Physics Formulae

Forces and Motion

1. **Force** = mass x acceleration

   F = ma

2. **Weight** = mass x gravity

   W = mg

3. **Momentum** = mass x velocity. (Momentum is represented by p)

   $\boldsymbol{p}$ = mv

4. **Distance** = speed x time

   D = st

5. **Change in velocity** = acceleration x time taken

   V-U = at

6. **Change in velocity** = 2 x acceleration x distance

   $\mathbf{V^2-U^2}$ = 2ad

7. **Change in momentum** = force x time

   MV-MU = ft

8. **Work done** = force x distance moved

   Wd = fd

9. **Work done** = power x time taken

   Wd = pt

10. **Mass** = density x volume

    M = dv

Waves

1. **Wave speed (V)** = frequency x wavelength

   V = $f\lambda$

2. **Distance** = wave speed x time

   D = st

Energy

1. **Kinetic Energy** = (mass x velocity^2)/2 [remember as: "Half m v squared"]

   KE = ½mv^2

2. **Energy** = power x time

   E = Pt

3. Efficiency (%) = (**Energy out** ÷ energy in) x 100%.

4. **Change in gravitational potential energy** = mass x gravitational field strength x change in height.

   ΔGPE = mass x gravity x Δheight.

   ΔGPE = m g Δh.

Pressure

1. **Force** = pressure x area

   F = pa

2. Pressure$_1$ x Volume$_1$ = Pressure$_2$ x Volume$_2$

   $P_1V_1 = P_2V_2$

3. **Pressure due to a column of liquid** = height of column × density of liquid × gravitational field strength

   P = h x ρ x g

Electricity

1. **Voltage** = current x resistance

   V = ir

2. **Power** = voltage x current

   P = vi

3. **Charge** = current x time

   Q = it

4. **Energy** = voltage x charge

   E = vq

5. **Energy** = voltage x current x time

   E = vit

6. **Power dissipation** = i squared r

   P = i^2r

7. **Force on a conductor** = magnetic flux density x current x length

   F = BiL

8. **Transformer output (v or i)** = Transformer input (v or i) x secondary turns / primary turns

   Out = in x (secondary turns / primary turns)

Springs

1. **Force on a spring** = spring constant x extension

   F = kd

2. **Energy transferred in stretching** = 0.5 x spring constant x extension^2

   E = ½kd^2

Thermal

1. **Thermal energy for a change of state** = mass × specific latent heat

   Q = m x L

2. **Change in thermal energy** = mass × specific heat capacity × change in temperature

   ΔQ = m x c x Δθ

Normals

1. **Moment of a force** = force x distance normal to the direction of the force.

2. **Force normal to surface** = Pressure x area of that surface

   F = pa

Units

Length	Metres m
Mass	Kilograms Kg
Weight	Newton N
Time	Seconds s
Force	Newtons N
Power	Watts W
Energy	Joules J
Voltage	Volts V
Current	Amps A
Resistance	Ohms Ω
Charge	Coulomb Q
Magnetic flux density	Tesla T
Frequency	Hertz Hz
Pressure	Pascals Pa
Temperature	Kelvin K and Celsius C

Prefixes

tera	T	A Trillion	1,000,000,000,000	10^{12}
giga	G	A Billion	1,000,000,000	10^{9}
mega	M	A Million	1,000,000	10^{6}
kilo	k	A Thousand	1,000	10^{3}
centi	c	A Hundredth	0.01	10^{-2}
milli	m	A Thousandth	0.001	10^{-3}
micro	µ	A Millionth	0.000001	10^{-6}
nano	n	A Billionth	0.000000001	10^{-9}
pico	p	A Trillionth	0.000000000001	10^{-12}

Newton’s Laws of Motion

Newton's first law
An object will remain at rest, or will continue moving in a straight line, unless acted upon by an external force.

Newton’s second law
Any change in momentum of an object is proportional to the force applied.

$$F = \frac{mv - mu}{t} \qquad \text{Force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = ma$$

Newton’s third law
For every action there is an equal and opposite reaction.
If object A exerts a force on object B, then object B exerts an equal force on object A.