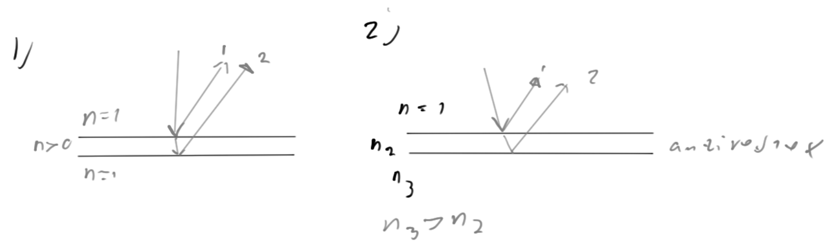
Lecture notes

Lukas Rahmn

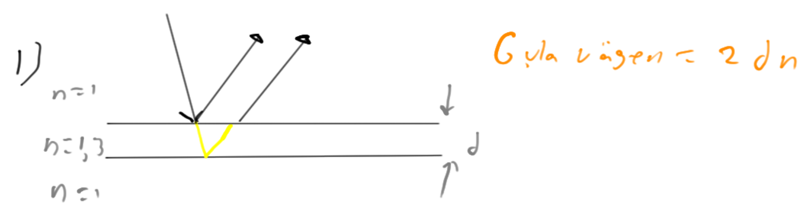
5 December 2016

1. Inteferens i tunna filmer
2. Diffraktion
3. Upplösningsförmåga
4. Rotations rörelser

Reflektion i tunna filmer



Fall 1

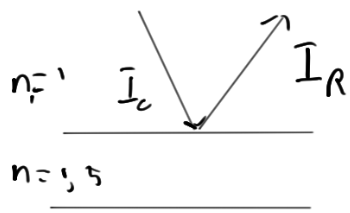


.

$$\begin{aligned}
\text{Fasskillnad:} \quad & 2\pi\frac{2dn}{\lambda} \pm \pi \\
\text{max:} \quad & 2\pi\frac{2dn}{\lambda} \pm \pi = m2\pi \\
& 2d = \left(m \pm \frac{1}{2}\right)\lambda \\
\text{min:} \quad & 2dn = m\lambda
\end{aligned}$$

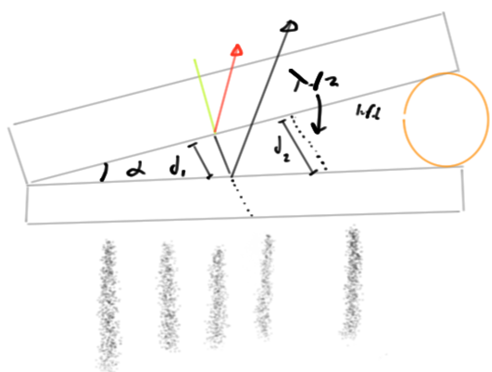
Fall 2

$$\text{max: } 2dn = m\lambda \; m = 1, 2, 3, ...$$
$$\text{min: } 2dn = (m + \frac{1}{2})\lambda \; m = 0, 1, 2, 3, ...$$
$$\text{minsta tjocklek som ger min:}$$
$$d = \frac{\lambda}{4n}$$



$$I_R = I_0 \left(\frac{n_2 - n_1}{n_2 + n_1} \right)^2$$

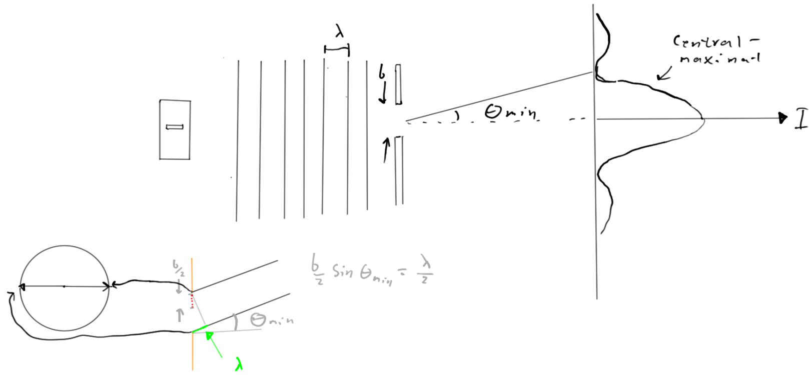
Antireflexbehandling av glasögon:

