

# The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: left;"> <p><b>MIRACLE LEARNING CENTRE PTE LTD</b>                      144 UPPER BUKIT TIMAH ROAD #03-01 BEAUTY WORLD CENTRE S(588177)                      Tel : 6463 8756 / 9839 9908                      www.miraclelearningcentre.com                      SCIENCE AND MATH SPECIALIST (Pri, Sec, JC)</p> </div> </div>										11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	98 Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	- Po polonium 84	- At astatine 85	- Rn radon 86
- Fr francium 87	- Ra radium 88	- Ac actinium 89 †															

\*58-71 Lanthanoid series  
†90-103 Actinoid series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	- Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	162 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	- Pa protactinium 91	238 U uranium 92	- Np neptunium 93	- Pu plutonium 94	- Am americium 95	- Cm curium 96	- Bk berkelium 97	- Cf californium 98	- Es einsteinium 99	- Fm fermium 100	- Md mendelevium 101	- No nobelium 102	- Lr lawrencium 103

Key 

a
X
b

 a = relative atomic mass  
X = atomic symbol  
b = proton (atomic) number

## SCIENCE AND MATH SPECIALIST

Formula			Units for symbols		
$\rho = \frac{m}{V}$	$P_1 V_1 = P_2 V_2$	$\theta = \frac{X_\theta - X_0}{X_{100} - X_0} \times 100$	$\rho$ (density)=kg m <sup>-3</sup> m(mass)= kg V(volume)= m <sup>3</sup> W(weight) = N g = N kg <sup>-1</sup> v(velocity) = m s <sup>-1</sup> d(displacement)=m t(time)= s a(acc)= m s <sup>-2</sup>	Moment= Nm F(force) = N W(work) = J E(energy) = J P(power)= W =Pa or Nm <sup>-2</sup> f(frequency)= Hz $\lambda$ (wavelength)= m T(period) = s	R(resistance) = $\Omega$ I(current) = A V(voltage) = V $\mathcal{E}$ (e.m.f) = V Q(charge) = C Q(energy) = J c(s.h.c.)= J kg <sup>-1</sup> K <sup>-1</sup> $\Delta\theta$ = K or °C $t_f$ (s.l.h. of fusion) = J kg <sup>-1</sup> $t_v$ (s.l.h. of vap.) = J kg <sup>-1</sup>
W = mg Ave speed = $\frac{\text{total dist}}{\text{total time}}$ $a = \frac{v - u}{t}$ v = u + at s = ut + $\frac{1}{2} at^2$ v <sup>2</sup> = u <sup>2</sup> + 2as	P = hpg P = $\frac{F}{A}$ v = f $\lambda$ f = $\frac{1}{T}$ n = $\frac{\sin i}{\sin r} = \frac{c}{v}$ sin c = $\frac{1}{n}$	Cost of electricity = Unit cost(\$/kWh) X Energy (kWh) P = IV = I <sup>2</sup> R = $\frac{V^2}{R}$ E = IVt = I <sup>2</sup> Rt = $\frac{V^2}{R} t$			
Moment = Fd (perpendicular dist from pivot)	F = ma (Net force)	W = Fs (dist moved in the dir of the force)	<p><b>Principle of Moments:</b> When a body is in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot.</p> <p><b>Faraday's Law of Electromagnetic Induction:</b> The e.m.f induced in a conductor is proportional to the rate of change of magnetic lines of force linking the circuit.</p> <p><b>Lenz's Law:</b> The direction of the induced e.m.f, and hence the induced current in a closed circuit, is always such that its magnetic effect opposes the motion or change producing it.</p>		
$P = \frac{W}{t} = \frac{E}{t}$	Q = It V = IR	$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{I_s}{I_p}$			
$E_k = \frac{1}{2} mv^2$ E <sub>p</sub> = mgh	V = $\frac{W}{Q}$	$\mathcal{E} = \frac{W}{Q}$			

**1st Law of Reflection:**  
The incident ray, the reflected ray and the normal to the reflecting surface all lie in the same plane.

**2nd Law of Reflection:**  
The angle of incidence is equal to the angle of reflection.

**Characteristics of the image formed by a plane mirror:**

- 1) The image is of the same size as the object.
- 2) Laterally inverted.
- 3) It is upright.
- 4) It is virtual.
- 5) The image distance is equal to the object distance.

Total internal reflection is the reflection of light as it travels from an optically **denser medium to a less dense** medium and in which the angle of incidence is **greater** than the critical angle.

Object distance, u	Image formed by a lens
$u = \infty$	<b>Type:</b> Real, Inverted, Diminished <b>Image dist:</b> Opp side of lens; at f
<b>Use:</b> Telescope	
$u > 2f$	<b>Type:</b> Real, Inverted, Diminished <b>Image dist:</b> Opp side of lens; $f < v < 2f$
<b>Use:</b> Camera	
$u = 2f$	<b>Type:</b> Real, Inverted, Same size <b>Image dist:</b> Opp side of lens; at 2f
<b>Use:</b> Photocopier	
$f < u < 2f$	<b>Type:</b> Real, Inverted, Magnified <b>Image dist:</b> Opp side of lens; $> 2f$
<b>Use:</b> Projector	
$u = f$	<b>Type:</b> Virtual, Upright, Magnified <b>Image dist:</b> Same side as lens; at $\infty$
<b>Use:</b> Spotlight	
$u < f$	<b>Type:</b> Virtual, Upright, Magnified <b>Image dist:</b> Same side as lens; behind object.

