Motion in One Dimension

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

$$a_{ave} = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}$$

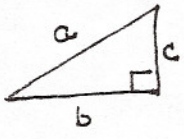
$$x = \tfrac{1}{2}(v_i + v_f)t \qquad v(t) = \frac{dx}{dt}$$

$$v_f = v_i + at \qquad a(t) = \frac{dv}{dt}$$

$$x = \tfrac{1}{2}at^2 + v_i t$$

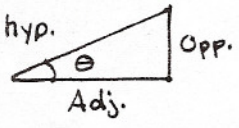
$$2ax = v_f^2 - v_i^2$$

2-Dimensional Motion and Vectors



Pythagorean Theorem

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



$$\tan\theta = \frac{opp}{adj}$$

$$\sin\theta = \frac{opp}{hyp}$$

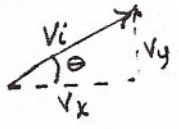
$$\cos\theta = \frac{adj}{hyp}$$

$$R = \frac{v_0^2 \sin 2\theta}{g}$$

vertical motion $y = \tfrac{1}{2}gt^2 + v_y t$, usually $v_y = 0$

horizontal motion $x = v_x t$

for projectiles:



$$x = v_i(\cos\theta)t$$

$$y = v_i(\sin\theta)t + \tfrac{1}{2}gt^2$$

$$g = \frac{v_{yf} - v_i(\sin\theta)}{t}$$

$$2gy = v_{yf}^2 - v_{yi}^2$$

Forces and the Laws of Motion

$$F = ma \qquad \mu_s = \frac{F_s}{F_N}$$

$$W = mg$$

$$F_N = W$$

$$F_A = F_s$$

Work and Energy

$$W = fd \qquad PE_{elastic} = \tfrac{1}{2}kx^2$$

$$KE = \tfrac{1}{2}mv^2 \qquad ME_i = ME_f = PE_i + KE_i = PE_f + KE_f$$

$$PE = mgh$$

$$P = \frac{W}{t}$$

$$W = \int_{x_i}^{x_f} F(x)\,dx$$

m/s	v_{ave} = average velocity
m/s^2	a_{ave} = average acceleration
m	x = displacement
m/s	v_f = final velocity
m/s	v_i = initial velocity
s	t = time
m	y = vertical displacement
m/s^2	g = gravity = $9.8\ m/s^2$
$N = kg\cdot\frac{m}{s^2}$	F = force
N	W = weight
N	F_N = normal force
N	F_s = static friction force
–	μ_s = coefficient of static friction
N	F_A = applied force
$J = kg\cdot\frac{m^2}{s^2}$	W = work
J	KE = kinetic energy
J	PE = potential energy
N/m	k = spring constant
J	ME = mechanical energy
W	P = power
kg·m/s	p = momentum
rad/s	ω = angular velocity
rad/s^2	α = angular acceleration
m	r = radius
m/s	v_t = tangential velocity
m/s^2	a_c = centripetal acceleration
N	F_c = centripetal Force
$\frac{N\cdot m^2}{kg^2}$	G = gravitational const = $6.673\times10^{-11}\ \frac{N\cdot m}{kg}$
N	F_g = gravitational force
J	E = energy
J·s	h = Planck's constant = 6.63×10^{-34} J·s
$Hz = 1/s$	f = frequency
J	hf_t = work function
Hz = 1/s	f_t = threshold frequency
m/s^2	c = speed of light = 3×10^8 m/s
m	λ = wavelength
	N = # of neutrons
	Z = # of protons
	A = Atomic mass #

Momentum and Collisions

$p = mv$

$F = \frac{\Delta p}{t} = \frac{mv_f - mv_i}{t}$

conservation of momentum / elastic collision:

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

inelastic collision:

$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$

Rotational Motion

$\omega = \frac{\Delta \theta}{t}$

$\alpha = \frac{\omega_2 - \omega_1}{t}$

$v_t = r\omega$

$a_c = \frac{v_t^2}{r} = r\omega^2$

$F_c = \frac{mv_t^2}{r} = mr\omega^2$

$F_g = G\frac{m_1 m_2}{r^2}$

Atomic Physics

$E = hf$

$KE_{max} = hf - hf_t$

$\lambda = \frac{h}{p} = \frac{h}{mv}$

$E = mc^2$

$c = \lambda f$

Subatomic Physics

$A = Z + N$

$E_{bind} = \Delta m c^2$

$\Delta m = Z(\text{atomic mass of H}) + N m_n - \text{atomic mass}$

$T_{1/2} = \frac{0.693}{\lambda}$

activity $= \lambda N$

$1 eV = 1.6 \times 10^{-19}$ J

Earth: $m_E = 5.98 \times 10^{24}$ kg, $r_E = 6.37 \times 10^6$ m

mars: $m_m = 6.34 \times 10^{23}$ kg, $r_m = 3.34 \times 10^6$ m

pluto: $m_p = 5 \times 10^{23}$ kg, $r_p = 4 \times 10^5$ m

	kg	u
proton	1.67×10^{-27}	1.00727
neutron	1.675×10^{-27}	1.00866
electron	9.109×10^{-31}	.00054

$1 u = 931.5$ MeV

$\alpha = {}^4_2He$ alpha

$\beta^- = {}^0_{-1}e$ Beta

$\beta^+ = {}^0_1e$ +Beta

$\gamma =$ photon gamma

neutron $= {}^1_0n$

$1 Ci = 3.7 \times 10^{10}$ 1/s

u : u = unified mass unit

u : m_n = mass of a neutron $= 1.008665\ u$

s : $T_{1/2}$ = half life

1/s : λ = decay constant

N = # of nuclei