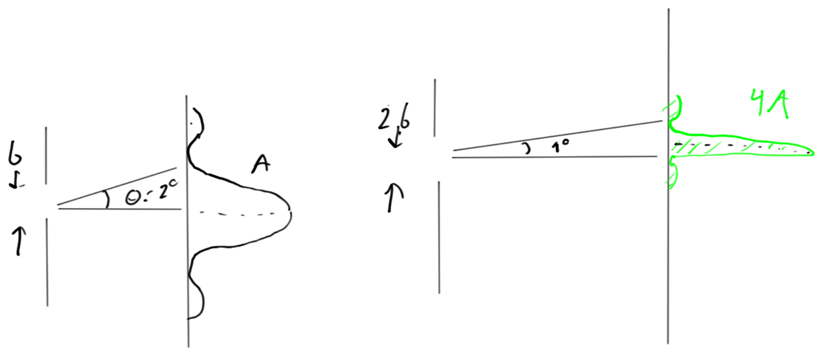


$$2d = (m + \frac{1}{2})\lambda$$
$$d_2 - d_1 = ?$$

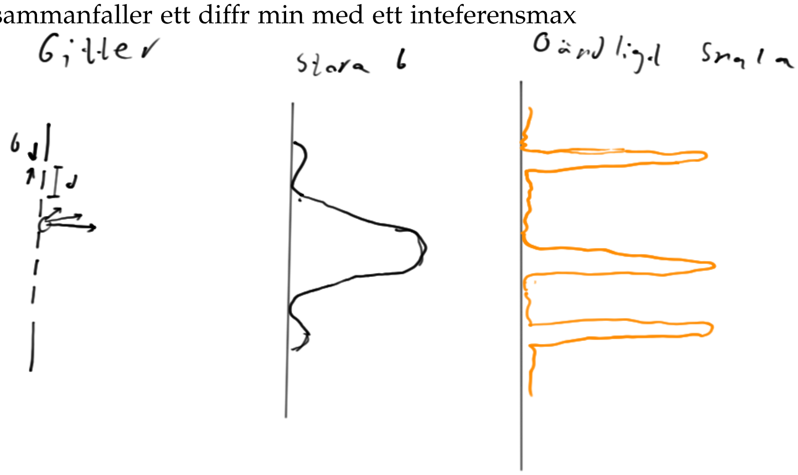
Diffraktion

$$\text{min: } b \sin\theta_{min} = \lambda \mid \text{Young, max: } d \sin\theta = \lambda$$





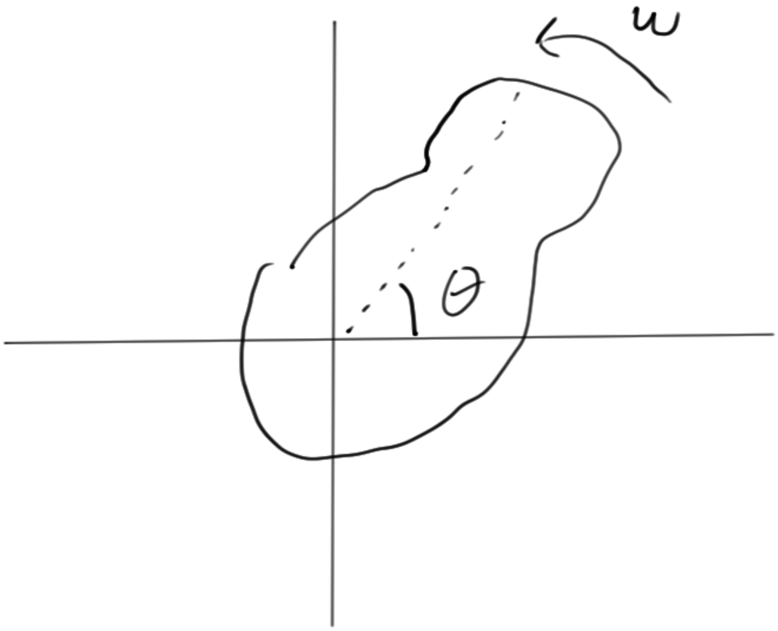
När sammanfaller ett diffr min med ett inteferensmax

