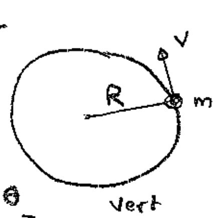
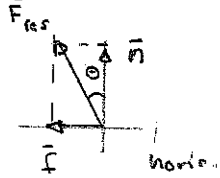
Tentamen i Fysik för Ingenjörer för I1. 2007-02-17

①

cirkulär centr. rörelse



$$\left.\begin{aligned} \tan\theta &= \frac{f}{n} \\ n &= mg \\ f &= m\frac{v^2}{R} \end{aligned}\right\} \Rightarrow m\frac{v^2}{R} = mg\tan\theta$$



$$\Rightarrow v^2 = Rg\cdot\tan\theta$$

$$\Rightarrow v = \sqrt{20\cdot 9{,}81\ \tan 15^\circ} = 7{,}251\ \text{m/s} = \underline{\underline{7{,}2\ \text{m/s}}}$$

max. värde på friktionskraften $f_{max} = \mu_s mg$

$$f = 0{,}5\,\mu \cancel{m} g = \cancel{m}\frac{v^2}{R} \Rightarrow \mu = \frac{v^2}{R\,0{,}5g} =$$

$$= \underline{\underline{0{,}53}}$$

②

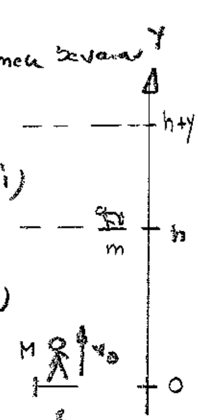
i) upphopp (endast akrobat) E_{mek} bevaras

$$v_h^2 = v_0^2 - 2gh \quad (1)$$

ii) Infångning $\bar{p}$ bevaras.

$$Mv_h = (M+m)v_g \qquad v_g = \text{gemens. fart}$$

$$\Rightarrow v_g = \frac{M}{M+m}v_h \quad (2)$$



iii) Akrobat + apa rör sig uppåt E_{mek} bevaras:

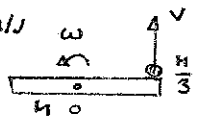
$$v_{h+y}^2 = 0 = v_g^2 - 2gy \Rightarrow y = \frac{v_g^2}{2g}$$

Ins. av v_g och v_h från (2) och (1) ger

$$y = \frac{\left(\frac{M}{m+M}\right)^2\left(v_0^2 - 2gh\right)}{2g} = \underline{\underline{1{,}2\ \text{m}}}$$

③

$\omega_i = 20{,}0$ rad/s $\quad \Delta v = 6{,}00$ m/s
$L = 0{,}800$ m



Alla moment beräknas m.a.p. o

Inga yttre vrid. moment. ∴ L bevaras

$$L_i = \left[\frac{1}{12}ML^2 + \frac{M}{3}\left(\frac{L}{2}\right)^2\right]\omega_i = \frac{1}{6}ML^2\cdot\omega_i$$

$$\left.\begin{aligned} L_f &= \frac{1}{12}ML^2\cdot\omega_f + \frac{M}{3}\left(\frac{L}{2}\right)v \\ v &= \Delta v + \frac{L}{2}\omega_f \end{aligned}\right\} \Rightarrow$$

$$\Rightarrow L_f = \frac{1}{12}ML^2\omega_f + \frac{ML}{6}\Delta v + \frac{1}{12}ML^2\omega_f$$

$$L_f = L_i \Rightarrow \omega_f = \omega_i - \frac{\Delta v}{L}$$

$$\Rightarrow v = \Delta v + \frac{L}{2}\left(\omega_i - \frac{\Delta v}{L}\right) = \frac{\Delta v}{2} + \frac{L}{2}\omega_i =$$

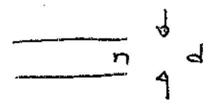
$$= 3{,}00 + \frac{0{,}800}{2}\cdot 20{,}0 = \underline{\underline{11{,}0\ \text{m/s}}}$$

④

a) Maxintensiteten fyrdubblas men bredden halveras.
⇒ ytan under intensitetskurvan fördubblas.

b)

Villkor för maximum i refl. ljus.



$$2nd = \left(m + \frac{1}{2}\right)\lambda \qquad m = 0, 1, 2, \ldots$$

$$\Rightarrow \lambda = \frac{4n}{2m+1}d \qquad m = 1 \text{ ger } \lambda \text{ i synl. området}$$

$$\lambda = \frac{4\cdot 1{,}33}{2\cdot 1+1}\ 320\ \text{nm} = \underline{\underline{567\ \text{nm}}}$$

⑤

Spaltbredd $= a$ $\quad \lambda = 0{,}250\,a$
Gitterkonstant $= 5a$, $\quad N = 8$

Gitterformeln $5a\cdot\sin\theta = m\cdot 0{,}250\,a$

$$\Rightarrow \sin\theta = m\cdot 0{,}05$$

$$\theta = \text{i grader} \begin{cases} 0 & 0 \\ 2{,}9 & 1 \\ 5{,}7 & 2 \\ 8{,}6 & 3 \\ 11{,}5 & 4 \\ (14{,}5 & 5) \\ 17{,}5 & \end{cases}$$

men 1:a diff. min ges av $a\cdot\sin\theta = \lambda$

⇒ $14{,}5^\circ$ syns inte

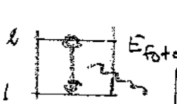
Upplösning $\Delta\lambda = 0{,}005\,a$

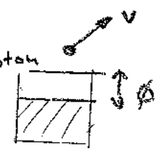
$$\frac{\lambda}{\Delta\lambda} \le mN \quad \Rightarrow \frac{0{,}250}{0{,}005} = 50 \le m\cdot 8$$

∴ Upplösning om $m > \frac{50}{8}$ dvs. 7, 8, 9 ...

⑥

$$E_{foton} = \frac{1}{2}mv_{max}^2 + \phi$$





$v_{max} = 1{,}0\cdot 10^6$ m/s

$$\Rightarrow \frac{1}{2}mv_{max}^2 = \frac{1}{2}\,9{,}11\cdot 10^{-31}\cdot\left(1{,}0\cdot 10^6\right)^2\frac{1}{1{,}6\cdot 10^{-19}}\ \text{eV}$$

$$= 2{,}84\ \text{eV}$$

$$\Rightarrow E_{foton} = 4{,}84\ \text{eV} = 7{,}75\cdot 10^{-19}\ \text{J}$$

$$E_{foton} = E_2 - E_1 = \left(2^2 - 1^2\right)\frac{h^2}{8mL^2}$$

$$\Rightarrow L = \sqrt{\frac{3h^2}{8m\,E_{foton}}} = \sqrt{\frac{3\left(6{,}63\cdot 10^{-34}\right)^2}{8\cdot 9{,}11\cdot 10^{-31}\cdot 7{,}75\cdot 10^{-19}}}$$

$$\Rightarrow L = 4{,}8\cdot 10^{-10}\ \text{m} = \underline{\underline{4{,}8\ \text{Å}}}$$