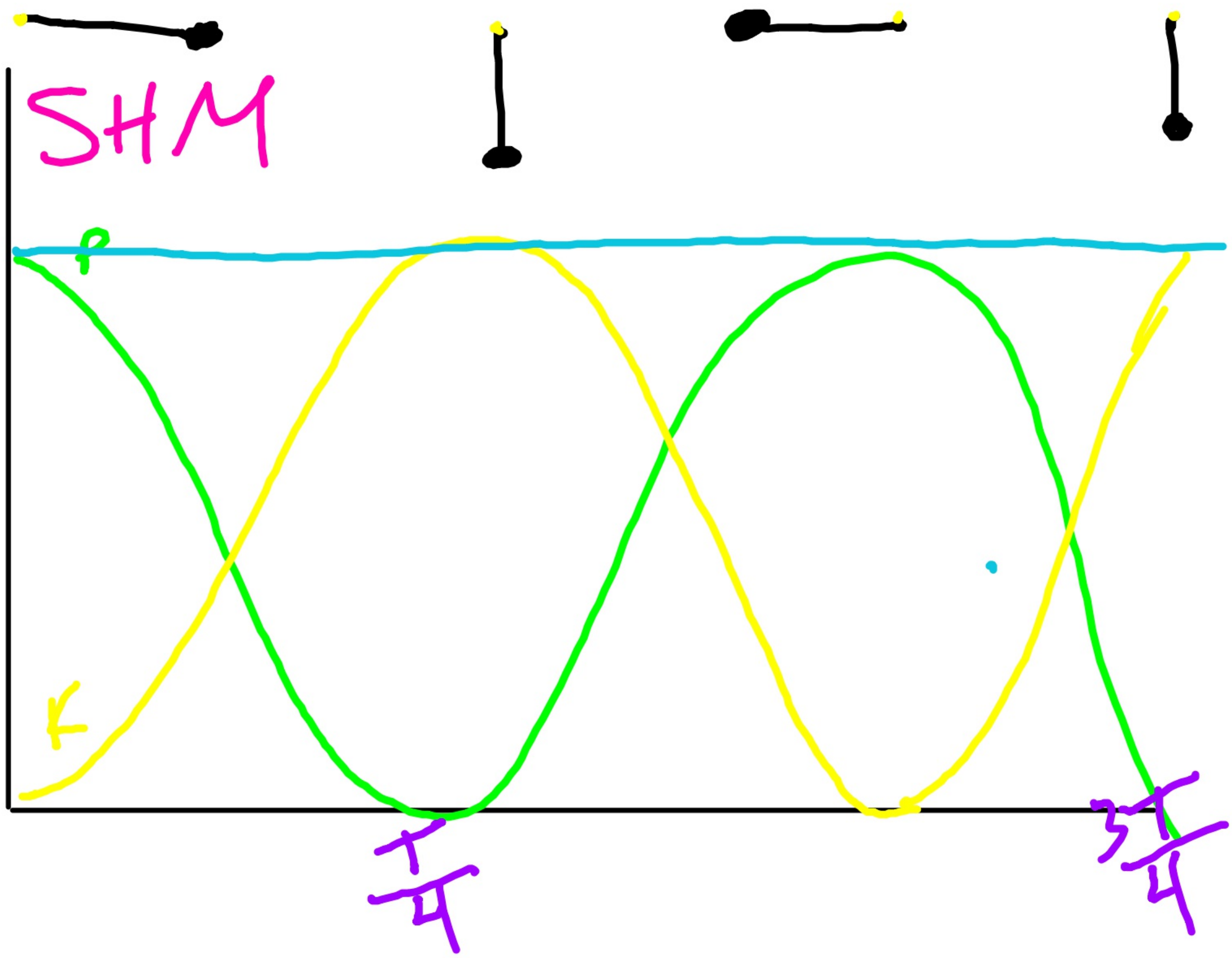


SHM
P
K
T/4
3T/4

$$E_k = \frac{1}{2} m v^2$$

$$E_p = \frac{1}{2} m \omega^2 x^2$$

$$E_T = E_K + E_P$$

$v = \omega r$

$v = \omega \sqrt{x_0^2 - x^2}$

$$E_K = \frac{1}{2} m \omega^2 (x_0^2 - x^2)$$

$$E_T = \frac{1}{2} m \omega^2 x_0^2$$

Find the total energy of a pendulum that has a frequency of 24 Hz with an amplitude of 0.80 m and a mass of 16 kg.

$$E = \frac{1}{2} m \omega^2 x_0^2$$

$$\omega = 2\pi f$$

$$\omega = 2\pi(24)$$

$$\omega = 48\pi$$

$$E_T = \frac{1}{2}(16\,kg)(48\pi)^2(0.$$

$$E_T = 116,426$$

$$\approx 120,000\ J$$

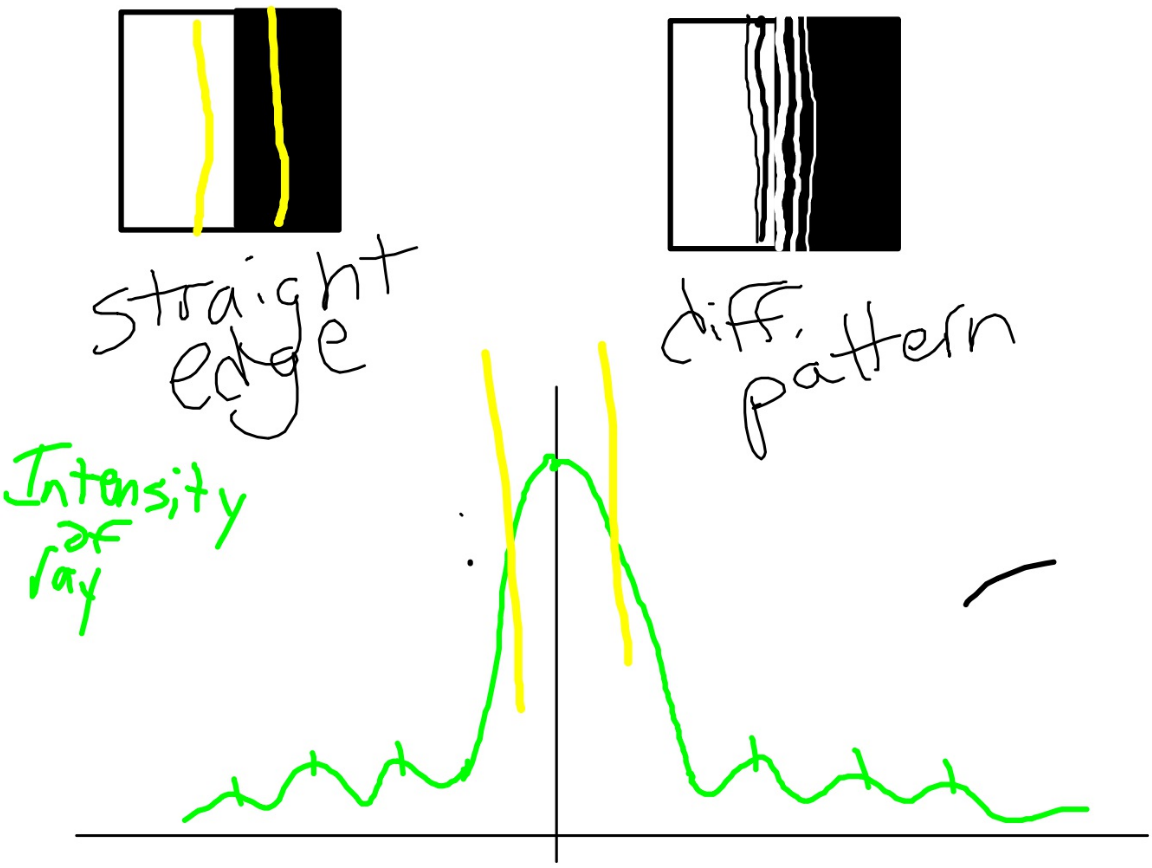
Find the total energy of a pendulum that has a period of 4.5 s with an amplitude of 0.75 m and a mass of 25 kg.

