> 4
<b>2</b>	3 1.0 <b>Li</b> 7	4 1.5 <b>Be</b> 9													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 5 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
$\text{Cr}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ 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
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+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
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2\text{O}_2$	+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
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $2\text{H}_2\text{O}$	+1.77
$\text{F}_2(\text{g}) + 2\text{e}^-$	$\rightleftharpoons$ $2\text{F}^-$	+2.87

Increasing oxidising ability

Increasing reducing ability