Kinematics

$$x = x_o + v_o t + \frac{1}{2}at^2$$

$$v = v_o + at$$

$$v^2 - v_o^2 = 2a(x - x_o)$$

x-displacement
v-velocity
t-time
a-acceleration

Dynamics

$$\Sigma F = ma$$

$$f = \mu_k F_N$$

$$w = mg$$

F-force
m-mass
a-acceleration
f-friction
μ_k-coefficient of kinetic friction
F_N-normal force
w-weight
g-acceleration due to gravity

Centripetal Acceleration

$$a = \frac{v^2}{r}$$

$$T = \frac{t}{N} = \frac{1}{f}$$

$$f = \frac{N}{t} = \frac{1}{T}$$

$$v = \frac{2\pi r}{T} = 2\pi r f$$

a-acceleration
v-velocity
r-distance
T-period
t-elapsed time
f-frequency
N-number of cycles

Universal Gravitation

$$F_G = \frac{Gm_1 m_2}{r^2}$$

$$g = \frac{GM}{r^2}$$

$$v = \sqrt{\frac{GM}{r}}$$

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

F_G-gravitational force
G-gravitational constant
m_1, m_2, M-mass
r-distance
g- acceleration due to gravity
T-period

Energy

$$W = Fd_{parallel}$$

$$GPE = mgh$$

$$KE = \frac{1}{2}mv^2$$

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

$$P = Fv_{parallel}$$

$$E_o + W = E_f$$

$$F_{spring} = -kx$$

$$EPE = \frac{1}{2}kx^2$$

W-work
F-force
d-distance
GPE-gravitational potential energy
m-mass
g-acceleration due to gravity
h-height
KE-kinetic energy
v-velocity
P-power
t-time
E-energy
F_{spring}-force of a spring
k-spring constant
x-extension or compression
EPE-elastic potential energy

Momentum

$$p = mv$$

$$\Sigma p = m_1 v_1 + m_2 v_2 + \ldots$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$v_1 + v_1' = v_2 + v_2'$$

$$I = \Delta p$$

$$I = m\Delta v$$

$$I = F\Delta t$$

p-momentum
m, m_1, m_2-mass
v-velocity
v_1, v_2-initial velocity
v_1', v_2'-final velocity
I-impulse
F-force
t-time

Fluids

$$P = \frac{F}{A}$$

$$\rho = \frac{m}{V}$$

$$P = \rho g h$$

$$SG = \frac{\rho}{\rho_{water}}$$

$$P_{in} = P_{out}$$

$$P_{abs} = P_{atm} + P_{gauge}$$

$$F_B = m_{fluid} g$$

$$F_B = \rho g V$$

P-pressure
F-force
A-area
ρ-density
m-mass
V-volume
g-acceleration due to gravity
h-height
SG-specific gravity
P_{abs}-absolute pressure
P_{atm}-atmospheric pressure
P_{gauge}-gauge pressure
F_B-buoyant force
m_{fluid}-mass of fluid

Electrostatics, Fields and Potential

$$F_E = \frac{kq_1 q_2}{r^2}$$

$$E = \frac{F}{q}$$

$$E_{point} = \frac{kq}{r^2}$$

$$U_E = \frac{kq_1 q_2}{r}$$

$$U_E = -q\Delta V$$

$$V_{point} = \frac{kq}{r}$$

$$E_{uniform} = \frac{\Delta V}{r}$$

$$U_E = -qEr$$

F_E-electric force
k-electric constant
q, q_1, q_2, Q-charge
r- distance
E-electric field
F-force
E_{point}- point charge electric field
U_E-electric potential energy
ΔV-potential difference or Voltage
V_{point}-voltage due to a point charge
$E_{uniform}$-uniform electric field

Electric Current

$$I = \frac{Q}{t}$$

$$V = IR$$

$$R = \rho\frac{l}{A}$$

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

$$P = IV = I^2 R = \frac{V^2}{R}$$

I- current
Q-charge
t-time
V-voltage
R-resistance
ρ-resistivity
l-length
A-area
P-power
U_E-electric potential energy

Resistors in Series

$$V_T = V_1 + V_2 + V_3 \ldots$$

$$I_T = I_1 = I_2 = I_3 \ldots$$

$$R_{Eq} = R_1 + R_2 + R_3 \ldots$$

V_T-total voltage
V_1, V_2, V_3-voltage
I_T-total current
I_1, I_2, I_3-current
R_{Eq}-equivalent resistance
R_1, R_2, R_3-resistance

Resistors in Parallel

$$V_T = V_1 = V_2 = V_3 \ldots$$

$$I_T = I_1 + I_2 + I_3 \ldots$$

$$\frac{1}{R_{EQ}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$$

V_T-total voltage
V_1, V_2, V_3-voltages
I_T-total current
I_1, I_2, I_3-current
R_{Eq}-equivalent resistance
R_1, R_2, R_3-resistance