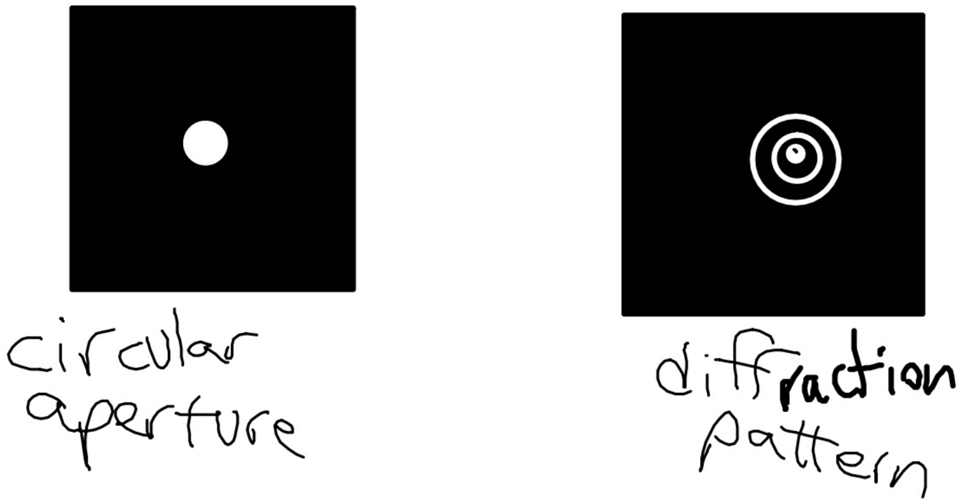
$T = \frac{1}{f}$

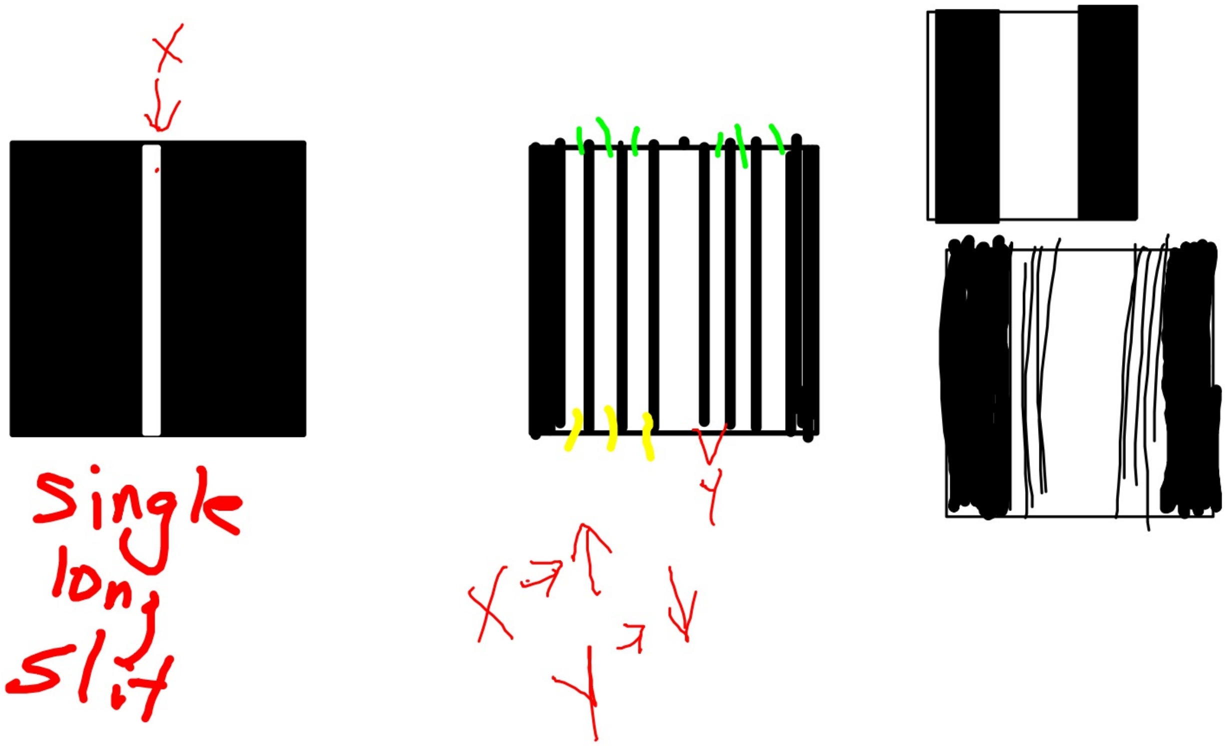
$E_T = \frac{1}{2} m \omega^2 x_0^2$

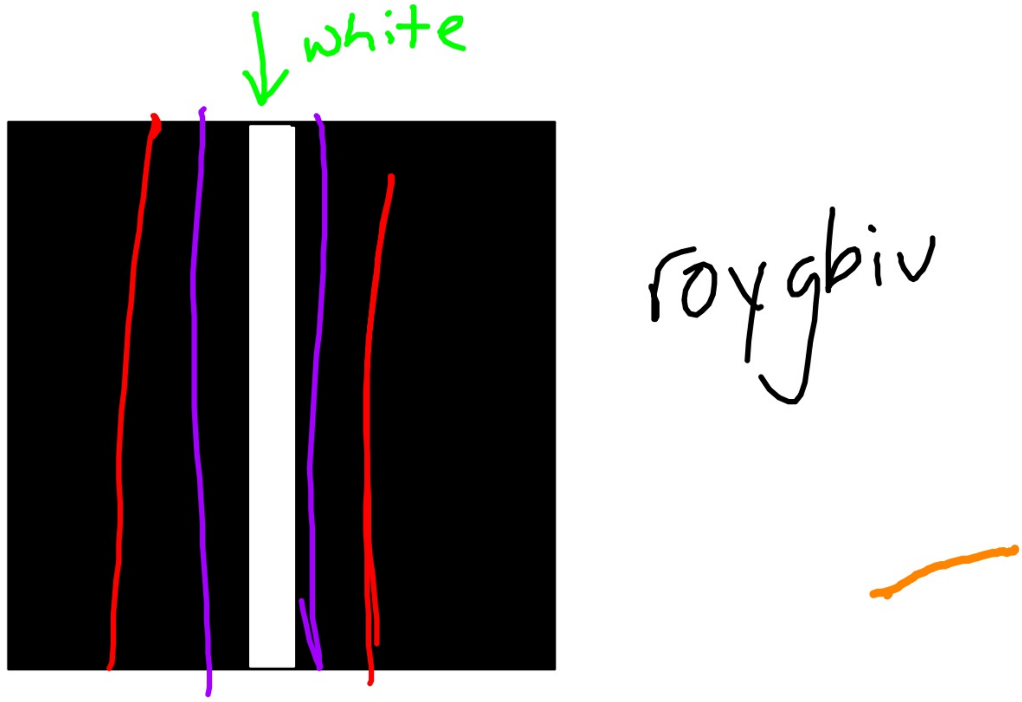
$\omega = \frac{2\pi}{T}$

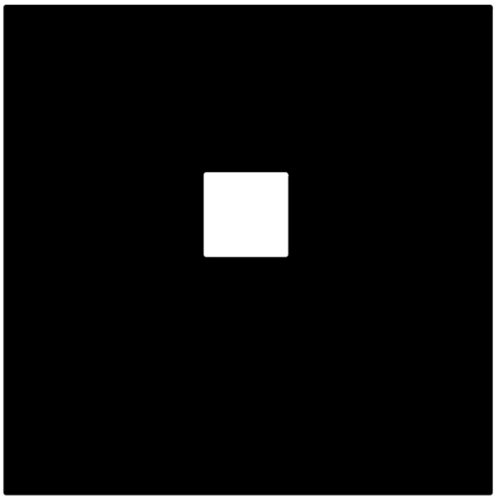
Find the total energy of a pendulum that has a period of 0.45 s with an amplitude of 0.50 m and a mass of 33 kg.

