$v = \frac{v_i + v_f}{2}$

$v = \frac{d}{t}$

$d = v \cdot t$

$v_f = v_i + at$

$v_f^2 = v_i^2 + 2ad$

$d = \frac{1}{2}at^2 + v_i t$

Angular

$\omega = \frac{\omega_i + \omega_f}{2}$

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

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

$\omega_f = \omega_i + \alpha t$

$\omega_f^2 = \omega_i^2 + 2\alpha\theta$

$\theta = \frac{1}{2}\alpha t^2 + \omega_i t$

Radians

$d = \theta r$

$v = \omega r$

$a = \alpha r$

Angular acceleration =

Angular velocity =

Angular motion =

$\tau = F_\perp \cdot d \rightarrow \tau$ = Torque [Nm, lb·ft]

$\Sigma\tau_x + \Sigma\tau_y + \Sigma\tau_z = 0$

$I = mr^2$ $I = \frac{1}{12}ml^2$ $I = \frac{3}{5}mr^2$

$I = \frac{1}{2}mr^2$ $I = \frac{1}{3}ml^2$

$L = mvr$ $L = I\omega$

$F_g = \frac{GmM}{d^2}$ (grav'l) $F_e = \frac{kq_1q_2}{d^2}$ (elec'l)

$v_e = \sqrt{\frac{2GM}{d}}$ $T = 2\pi\sqrt{\frac{L}{g}}$

$v_T = v_1 + v_2$ $\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$

$L = L_0\sqrt{1 - \frac{v^2}{c^2}}$ $E_0 = m_0c^2$

$E = \frac{E_0}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{m_0c^2}{\sqrt{1-\frac{v^2}{c^2}}}$

$D = \frac{m}{V}$ $\sigma = \frac{F}{A}$ $\varepsilon = \frac{\Delta L}{L}$

$Y = \frac{\sigma}{\varepsilon}$ $Y = \frac{F/A}{\Delta L / L}$ $Y = \frac{FL}{A\Delta L}$

$F = \frac{YA\Delta L}{L}$ $F = k\Delta L$

Letter Key

τ = Torque [Nm, lb·ft]

I = Moment of inertia [kg·m²]

L = Angular Momentum $\left[\frac{kg \cdot m^2}{s}\right]$

G = Universal grav'l constant $\left[6.67\times10^{-11} \frac{Nm^2}{kg^2}\right]$

$k = 9\times10^9 \left[\frac{Nm^2}{C^2}\right]$

v_e = Escape Speed in [m/s]

T = Period of oscillation in [s]

C = speed of light [3×10^8 m/s]

E_0 = Rest energy of obj in [J]

D = Density [kg/m³]

σ = Stress [N/m²]

ε = Strain

Y = Modulus [N/m²]

k = Constant of proportionality [N/m]

open + closed

$P_h = P_{atm} + Dgh$ $P_h = Dgh$

$F_b = DgV$ $\Delta P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$

specific gravity $= \frac{D_{mat'l}}{D_{water}}$

constant T, constant P

$\frac{P_iV_i}{T_i} = \frac{P_fV_f}{T_f}$ $P_iV_i = P_fV_f$ $\frac{V_i}{T_i} = \frac{V_f}{T_f}$ (Temp)

(Period) $T = 2\pi\sqrt{\frac{m}{k}}$ $\Delta L = L_0\alpha\Delta T$

(Temp: $T_C = \frac{5}{9}(T_F - 32)$

$T_F = \left(\frac{9}{5}T_C\right) + 32$

$T_C = T_K - 273$)

$\Delta A = 2A_0\alpha\Delta T$ $\Delta V = V_0\beta\Delta T$

$\Delta Q = mc\Delta T$ $\Delta Q = mh_f$

$\Delta Q = mh_v$ $(mc\Delta T)_{lost} = (mc\Delta T)_{gained}$

(ΔT(when cooling) $= (T_i - T_f)$)

$v = \lambda f$ $f = f_i\left(\frac{v + v_o}{v - v_s}\right)$

waves in strings:

fundamental	$f = \frac{nv}{2L}$	$n=1$
1st overtone	$f = \frac{v}{L}$	$n=2$
2nd overtone	$f = \frac{3v}{2L}$	$n=3$
3rd overtone	$f = \frac{2v}{L}$	$n=4$

waves in pipes:

open ends	$f = \frac{nv}{2L}$	$n = 1, 2, 3, \ldots$
one closed end	$f = \frac{nv}{4L}$	$n = 1, 3, 5, \ldots$

n = # of notes $v_{sound} = 340$ m/s

$v_{light} = c = 3\times10^8$ m/s

D = Density [kg/m³] (D_{water} = 1000)

