# Physics Equations

$v_{ave} = \Delta x/t$

$a = \Delta v/t = (v_f - v_i) / t$

$v_{ave} = (v_i + v_f) /2$

$\Delta x = 1/2(v_i + v_f)\, t$

$v_f = v_i + at$

$\Delta x = v_i t + 1/2at^2$

$v_f^2 = v_i^2 + 2a\Delta x$

$R = (v_i^2/g)\sin 2\theta$

$h = (v_i \sin\theta)^2 / 2g$

$t = (2v_i/g)\sin\theta$

$weight = mg$

$F_{net} = ma$

$f = \mu N$

work = area under F vs $\Delta x$ curve = $\Delta E$

$work = F\Delta x\cos\theta$ (const. F only)
(cos θ = 1 if F and Δx are in same direction)

$E_g = PE = mgh$

$E_k = KE = 1/2\, mv^2$

$E_{el} = PE_{elastic} = 1/2k\Delta x^2$

$F = k\Delta x$

$P = work/t$

$P = Fv\cos\theta$ (const. F only)
(cos θ = 1 if F and Δx are in same direction)

$v = 2\pi r/T$

$\omega = v/r$

$a_c = v^2/r = 4\pi^2 r/T^2 = \omega^2 r$

$F_c = ma_c$

$F_g = GmM/r^2$

$\tan\theta = v^2/rg$

$g = GM/r^2$

$p = mv$

$impulse = Ft = \Delta p = m(v_f - v_i)$

**right angle trig functions (remember Chief SOH CAH TOA):**
$\sin\theta$ = opp/hyp  $\cos\theta$ = adj/hyp  $\tan\theta$ = opp/adj
**law of sines:** sinA/a = sinB/b = sinC/c
**law of cosines:** $c^2 = a^2 + b^2 - 2ab\cos C$
**quadratic formula:** (to solve $ax^2 + bx + c = 0$)

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Variables:**

| | | |
|---|---|---|
| $\Delta x$ | displacement | m |
| t | time | s |
| v | velocity | m/s |
| a | acceleration | $m/s^2$ |
| R | range | m |
| h | height | m |
| W | weight | N |
| $F_{net}$ | total or net force | N |
| f | friction | N |
| $\mu$ | coefficient of friction | (no units) |
| N | normal force | N |
| m | mass | kg |
| W | work | j |
| $\theta$ | angle betw. F and $\Delta x$ | degrees |
| k | spring constant | N/m |
| $E_g$/PE | grav. pot. energy | j |
| $E_k$/KE | kinetic energy | j |
| $E_e$/$PE_{elastic}$ | elastic pot. energy | j |
| P | power | w (watts) |
| $\omega$ | angular velocity | rad/s |
| $F_g$ | grav. force | N |
| $a_c$ | centripetal acc. | $m/s^2$ |
| $F_c$ | centripetal force | N |
| G | grav. constant. | $6.67 \times 10^{-11}$ $Nm^2/kg^2$ |
| g | grav. acc on Earth | 9.8 $m/s^2$ |
| p | momentum | kgm/s |
| I | impulse | Ns |