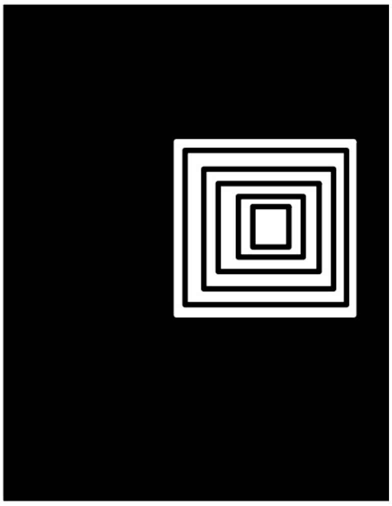

straight edge
diff. pattern
Intensity of ray

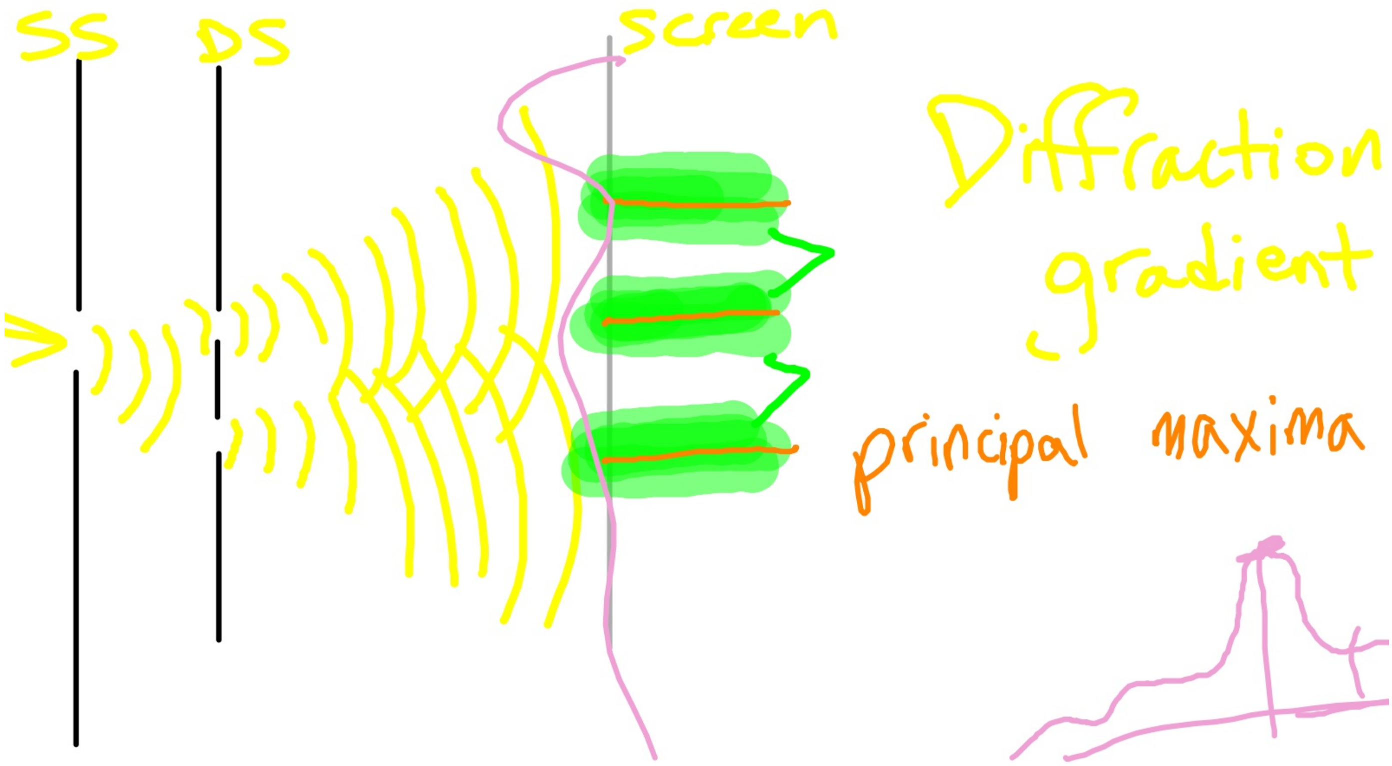

circular aperture