P = Pressure [N/m² = Pa] ($P_{atm} = 1.01\times10^5$)

T = Temp [Kelvins] (Kelvins = C° + 273)

k = Spring Constant [N/m]

T = Period [s]

α = coefficient of linear expansion [°C⁻¹]

β = coefficient of Volume expansion [°C⁻¹]

C = Specific Heat [illegible]

$C_{water} = 4187 \frac{J}{kg°C}$

$C_{ice} = 2090 \frac{J}{kg°C}$

Q = Heat transfer [J]

h_f = Heat Fusion

h_f(water) $= 3.35\times10^5$ [J/kg]

h_v = Heat Vaporization

h_v water $= 2.26\times10^6$ J/kg

cal = calorie = 4.184 J

Kcal = 1000 cal

Btu = 778 ft·lb = 252 cal

h_f(water) = 80 cal/g = 144 Btu/cal

h_v(water) = 540 cal/g = 970 Btu/cal

λ = wavelength [m]

V = Velocity

f = frequency [Hz]

$\theta_i = \theta_r$ $\quad c = f\lambda$

θ_i = angle of incidence

θ_r = angle of reflection

c = speed of light 3×10^8 m/s

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

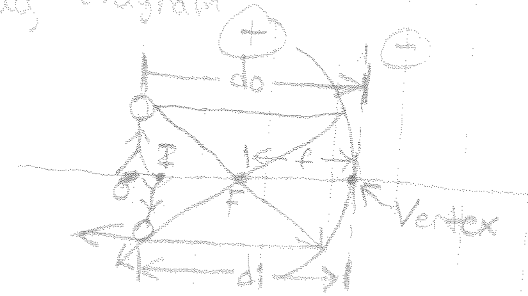
f = focal Δd

do = Obj Δd

di = Image Δd (to vertex)

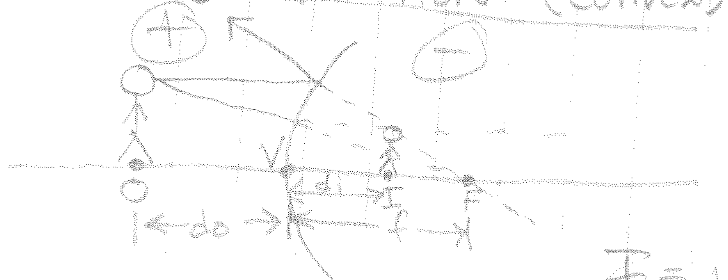
Converging (+) mirrors: (concave)

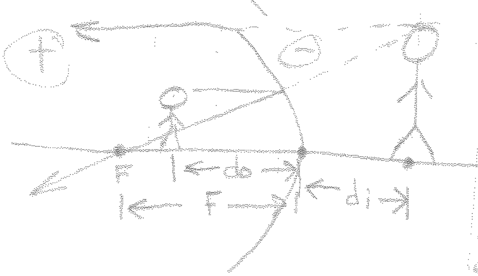
ray diagram



I = inverted real

Converging (−) mirrors: (convex)





I = virtual smaller, upright

I = upright virtual

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

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$n_1 \sin\theta_i = n_2 \sin\theta_r$

n = index of refraction

$n_1 \sin\theta_c = n_2 \sin 90°$

$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$

θ_c = critical angle

$n_{water} \approx 1$

$n_{air} \approx 1.33$

$$P = \frac{1}{f} = \frac{1}{d_{o(\text{w/ glasses})}} + \frac{1}{d_{o(\text{w/o glasses})}}$$

P = Power of lens dioters (m^{-1})

p = obj. distance

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q} \qquad \frac{1}{f_{(total)}} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$m = \frac{h_i}{h_o} = \frac{d_i}{d_o} \qquad m = \frac{\text{nearpoint}}{d_o}$$

m = magnification

$$\lambda = \frac{dx}{L}$$

λ = wavelength

d = d between slits

x = d between bands

L = slit to screen

$$B = \frac{F}{qv} \qquad \varnothing = BA \qquad V = \frac{N\Delta\varnothing}{\Delta t}$$

B = Strength of magnetic field [N/A·m = Tesla (T)]

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad F = ILB$$

q = Charge [Coulombs]

T = Tesla

Charge of protons or electrons = 1.60×10^{-19} C

Ø = Magnetic Flux [$Wb = T \cdot m^2$]

t = time [s]

N = # of turns in wire

V = pot'l dif. [V]

A = area of flux [m^2]

L = length of wire

I = curre [A]

K = Constant of proportionality [N/m]