

# DATA

|                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Avogadro constant (N) = $6.022 \times 10^{23} \text{ mol}^{-1}$                                                                                                                                                                      | Velocity of light (c) = $2.998 \times 10^8 \text{ m s}^{-1}$                                                                                                                                                                                                                 |
| 1 Faraday = 96 485 coulombs                                                                                                                                                                                                          | Density of water at 25 °C = $0.9971 \text{ g cm}^{-3}$                                                                                                                                                                                                                       |
| 1 A = 1 C s <sup>-1</sup>                                                                                                                                                                                                            | Acceleration due to gravity = $9.81 \text{ m s}^{-2}$                                                                                                                                                                                                                        |
| Universal gas constant (R)<br>8.314 J K <sup>-1</sup> mol <sup>-1</sup><br>$8.206 \times 10^{-2} \text{ L atm K}^{-1} \text{ mol}^{-1}$                                                                                              | 1 newton (N) = $1 \text{ kg m s}^{-2}$                                                                                                                                                                                                                                       |
| Planck's constant (h) = $6.626 \times 10^{-34} \text{ J s}$                                                                                                                                                                          | 1 pascal (Pa) = $1 \text{ N m}^{-2}$                                                                                                                                                                                                                                         |
| Molar volume of ideal gas <ul style="list-style-type: none"> <li>at 0 °C and 100 kPa = 22.71 L</li> <li>at 25 °C and 100 kPa = 24.79 L</li> <li>at 0 °C and 101.3 kPa = 22.41 L</li> <li>at 25 °C and 101.3 kPa = 24.47 L</li> </ul> | $\text{pH} = -\log_{10}[\text{H}^+]$<br>$\text{pH} + \text{pOH} = 14.00 \text{ at } 25^\circ\text{C}$<br>$K_a = \{[\text{H}^+][\text{A}^-]\} / [\text{HA}]$<br>$\text{pH} = \text{p}K_a + \log_{10}\{[\text{A}^-] / [\text{HA}]\}$<br>$\text{PV} = n\text{RT}$<br>$E = h\nu$ |
| Surface area of sphere $A = 4\pi r^2$                                                                                                                                                                                                | $c = \nu\lambda$                                                                                                                                                                                                                                                             |

## Periodic Table of Elements

|                   |  |                   |                                          |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |  |  |  |  |  |  |  |    |
|-------------------|--|-------------------|------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--|--|--|--|--|--|--|----|
| 1                 |  |                   |                                          |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |  |  |  |  |  |  |  | 18 |
| 1<br>H<br>1.008   |  | 2                 | atomic number<br>Symbol<br>atomic weight |                   |                   |                   |                   |                   |                   |                   |                   |                   | 13                | 14                | 15                | 16                | 17                | 2<br>He<br>4.003  |  |  |  |  |  |  |  |    |
| 3<br>Li<br>6.94   |  | 4<br>Be<br>9.01   |                                          |                   |                   |                   |                   |                   |                   |                   |                   |                   | 5<br>B<br>10.81   | 6<br>C<br>12.01   | 7<br>N<br>14.01   | 8<br>O<br>16.00   | 9<br>F<br>19.00   | 10<br>Ne<br>20.18 |  |  |  |  |  |  |  |    |
| 11<br>Na<br>22.99 |  | 12<br>Mg<br>24.31 | 3                                        | 4                 | 5                 | 6                 | 7                 | 8                 | 9                 | 10                | 11                | 12                | 13<br>Al<br>26.98 | 14<br>Si<br>28.09 | 15<br>P<br>30.97  | 16<br>S<br>32.07  | 17<br>Cl<br>35.45 | 18<br>Ar<br>39.95 |  |  |  |  |  |  |  |    |
| 19<br>K<br>39.10  |  | 20<br>Ca<br>40.08 | 21<br>Sc<br>44.96                        | 22<br>Ti<br>47.87 | 23<br>V<br>50.94  | 24<br>Cr<br>52.00 | 25<br>Mn<br>54.94 | 26<br>Fe<br>55.85 | 27<br>Co<br>58.93 | 28<br>Ni<br>58.69 | 29<br>Cu<br>63.55 | 30<br>Zn<br>65.38 | 31<br>Ga<br>69.72 | 32<br>Ge<br>72.63 | 33<br>As<br>74.92 | 34<br>Se<br>78.97 | 35<br>Br<br>79.90 | 36<br>Kr<br>83.80 |  |  |  |  |  |  |  |    |
| 37<br>Rb<br>85.47 |  | 38<br>Sr<br>87.62 | 39<br>Y<br>88.91                         | 40<br>Zr<br>91.22 | 41<br>Nb<br>92.91 | 42<br>Mo<br>95.95 | 43<br>Tc<br>-     | 44<br>Ru<br>101.1 | 45<br>Rh<br>102.9 | 46<br>Pd<br>106.4 | 47<br>Ag<br>107.9 | 48<br>Cd<br>112.4 | 49<br>In<br>114.8 | 50<br>Sn<br>118.7 | 51<br>Sb<br>121.8 | 52<br>Te<br>127.6 | 53<br>I<br>126.9  | 54<br>Xe<br>131.3 |  |  |  |  |  |  |  |    |
| 55<br>Cs<br>132.9 |  | 56<br>Ba<br>137.3 | 57-71                                    | 72<br>Hf<br>178.5 | 73<br>Ta<br>180.9 | 74<br>W<br>183.8  | 75<br>Re<br>186.2 | 76<br>Os<br>190.2 | 77<br>Ir<br>192.2 | 78<br>Pt<br>195.1 | 79<br>Au<br>197.0 | 80<br>Hg<br>200.6 | 81<br>Tl<br>204.4 | 82<br>Pb<br>207.2 | 83<br>Bi<br>209.0 | 84<br>Po<br>-     | 85<br>At<br>-     | 86<br>Rn<br>-     |  |  |  |  |  |  |  |    |
| 87<br>Fr<br>-     |  | 88<br>Ra<br>-     | 89-103                                   | 104<br>Rf<br>-    | 105<br>Db<br>-    | 106<br>Sg<br>-    | 107<br>Bh<br>-    | 108<br>Hs<br>-    | 109<br>Mt<br>-    | 110<br>Ds<br>-    | 111<br>Rg<br>-    | 112<br>Cn<br>-    | 113<br>Nh<br>-    | 114<br>Fl<br>-    | 115<br>Mc<br>-    | 116<br>Lv<br>-    | 117<br>Ts<br>-    | 118<br>Og<br>-    |  |  |  |  |  |  |  |    |

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| 57<br>La<br>138.9 | 58<br>Ce<br>140.1 | 59<br>Pr<br>140.9 | 60<br>Nd<br>144.2 | 61<br>Pm<br>- | 62<br>Sm<br>150.4 | 63<br>Eu<br>152.0 | 64<br>Gd<br>157.3 | 65<br>Tb<br>158.9 | 66<br>Dy<br>162.5 | 67<br>Ho<br>164.9 | 68<br>Er<br>167.3 | 69<br>Tm<br>168.9 | 70<br>Yb<br>173.0 | 71<br>Lu<br>175.0 |
| 89<br>Ac<br>-     | 90<br>Th<br>232.0 | 91<br>Pa<br>231.0 | 92<br>U<br>238.0  | 93<br>Np<br>- | 94<br>Pu<br>-     | 95<br>Am<br>-     | 96<br>Cm<br>-     | 97<br>Bk<br>-     | 98<br>Cf<br>-     | 99<br>Es<br>-     | 100<br>Fm<br>-    | 101<br>Md<br>-    | 102<br>No<br>-    | 103<br>Lr<br>-    |