diffraction pattern


X
single
long
slit
Y
X
Y

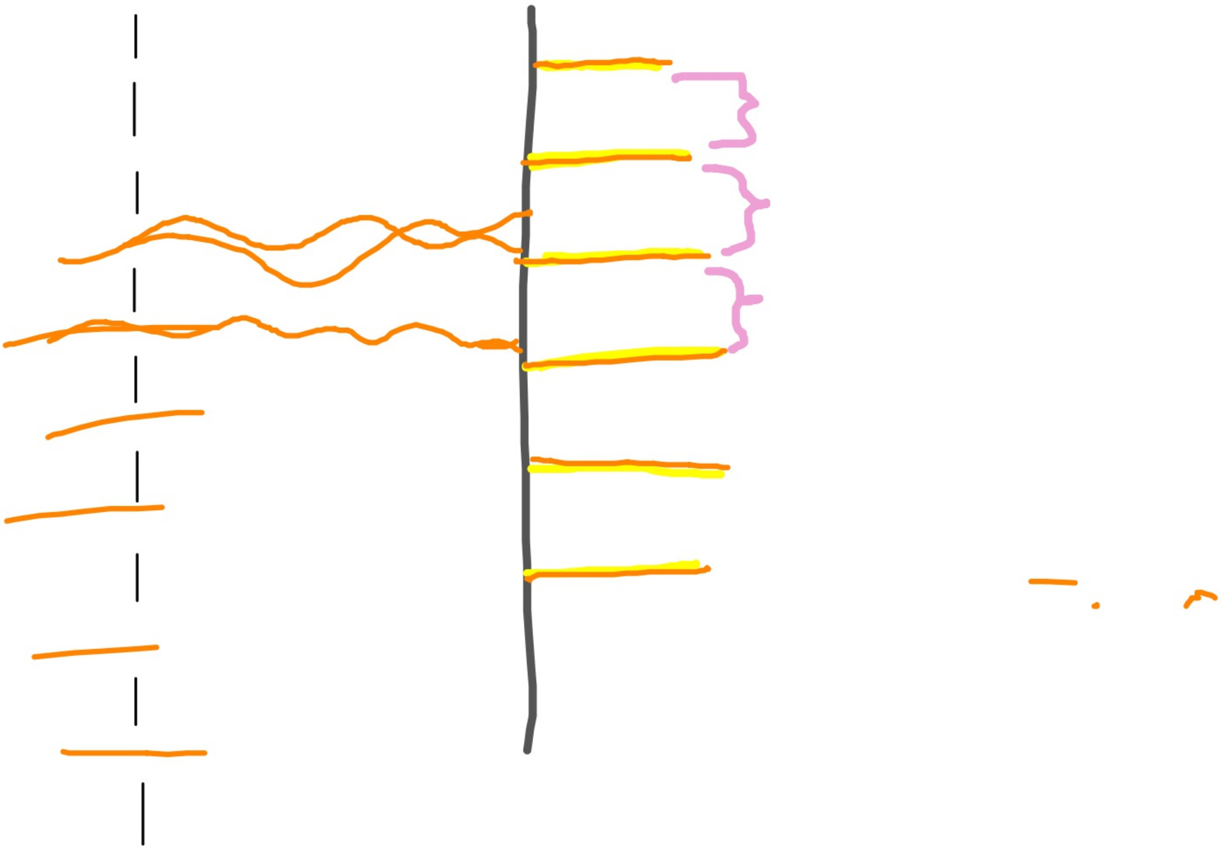

white
roygbiv

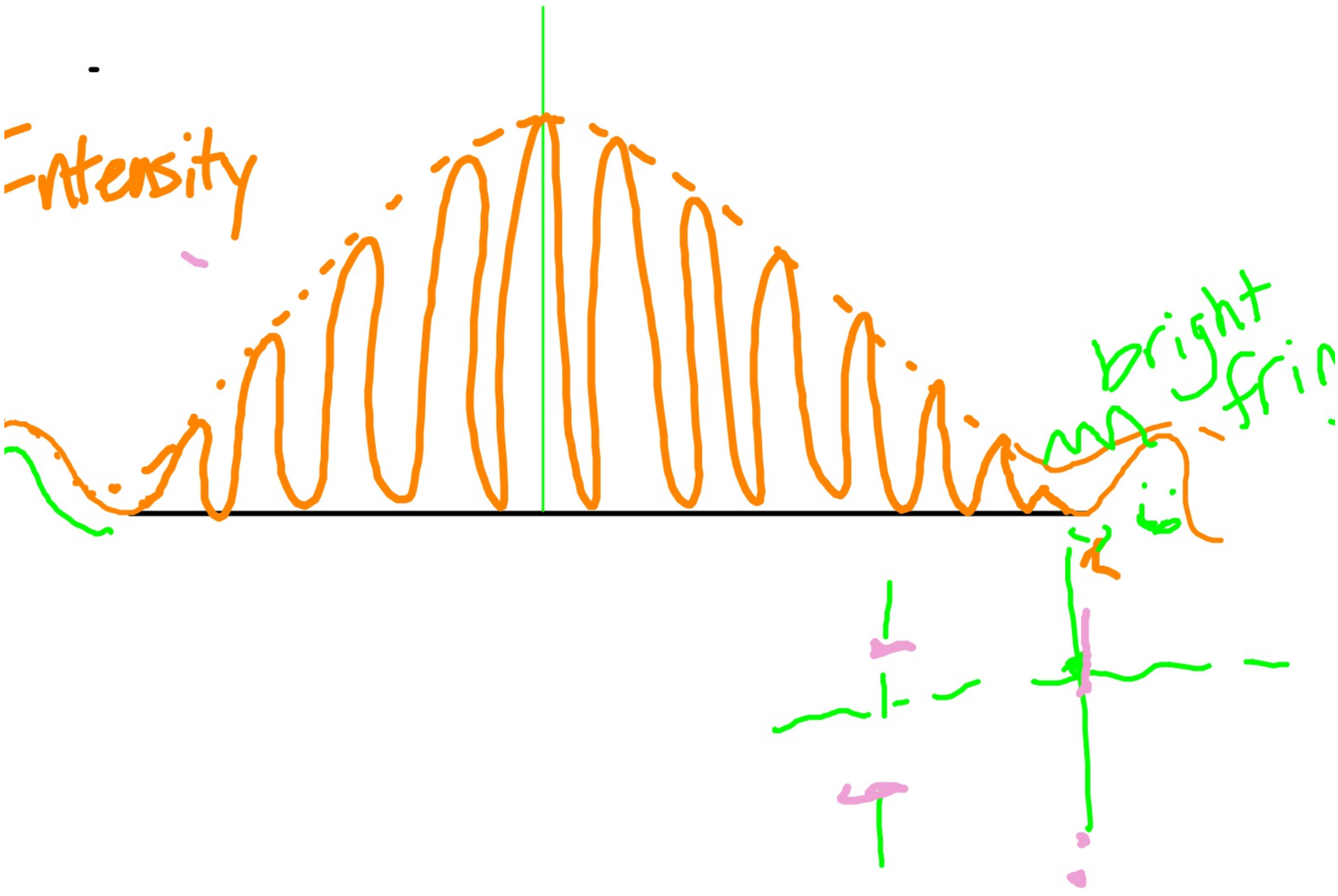


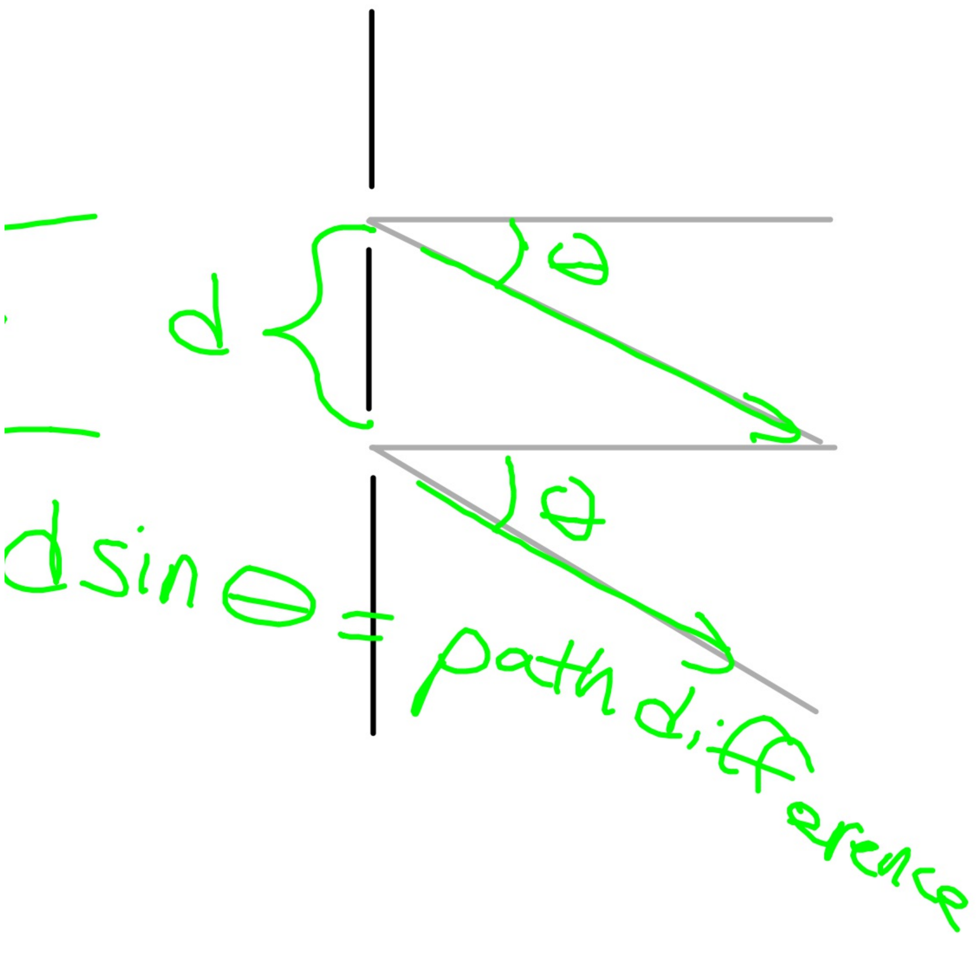