EMF

$$\mathcal{E} = IR + Ir$$

$$V_T = \mathcal{E} - Ir$$

ε-emf
I-current
R-resistance
r-internal resistance
V_T-teminal voltage

Magnetic Fields

$F = IlB_\perp$

$F = qvB_\perp$

$B = \frac{\mu_o}{2\pi}\frac{I}{r}$

$F_2 = \frac{\mu_o}{2\pi}\frac{I_1 I_2}{d} l_2$

F-force
I, I_1, I_2-current
l, l_2-length
B-magnetic field
q-charge
v-velocity
r, d-distance
$\frac{\mu_o}{2\pi}$ -permeability constant

Magnetic Flux

$\Phi = BA$

$\varepsilon = \frac{-N\Delta\Phi}{t}$

$\varepsilon = Blv$

Φ-flux
B-magnetic field
A-area
ε-emf
N-number of coils
t-time

Quantum Physics

$E = hf = \frac{hc}{\lambda}$

$KE_{\max} = eV_o$

$hf = KE + W_o$

$E = mc^2$

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

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

$r_n = \frac{n^2 r_1}{Z}$

$E = \frac{E_1}{n^2}$

E_1 (hydrogen) = -13.6eV
E-Energy
h-Plank's constant
f-frequency
c-speed of light
λ-wavelength
KE_{max}-max kinetic energy
e-electron charge
V_o-stopping voltage
W_o-work function
m-mass
p-momentum
v-velocity
r-atomic radius
n-energy level
Z-atomic number

Simple Harmonic Motion

Mass – Spring

$T = 2\pi\sqrt{\frac{m}{k}}$

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Pendulum

$T = 2\pi\sqrt{\frac{l}{g}}$

$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$

T-period
m-mass
k-spring constant
f-frequency
l-length
g-acceleration due to gravity

Waves / Sound Waves

$v = \lambda f$

$v = \sqrt{\frac{F_T}{\mu}}$

$\lambda_n = \frac{2L}{n}$

$f_n = \frac{v}{\lambda_n} = n\frac{v}{2L} = nf_1$

Open Tubes

$f_n = \frac{v}{\lambda_n} = n\frac{v}{2L} = nf_1$

$\lambda_n = \frac{2L}{n}$

$n = 1,2,3...$

Closed Tubes

$f_n = \frac{v}{\lambda_n} = n\frac{v}{4L} = nf_1$

$\lambda_n = \frac{4L}{n}$

$n = 1,3,5...$

f-frequency
v-velocity
λ-wavelength
F_T-tension
μ-linear density
L-length
n- harmonic number
L-length

EM Waves / Light

$c = \lambda f$

$n = \frac{c}{v}$

$\lambda_n = \frac{\lambda}{n}$

Double Slit

$x_{\max} \approx \frac{m\lambda L}{d}$

$x_{\min} \approx \frac{(m + 1/2)\lambda L}{d}$

$m = 0,1,2...$

Single Slit

$x_{\min} \approx \frac{m\lambda L}{D}$

$m = 0,1,2...$

Thin Films

$film_{\max}, bubble_{\min} : 2t = m\lambda$

$film_{\min}, bubble_{\max} :$

$2t = \left(m + \frac{1}{2}\right)\lambda$

c-speed of light
λ-wavelength
f-frequency
x-distance to maxima/minima
L-distance to screen
d-distance between slits
D-slit width
n-index of refraction
v-velocity
t-thickness of film

Optics

$f = \frac{r}{2}$

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$m = \frac{d_i}{d_o} = \frac{h_i}{h_o}$

f-focal length
r-radius of curvature
d_i-image distance
d_o-object distance
m-magnification
h_i-image height
h_o-object height

Constants

$g = 9.8\frac{m}{s^2}$

$\pi = 3.14$

$G = 6.67x10^{-11}\frac{Nm^2}{kg^2}$

$m_E = 6.0x10^{24} kg$

$r_E = 6.4x10^6 m$

$\rho_{water} = 1000\frac{kg}{m^3} = 1\frac{g}{cm^3}$

$P_{atm} = 1atm = 101kPa = 1.01\times 10^5 Pa$

$k = 9.0x10^9\frac{Nm^2}{C^2}$

$q_{electron} = e = -1.6x10^{-19} C$

$m_{electron} = 9.11x10^{-31} kg$

$m_{proton} = 1.67x10^{-27} kg$

$\frac{\mu_o}{2\pi} = 2x10^{-7}\frac{Tm}{A}$

$v_{sound} = 340\frac{m}{s}$

$c = 3.0x10^8\frac{m}{s}$

$h = 6.6x10^{-34} Js = 4.14x10^{-15} eVs$

Conversions

$mega(M) = x10^6$

$kilo(k) = x10^3$

$centi(c) = x10^{-2}$

$milli(m) = x10^{-3}$

$micro(\mu) = x10^{-6}$

$nano(n) = x10^{-9}$

$pico(p) = x10^{-12}$

Geometry

$r = \frac{d}{2}$

$A_{circle} = \pi r^2$

$C = 2\pi r$

$Area_{triangle} = \frac{1}{2}bh$

$Area_{rec\tan gle} = bh$

$Volume = Ah$

r-radius
d-diameter
A-area
C-circumference
b-base
h-height