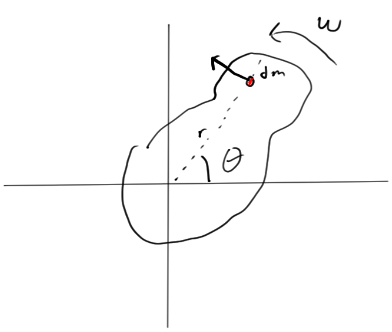


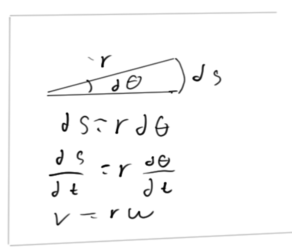
$$b \sin\theta = \lambda, d \sin\theta = m\lambda \to \frac{d}{b} = m$$

Rotationsrörelse

Rotationskinematik







$$\text{läge: } \theta \text{ jfr. } x$$

$$\text{hastighet: } \omega = \frac{d\omega}{dt} \ \bar{v}$$

$$\text{acceleration: } \alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2} \ \bar{a}$$

$$\theta_f - \theta_i = \omega_0 t + \frac{1}{22}\alpha t^2$$

$$\omega_f^2 - \omega_i^2 = 2\alpha\Delta\theta \text{Rotations energi:}$$

$$dK_R = \frac{1}{2} dm \cdot v^2$$

$$v = \omega r$$

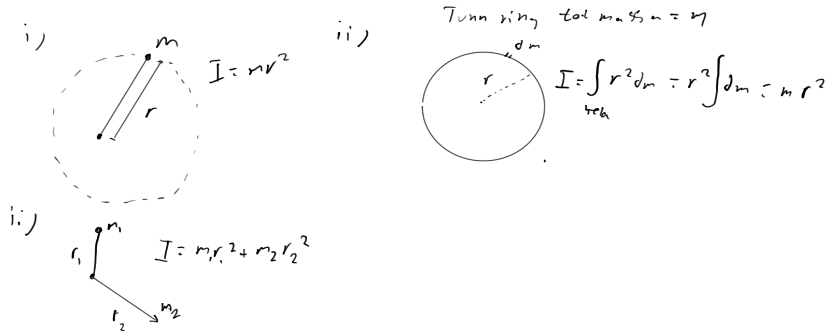
$$\text{Hela rotations energin:}$$

$$K_R = \int_{hela} dK_r = \int_{hela} \frac{1}{2}\omega^2 dm r^2 = \frac{1}{2}\omega^2 \int_{hela} r^2 dm$$

$$\int r^2 dm = \text{tröghets}\underline{\text{momentest}} \ = I$$

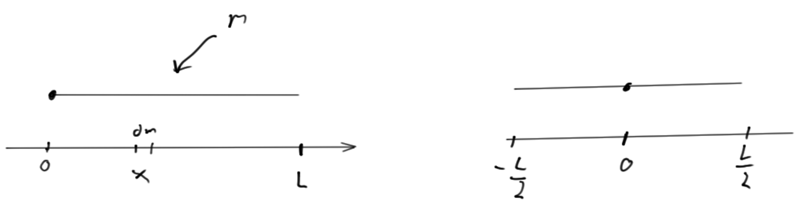
$$K_R = \frac{1}{2} I\omega^2 \ \text{ jämför med } \ K = \frac{1}{2} mv^2$$

Exempel



Smal pinne

$$\frac{dm}{M} = \frac{dx}{L} \rightarrow dm = \frac{M}{L}dx$$



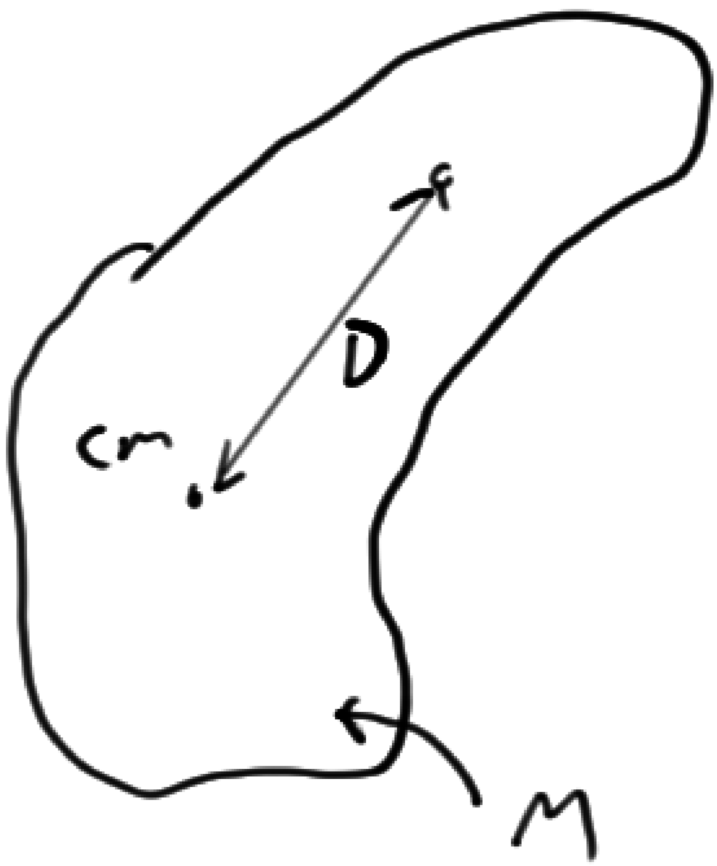
Fall 1:

$$I = \int_0^L x^2 dm = \int_0^L \frac{M}{L} x^2 dx = \frac{M}{L}\left[\frac{1}{3}x^3\right]_0^L = \frac{1}{3}ML^2$$

Fall 2:

$$I = \int_{-\frac{L}{2}}^{\frac{L}{2}} \frac{M}{L} x^2 dx = \frac{M}{L}\left[\frac{L^3}{3}\right]_{-\frac{L}{2}}^{\frac{L}{2}} = \frac{ML^2}{12}$$

Parallellförskjutningssatsen



$$I_0 = I_{cm} + MD^2$$

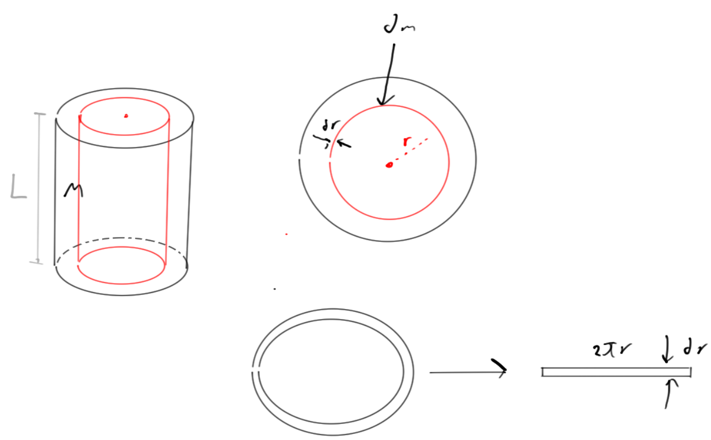
Smal pinne:

$$I_{cm} = \frac{ML^2}{12}$$

$$I = \frac{ML^2}{12} + M\left(\frac{L}{2}\right)^2 = ML^2\left(\frac{1+3}{12}\right) = \frac{ML^2}{3}$$

I för en homogen cylinder

$$dI = r^2 dm$$
$$\rho = \frac{M}{\pi R^2 L} = \text{tätheten}$$
$$dV = (2\pi r)dr * L$$
$$dm = 2\pi r dr L \frac{M}{\pi R^2 L} = \frac{2M}{R^2} r dr$$
$$I = \int_0 di = \frac{2M}{R^2} \int_0 r * r^2 dr = \frac{2M}{R^2} \left[\frac{R^4}{4} \right]_0^R = \frac{2M}{R^2} \frac{1}{4} R^4 = \frac{1}{2} MR^2$$



Kryssprodukt

$$\bar{A} \times \bar{B}$$
$$\hat{\imath} \times \hat{\jmath} = \hat{k}$$
$$\hat{\jmath} \times \hat{\imath} = -\hat{k}$$
$$|\bar{A} \times \bar{B}| = |\bar{A}| \cdot |\bar{B}| \cdot \sin \rho$$

Vridande moment

$$\bar{\tau} \equiv \bar{r} \times \bar{F}$$

Rörelsemängdsmoment

$\bar{L} \equiv \bar{r} \times \bar{p}$

Samband mellan $\bar{\tau}$ och $\bar{L}$

$$\frac{d\bar{L}}{dt} = \frac{d}{dt}(\bar{r} \times m\bar{v}) = \frac{d\bar{r}}{dt} \times m\bar{v} + \bar{r} \times \frac{d}{dt}(m\bar{v}) = \bar{r} \times \bar{F} = \bar{\tau}$$

$$\bar{\tau} = \frac{d\bar{L}}{dt}$$