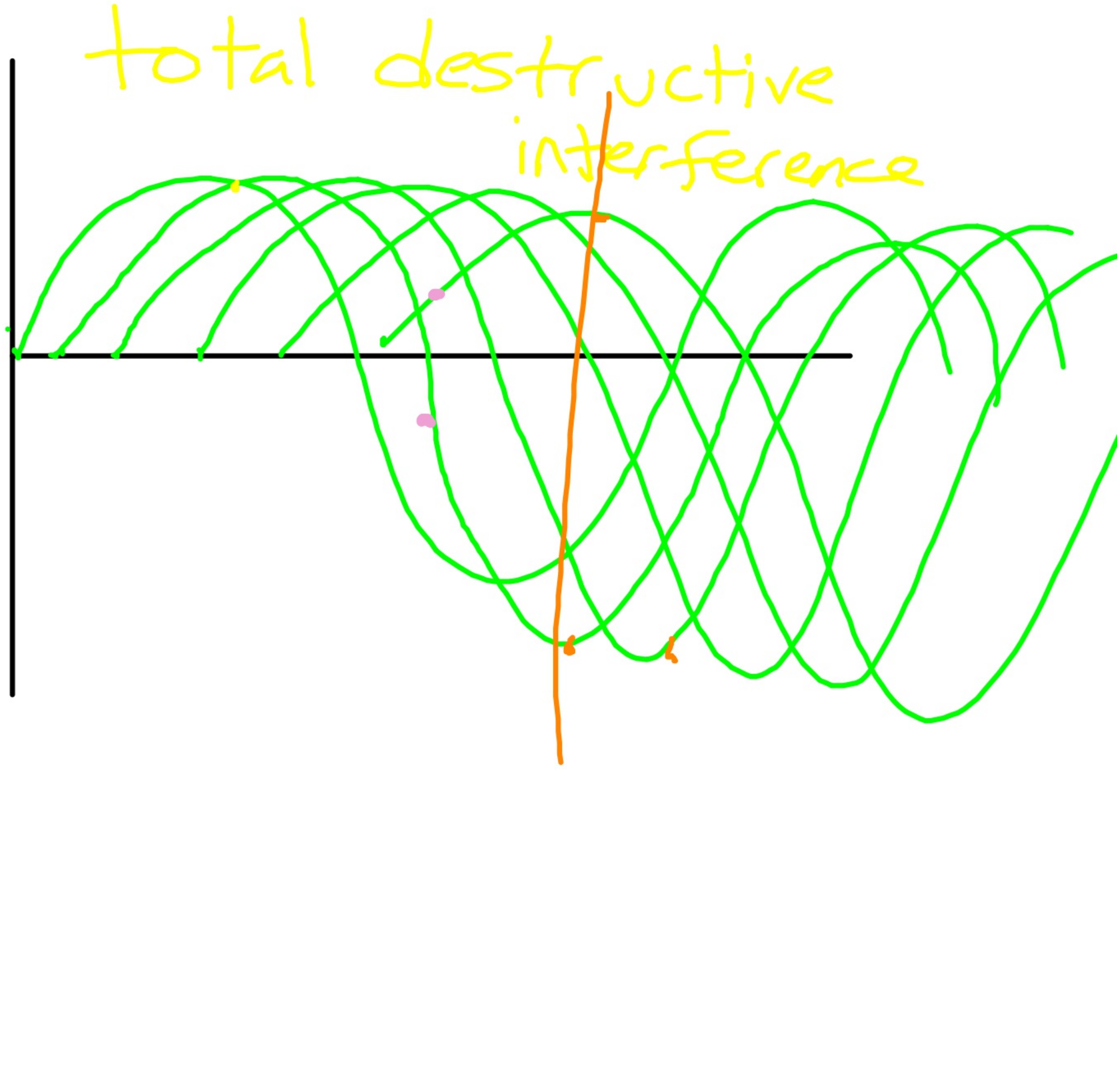


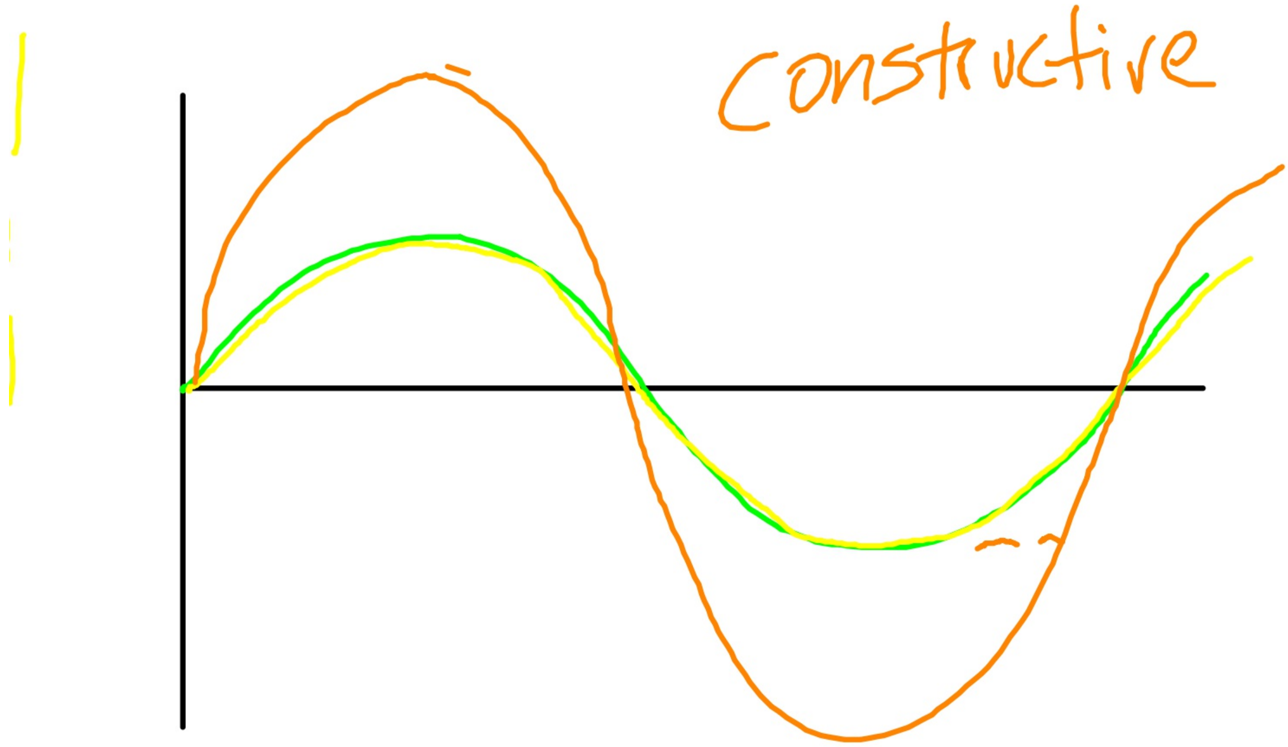
SS
DS
screen
Diffraction gradient
principal maxima



