Physics 113 – Midterm 1

Lenses

$1/f = 1/d_i + 1/d_o$ (d_i is positive behind the lens, d_o is positive in front of the lens) (observer is behind)

f=+ for converging, f= - for diverging

$m = h_i/h_o = -d_i/d_o$ (image is virtual in front of the lens, and real behind it)

Power of a Lens = 1/f (in meters)

Magnifying Power= θ_i/θ^{ref} magnifying glass or microscope θ^{ref} = height at nearpoint

Telescope Magnifying Power = angular size of object where it is

Magnifying Glass

$M = \theta_i/\theta^{ref} = (h_o/d_o)/(h_o/N) = N/d_o = N(1/f - 1/d_i)$

$\theta^{ref}=\theta$ at near point d_i is negative/virtual

Microscope (image is virtual/inverted)

$M = [-(L - f_{eyepiece})N]/(f_e f_o)$

L=length between eyepiece and objective

Telescope

$M = -f_o/f_e$ The best telescopes have focal lengths that just overlap

Springs and Harmonic Motion

$F=-kx$ (x in meters) $f=w/2\pi$

$w=(k/m)^{1/2}$ $f= 1/T$

$a_{max}=Aw^2$

Pendulum

$w=(g/L)^{1/2}$

$1/T=(1/2\pi)(g/L)^{1/2}$

Glasses

near sighted-virtual,upright

far sighted-virtual, upright

VIRTUAL IMAGES WON'T SHOW ON A SCREEN at d_i

Wave Equation

Toward + X $y=A\sin(2\pi ft - 2\pi x/\lambda)$

Toward – X $y= A\sin(2\pi ft + 2\pi x/\lambda)$ g

DISTANCE BETWEEN NODES = $\lambda/2$

Sound **speed of sound = about 340 m/s**

Sound Intensity = $P/4\pi r^2 = P/A$

Decibals $\beta=(10dB)\log(I/I_0)$ relative to another sound or to the threshold of hearing (1×10^{-12})

Doppler Effect

$f_o=f_s[(1 +/- v_o/v)/(1 +/- v_s/v)]$ v = speed of sound

Sound Diffraction

Single Slit first minimum $\sin\theta= \lambda/D$

Circular slit diffraction first minimum $\sin\theta= 1.22\, \lambda/D$

Standing Wave (Resonance)

Tube open at both ends $f_n= n\,(v/2L)$

Tube open at one end $f_n=n\,(v/4L)$ **overtones only happen at odd harmonics**

beat frequency = $freq^1 - freq^2$

Doppler Effect of Light

$F_o=f_s(1+/-V/c)$

Light Diffraction

Bright Fringes of A Double Slit/multiple slits - $\sin\theta= m\, \lambda/d$

Bright fringes of a single slit $w\sin\theta= m\lambda$

Resolving Power **must be in RADIANS**

$\sin\theta=1.22\lambda/D$ $s=\theta h$

D = diameter of eye , s=seperation of objects

Thin Film Interference

$L_b-L_a = 0, \lambda^1, 2\lambda^1$ or $\lambda/2, 3\lambda/2, 5\lambda/2$

-must add $\lambda/2$ whenever light reflects from a smaller n off a larger n

-must adjust the λ for the medium you are in by $\lambda^1=\lambda/n$

-The two smallest non zero thickness usually occur at $L_b-L_a = 0, \lambda^1$

Young's Double Slit Experiment(multi-slit)

Bright Fringes: $\sin\theta=m\lambda/d$

m is the order, central fringe is 0

Single Slit Interference

Dark Fringes: $\sin\theta=m\lambda/W$