

**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 ⁻²
Speed of light in a vacuum	c	3,0 × 10 ⁸ m·s ⁻¹
Magnitude of charge on electron	e	1,6 × 10 ⁻¹⁹ C
Mass of an electron	m _e	9,1 × 10 ⁻³¹ kg
Planck's constant	h	6,6 × 10 ⁻³⁴ J·s
1 electron volt	1 eV	1,6 × 10 ⁻¹⁹ J
Standard pressure	p ^θ	1,013 × 10 ⁵ Pa
Molar gas volume at STP	V _m	22,4 dm ³ ·mol ⁻¹
Standard temperature	T ^θ	273 K

TABLE 2 PHYSICS FORMULAE**MOTION**

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

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

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

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

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

ELECTRIC CIRCUITS

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

TABLE 3 CHEMISTRY FORMULAE

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

TABLE 4 PERIODIC TABLE

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

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

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 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 4OH^-	+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 2I^-	+0.54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons H_2O_2	+0.68
$\text{Fe}^{3+} + \text{e}^-$	\rightleftharpoons 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 2Br^-	+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
$\text{C} + 2\text{e}^-$	\rightleftharpoons 2C^-	+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 2F^-	+2.87

Increasing oxidising ability

Increasing reducing ability