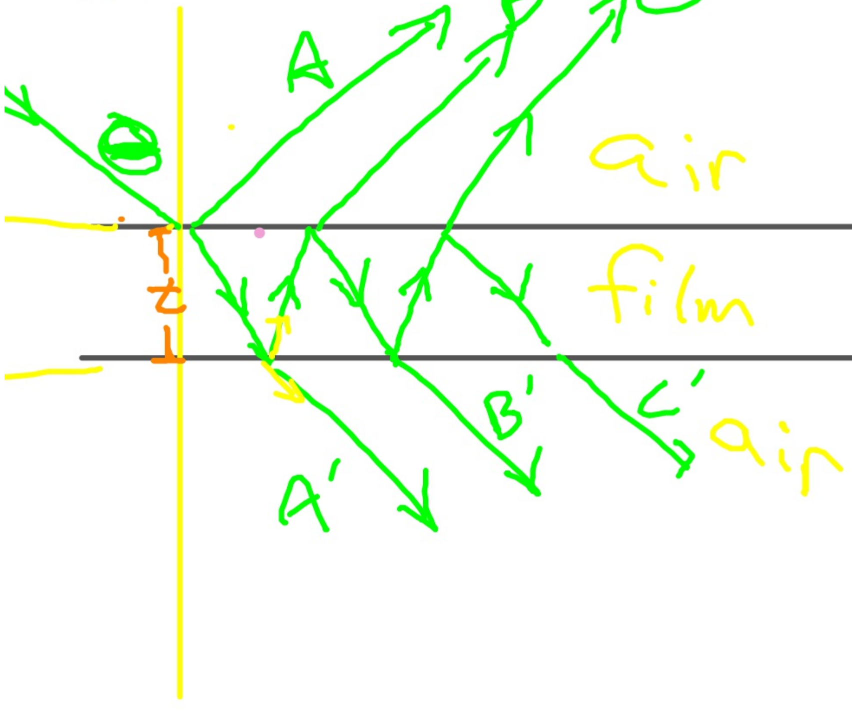

Intensity
bright
frin


d
θ
θ
d sin θ = path difference


total destructive
interference


Constructive

Thin-film Interference



n = refractive index

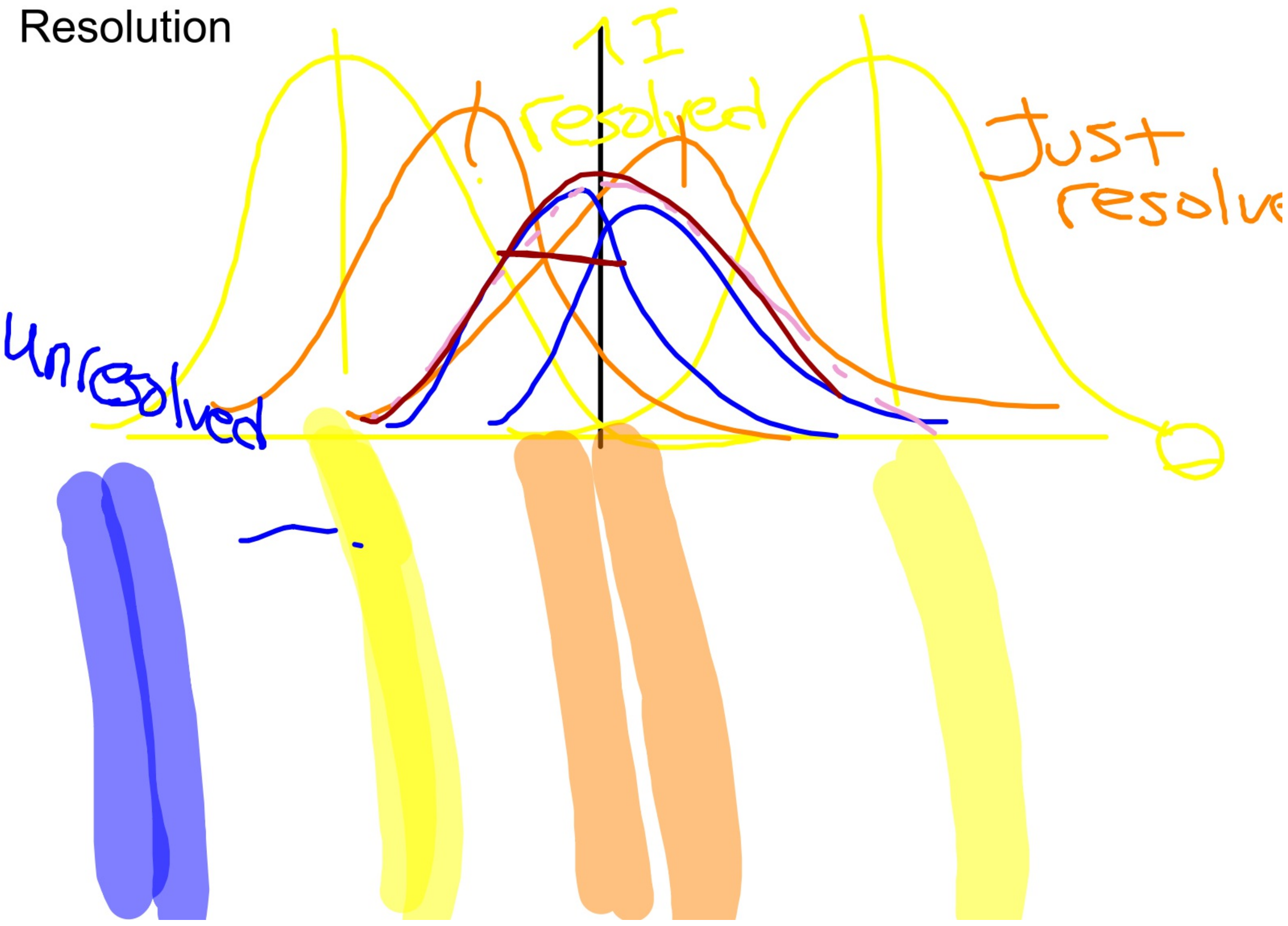
destructive interference

$2tn = m\lambda$

constructive inte

$2tn = (m+\frac{1}{2}$

Resolution



Slit $\Theta = \frac{\lambda}{b}$ → width of slit

min Θ for resolution

Circular aperture $\Theta = \frac{1.22\lambda}{b}$

If the wavelength of a light beam is 500 nm and the sources of light are 1.8 m away. If a student has pupils with a diameter of 4 mm, how far away would a car have to be to distinguish the two headlights.

$\theta = \frac{1.22\lambda}{b} = \frac{(1.22)(500\times10^{-9}\,m)}{4\times10^{-3}\,m} = 1.525\times$

$\theta = \frac{x}{D}$ $\qquad \frac{x}{\theta} = D \qquad \frac{1.8}{\theta} = 118$

10 k

A student observes two distant sources of light. The wavelength of each source is 550 nm. The angular separation between these two sources is 2.5×10^{-4} radians subtended at the pupil of a student's eye.

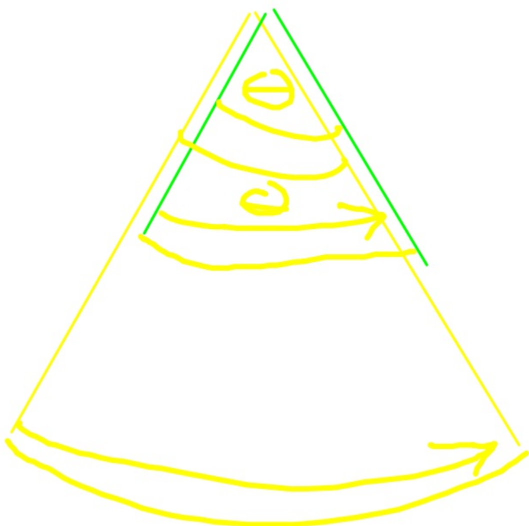
Estimate the diameter of the pupil of the eye if the two images are just to be resolved.

A car drives by a standing person at a rate of 33 m/s. The person is screaming with a frequency of 1.8 kHz. After the car passes the person, what is the frequency of the sound if sound travels at 330 m/s?

$$f' = f\left(\frac{v - v_o}{v}\right) = 1.8\left(\frac{330 - 33}{330}\right)$$

$$= 1.62 \text{ KHZ}$$

Two simple pendulum systems have the same mass, utilize the same small angle, but have different lengths of the bob. System 1 has a length of 1.8 m, while system 2 has a length of 4.2 m. Which has a longer period?



