Physics Reference Materials

Motion

$\text{average velocity} = \dfrac{\text{displacement}}{\text{change in time}} = \dfrac{\text{change in position}}{\text{change in time}}$	$v_{avg} = \dfrac{\Delta d}{\Delta t}$
$\text{acceleration} = \dfrac{\text{change in velocity}}{\text{change in time}}$	$a_{avg} = \dfrac{\Delta v}{\Delta t}$
$\text{displacement} = \begin{pmatrix}\text{initial}\\ \text{velocity}\end{pmatrix}\begin{pmatrix}\text{change}\\ \text{in time}\end{pmatrix} + \dfrac{1}{2}(\text{acceleration})\begin{pmatrix}\text{change}\\ \text{in time}\end{pmatrix}^2$	$\Delta d = v_i \Delta t + \dfrac{1}{2} a(\Delta t^2)$
$\text{final velocity} = \text{initial velocity} + (\text{acceleration})\begin{pmatrix}\text{change}\\ \text{in time}\end{pmatrix}$	$v_f = v_i + a\Delta t$
$(\text{final velocity})^2 = (\text{initial velocity})^2 + 2(\text{acceleration})\begin{pmatrix}\text{change}\\ \text{in displacement}\end{pmatrix}$	$v_f^2 = v_i^2 + 2a\Delta d$
$\text{displacement} = \dfrac{(\text{initial velocity} + \text{final velocity})}{2} \times \text{time}$	$\Delta d = \dfrac{(v_i + v_f)}{2}\Delta t$

Force

$\text{net force} = \text{mass} \times \text{acceleration}$	$F_{Net} = ma$
$\begin{pmatrix}\text{force of}\\ \text{gravitational}\\ \text{attraction}\end{pmatrix} = \begin{pmatrix}\text{universal}\\ \text{gravitational}\\ \text{constant}\end{pmatrix} \times \dfrac{\begin{pmatrix}\text{mass of}\\ \text{1st object}\end{pmatrix}\begin{pmatrix}\text{mass of}\\ \text{2nd object}\end{pmatrix}}{\begin{pmatrix}\text{distance between}\\ \text{centers of objects}\end{pmatrix}^2}$	$F_{grav} = G\dfrac{m_1 m_2}{d^2}$

Work, Power, Energy

$\text{work} = \text{force} \times \text{distance}$	$W = Fd$
$\text{power} = \dfrac{\text{work}}{\text{time}}$	$P = \dfrac{W}{t}$
$\text{total mechanical energy} = \text{potential energy} + \text{kinetic energy}$	$TME = PE + KE$
$\text{net work} = \text{change in kinetic energy}$	$W_{Net} = \Delta KE$
$\text{kinetic energy} = \dfrac{1}{2} \times \text{mass} \times (\text{velocity})^2$	$KE = \dfrac{1}{2}mv^2$
$\text{gravitational potential energy} = \text{mass} \times \text{acceleration due to gravity} \times \text{height}$	$PE_g = mgh$
$\text{energy} = \text{mass} \times (\text{speed of light})^2$	$E = mc^2$

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Centripetal Motion

average tangential speed $= \dfrac{\text{circumference}}{\text{time}}$	$v_t = \dfrac{2\pi r}{t} = \dfrac{\pi d}{t}$
centripetal acceleration $= \dfrac{\text{tangential speed}}{\text{radius of circular path}}$	$a_c = \dfrac{v_t^2}{r}$
centripetal force $=$ mass $\times \dfrac{(\text{tangential speed})^2}{\text{radius of circular path}}$	$F_c = \dfrac{mv_t^2}{r}$

Momentum

momentum = mass × velocity	$p = mv$
impulse = Force × change in time = mass × change in velocity	$J = F\Delta t = \Delta p = mv_f - mv_i$
Conservation of Momentum	$\Delta p_i = \Delta p_f$
Perfectly Inelastic Collision	$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2)v_f$
Elastic Collision	$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$
Recoil	$0 = m_1 v_1 + m_2 v_2$

Electrical

electric force $= \left(\begin{matrix}\text{Coulomb's}\\\text{constant}\end{matrix}\right) \times \dfrac{\left(\begin{matrix}\text{charge of}\\\text{1st particle}\end{matrix}\right)\left(\begin{matrix}\text{charge of}\\\text{2nd particle}\end{matrix}\right)}{(\text{distance between particles})^2}$	$F_{electric} = k\dfrac{q_1 q_2}{d^2}$
electric current $= \dfrac{\text{charge passing through a given area}}{\text{time interval}}$	$I = \dfrac{\Delta Q}{\Delta t}$
potential difference = voltage = current × resistance	$V = IR$
electric power = current × potential difference	$P = IV$
Series Circuit Resistance	$R = R_1 + R_2 + R_3 . . .$
Parallel Circuit Resistance	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} . . .$

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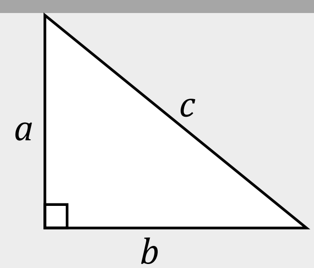
Waves and Optics

wave velocity = frequency × wavelength	$v = f\lambda$
$\text{period} = \dfrac{1}{\text{frequency}}$	$T = \dfrac{1}{f}$
$\dfrac{1}{\text{focal length}} = \dfrac{1}{\text{distance to image}} + \dfrac{1}{\text{distance to object}}$	$\dfrac{1}{f} = \dfrac{1}{d_i} + \dfrac{1}{d_o}$

Vector Addition

Pythagorean theorem



$a^2 + b^2 = c^2$

a = leg of right triangle

b = leg of right triangle

c = hypotenuse of right triangle

Constants and Conversions

g = acceleration due to gravity = $9.81 \dfrac{\text{m}}{\text{s}^2}$
c = speed of light = $3.00 \times 10^8 \dfrac{\text{m}}{\text{s}}$
G = universal gravitation constant = $6.67 \times 10^{-11} \dfrac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$
k_c = Coulomb's constant = $8.99 \times 10^9 \dfrac{\text{N} \cdot \text{m}^2}{\text{C}^2}$
m_E = mass of Earth = $5.98 \times 10^{24}\text{kg}$
r_E = radius of Earth = $6.37 \times 10^6\text{m}$
newton (N) = $\dfrac{\text{kg} \cdot \text{m}}{\text{s}^2}$
joule (J) = $\text{N} \cdot \text{m}$
watt (W) = $\dfrac{\text{J}}{\text{s}} = \dfrac{\text{N} \cdot \text{m}}{\text{s}}$
hertz (Hz) = $\dfrac{\text{cycle}}{\text{s}}$