(f=focal length, u=object dist, v=image dist)

Na <sup>+</sup>	IONS	fluoride
K <sup>+</sup>	chloride	F <sup>-</sup>
Ag <sup>+</sup>	bromide	Cl <sup>-</sup>
Cu <sup>+</sup>	iodide	Br <sup>-</sup>
H <sup>+</sup>	oxide	I <sup>-</sup>
NH <sub>4</sub> <sup>+</sup>	sulfide	O <sup>2-</sup>
Pb <sup>2+</sup>	nitride	S <sup>2-</sup>
Cu <sup>2+</sup>	<b>hydroxide</b>	N <sup>3-</sup>
Mg <sup>2+</sup>	<b>nitrate (V)</b>	OH <sup>-</sup>
Ca <sup>2+</sup>	nitrite/nitrate(III)	NO <sub>2</sub> <sup>-</sup>
Zn <sup>2+</sup>	<b>sulfate (VI)</b>	NO <sub>2</sub> <sup>2-</sup>
Ba <sup>2+</sup>	sulfite/sulfate(IV)	SO <sub>4</sub> <sup>2-</sup>
Fe <sup>2+</sup>	<b>carbonate</b>	SO <sub>3</sub> <sup>2-</sup>
Hg <sup>2+</sup>	phosphate (V)	CO <sub>3</sub> <sup>2-</sup>
Fe <sup>3+</sup>	hydrogen carbonate	PO <sub>4</sub> <sup>3-</sup>
Al <sup>3+</sup>	hydrogen sulfate	HCO <sub>3</sub> <sup>-</sup>
Cr <sup>3+</sup>	manganate(VII)	HSO <sub>4</sub> <sup>-</sup>
		MnO <sub>4</sub> <sup>-</sup>

**Newton's First Law:** An object at rest will remain at rest, an object in motion will continue its motion in a straight line unless a **NET external force acts on it.**

**Newton's Second law:**  
The acceleration of an object is directly proportional to the resultant force acting on the object.  
The net force acting upon an object is equal to the product of the mass and the acceleration of the object. (F=ma)

**Newton's Third law:**  
For every action, there is an equal and opposite reaction.

Proton	Relative charge	Relative mass	Proton no/ Atomic no is the no protons in an atom.
Electron	-1	1/1840	Mass no/ Nucleon no is the no of protons and neutrons in an atom.
Neutron	No charge	1	

**Valence electrons** are the electrons in the outermost shell of the atom. The number of valence electrons determines the **chemical properties** of the atom.  
Elements in **Group 0** have noble gas electronic structures.  
(**completely filled outermost shell.**)  
**Isotopes** are atoms of the same element which have the same number of protons but different number of neutrons.

All Sodium, Potassium, Ammonium, Gp I salts are **soluble**.  
All nitrates are **soluble**.  
All chlorides/iodides are **soluble** except AgCl, PbCl<sub>2</sub>  
All sulfates are **soluble** except PbSO<sub>4</sub>, BaSO<sub>4</sub>, CaSO<sub>4</sub>  
All carbonates **insoluble** except Na<sub>2</sub>CO<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>, (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> and group I carbonates.  
All hydroxides **insoluble** except NaOH, KOH, aq NH<sub>3</sub> and group I hydroxides.  
Mg(OH)<sub>2</sub>, Ca(OH)<sub>2</sub>, Ba(OH)<sub>2</sub> are slightly soluble.

Current	Series	Parallel
$I_1 = I_2 = I_3$	$V_t = V_1 + V_2 + V_3$	$I_t = I_1 + I_2 + I_3$
$R_t = R_1 + R_2 + R_3$	$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$	$V_1 = V_2 = V_3$
$R = \rho \frac{l}{A}$		

**Resistance is defined as the ratio of potential difference to the current flowing through the conductor.**

**Ohm's Law** states that the current through a metallic conductor is directly proportional to the potential difference across it if the temperature and physical conditions remains constant.

Cation	Effect of NaOH	Effect of aq NH <sub>3</sub>
Zn <sup>2+</sup>	White ppt, siegcs	White ppt, siegcs
Al <sup>3+</sup>	White ppt, siegcs	White ppt, iie
Pb <sup>2+</sup>	White ppt, siegcs	White ppt, iie
Ca <sup>2+</sup>	White ppt, iie	No ppt (or slight)
Cu <sup>2+</sup>	Blue ppt, iie	Blue ppt, siegdbbs
Fe <sup>2+</sup>	Green ppt, iie	Green ppt, iie
Fe <sup>3+</sup>	Reddish-brown ppt, iie	Reddish-brown ppt, iie
NH <sub>4</sub> <sup>+</sup>	Ammonia produced	—
Na <sup>+</sup>	No ppt	No ppt
K <sup>+</sup>	No ppt	No ppt

\* (siegcs) soluble in excess giving a colourless solution  
\* (siegdbbs) soluble in excess giving a dark blue solution  
\* (iie) insoluble in excess

Gas	Test and test results
Ammonia, NH <sub>3</sub>	Turns damp red litmus paper blue.
Carbon dioxide, CO <sub>2</sub>	Gives a white precipitate when bubbled into limewater.
Chlorine, Cl <sub>2</sub>	Bleaches damp litmus paper.
Hydrogen, H <sub>2</sub>	Extinguishes a lighted splint with a 'pop' sound.
Oxygen, O <sub>2</sub>	Relights a glowing splint.
Sulfur dioxide, SO <sub>2</sub>	Turns acidified aq. KMnO <sub>4</sub> purple to colourless. (Turns acidified aq. K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> orange to green)