Doppler Effect w/ Light

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

$f' = f\left(\frac{V \pm V_0}{V}\right)$

$c = 3.0 \times 10^8$

$f\lambda$

$f' = f\left(\frac{V}{V \pm V_0}\right) \Rightarrow f' = f(1 \pm$

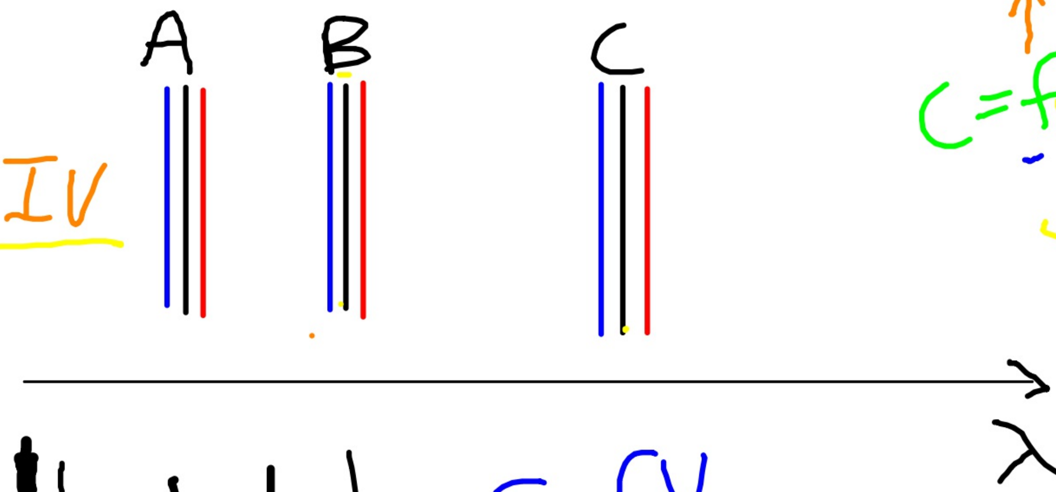
$f' = f\left(1 - \frac{v}{c}\right)$ $f' = f - f\frac{v}{c} \Rightarrow$ $\Delta f =$

As the Sun rotates, light waves received on Earth from opposite ends of a diameter show equal but opposite Doppler shifts. The speed of the edge of the Sun relative to the Earth is 1.90 km/s. What wavelength shift should be expected in the helium line having wavelength 587.5618 nm?

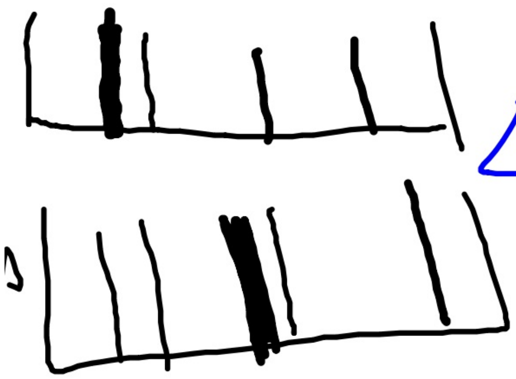
$$\Delta\lambda = \lambda \frac{v}{c} \qquad \Delta\lambda = 0.0037\ \text{nm}$$

$$\Delta\lambda = 587.5618\ \text{nm} \left(\frac{1.90 \times 10^{3}\ \text{m}}{3.0 \times 10^{8}\ \text{m}} \right)$$

BIV

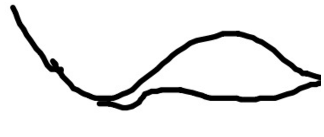


$$c = f\lambda$$



$$\Delta f = f\frac{v}{c}$$

$$\Delta\lambda = \lambda\frac{v}{c}$$



4. $v = \omega r$

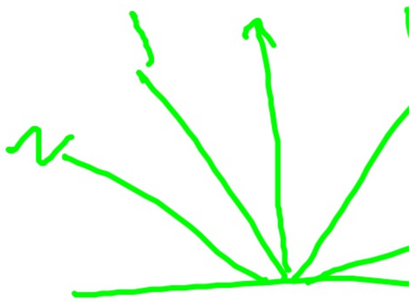
18. $\omega = \frac{2\pi}{T}$

37.

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

62.

$$\theta = \frac{\lambda}{b} \qquad b\theta = \lambda$$



(a).

$\theta = \frac{x}{D}$

1.75 cm

D

5.25 m

$f = 5.66 \times 10^{14}$ Hz

$b = \frac{\lambda}{\theta}$

$\theta = \frac{\lambda}{b}$

$c = f\lambda$

$c =$

$b = \frac{\lambda}{\theta} = \frac{D\lambda}{x} = \frac{Dc}{fx}$

$\frac{c}{f} = \lambda$

$$\omega = \frac{2\pi}{T}$$

$$a = -\omega^2 x$$

$$x = x_0 \sin(\omega t)$$

$$v = \omega x_0 \cos(\omega t)$$

$$v = \pm\omega\sqrt{x_0^2 - x^2}$$

$$E_K = \frac{1}{2} m\omega^2 (x_0^2 - x^2)$$

$$E_T = \frac{1}{2} m\omega^2 x_0^2$$

$$T_{pen} = 2\pi\sqrt{\frac{l}{g}}$$

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

Slit $\theta = \frac{\lambda}{b}$ — width

$\theta = \frac{x}{D}$ - separation — distance

distance between slits

Circle $\theta = \frac{1.22\lambda}{b}$

$n\lambda = d\sin\theta$ — n = integer

Constructive $2dn = (m + \frac{1}{2})\lambda$

Destructive $2dn = m\lambda$

n = refractive
m = integer

$$f' = f\left(\frac{v}{v \mp v_s}\right)$$

$$f' = f\left(\frac{v \pm v_o}{v}\right)$$

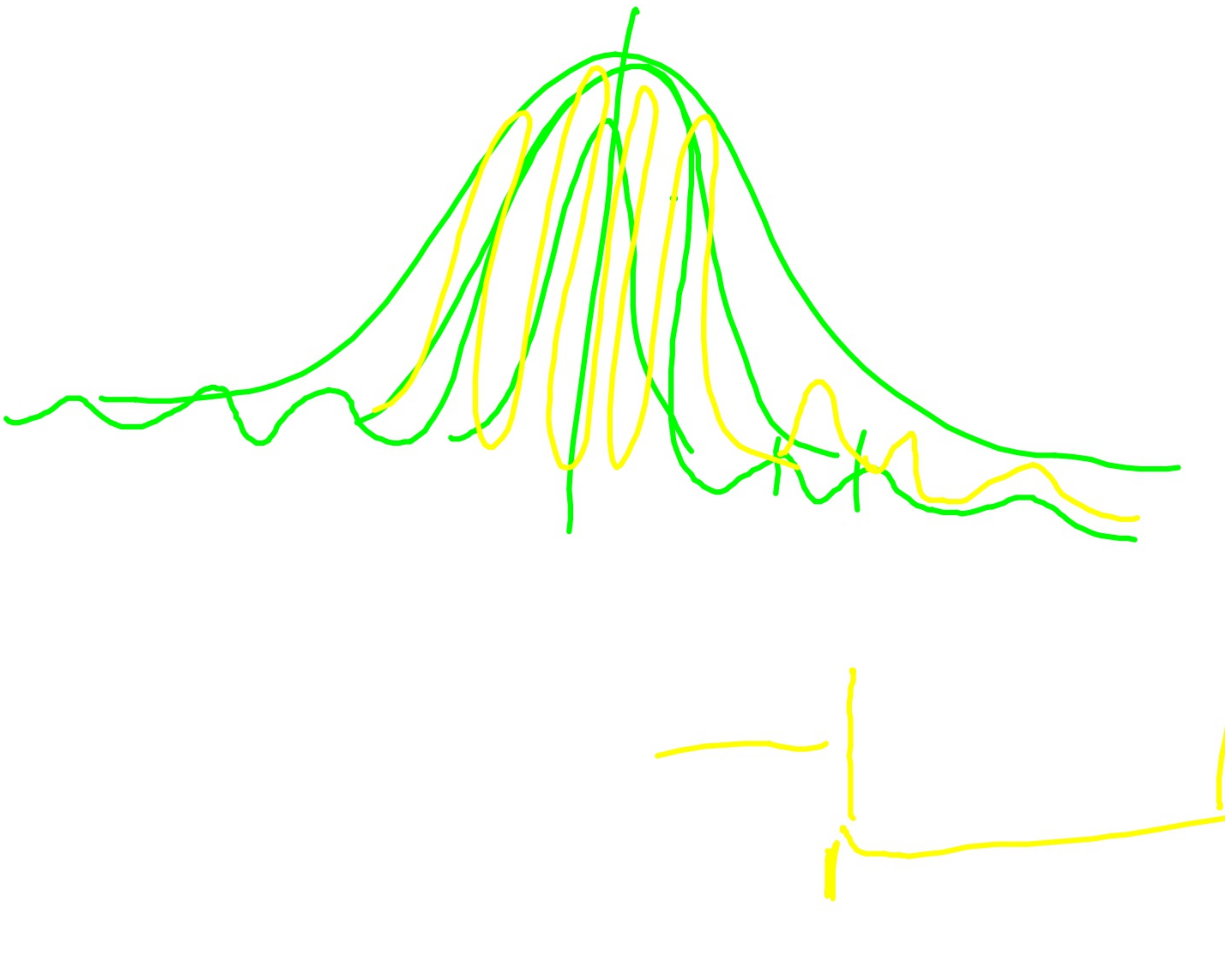
$$\Delta f = f\frac{v}{c} \quad \Delta\lambda = \lambda\frac{v}{c}$$

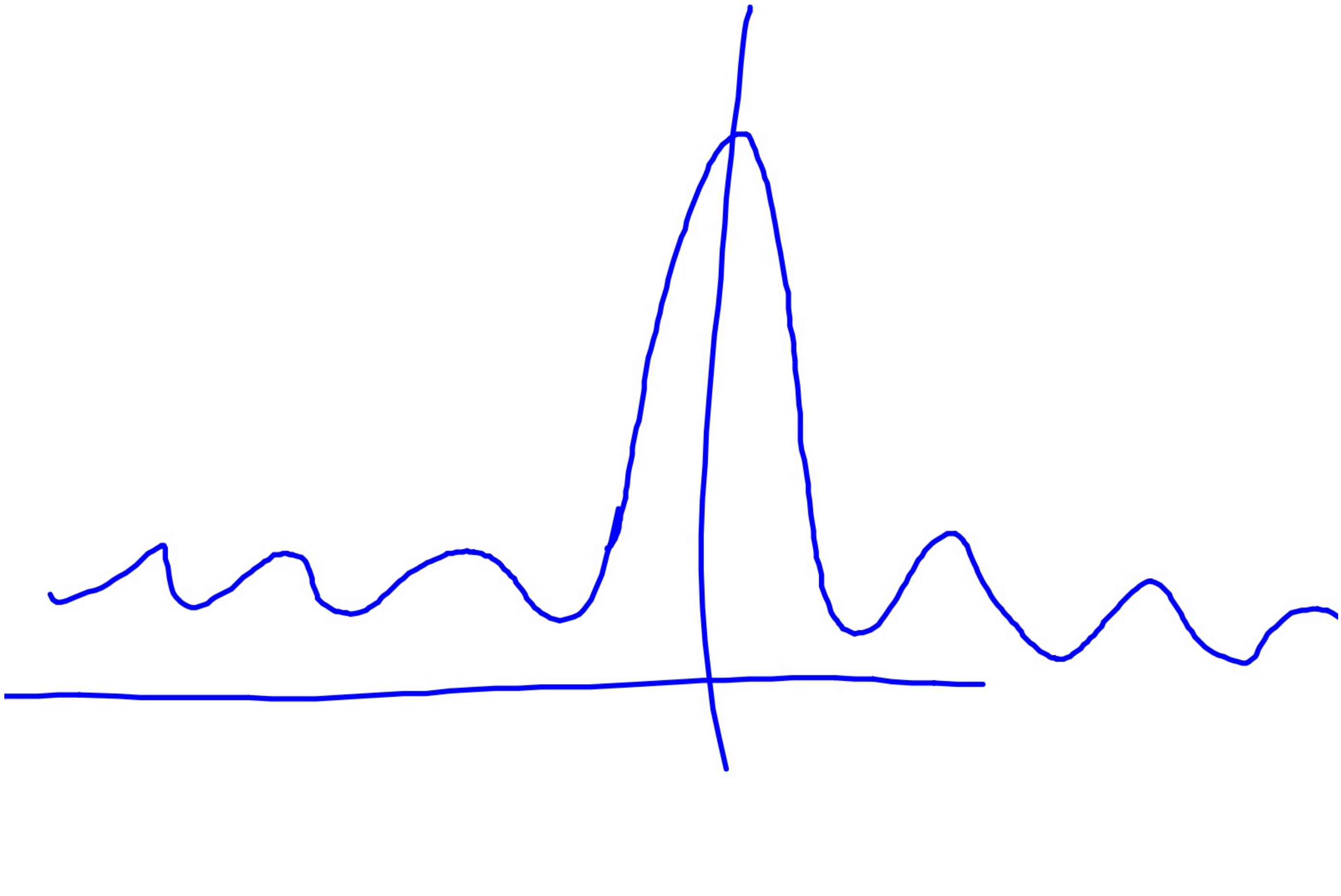
$T = 1\,s$

$f = 1\,Hz$

Amp. = 4cm

$\phi = \pi$





$V = 345 \frac{m}{s}$

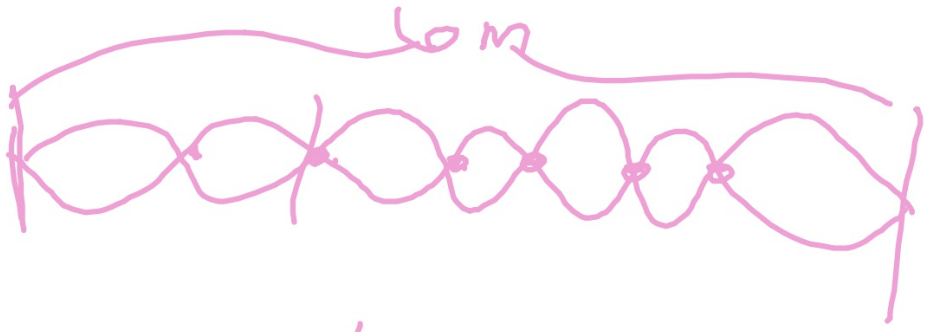
$f = 512 Hz$

$f' = 600 Hz$

$V_o = 26.8 m/s$

$$f' = f\left(\frac{V \pm V_o}{V \pm V_s}\right)$$

$$f' = f\left(\frac{V}{V \pm V_s}\right)$$



$$\frac{6}{7} \cdot 2 = \frac{12}{7}\,m$$

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$$f' = f\left(\frac{V \pm V_{o,s}}{V \mp V_{s,o}}\right)$$