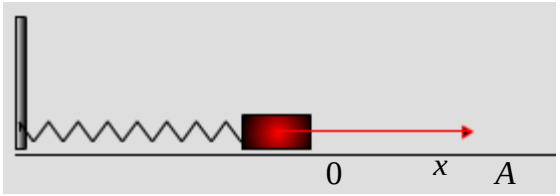
# Kap 14 Periodisk bevegelse

| | | | | | |
|---|---|---|---|---|---|
| $A$ | Amplitude | Maxutslag i x – retning | | Enhet | m |
| $T$ | Periode (Svingetid ) | Tiden for en hel svingning | | Enhet | s |
| $f$ | Frekvens | Antallsvin gningerprt idsenhet | $f = \frac{1}{T}$ | Enhet | Hz $= s^{-1}$ |
| $\omega$ | Vinkelfrek vens | Rotasjonsh astighet | $\omega = 2\pi f$ | Enhet | $s^{-1}$(eller rad/s) |




SHM $\boxed{F = -kx}$

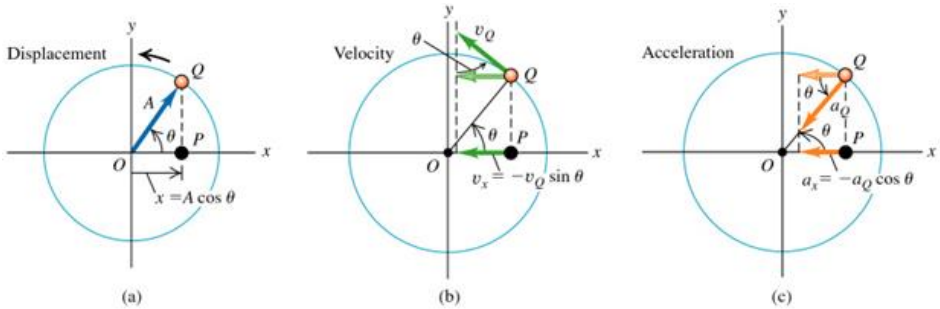
Amplitude $A$

Periode $T$

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

Vinkelfrek vens $\omega = 2\pi f$

Energi $E = E_k + E_p = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \underbrace{\frac{1}{2}mv_{max}^2}_{\text{I origo Likevekt stilling Max } E_k} = \underbrace{\frac{1}{2}kA^2}_{\text{I ytterpunkt ene Max } E_p}$




Hastighet $v = \pm\sqrt{\frac{k}{m}} \cdot \sqrt{A^2 - x^2}$

Diff.lign. $m\ddot{x} + kx = 0$

Posisjon $\boxed{x = A\cos(\omega t + \varphi)}$

$x = A\cos(\omega t + \varphi)$

Start i ro i høyre ytterstill ing $\varphi = 0 \Rightarrow x = A\cos(\omega t)$

Starter klokka ved passering origo på vei mot høyre $\varphi = -\frac{\pi}{2} \Rightarrow x = A\sin(\omega t)$

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

Frekvens $f = \frac{1}{T} = \frac{\omega}{2\pi}$

Vinkelfrek vens $\omega = 2\pi f = \sqrt{\frac{k}{m}}$

Fasevinkel $\varphi = \arctan(-\frac{v_0}{\omega x_0})$

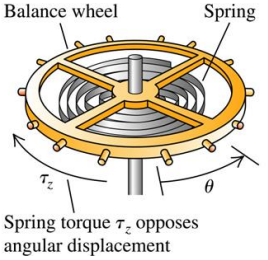
Amplitude $A = \sqrt{x_0^2 + \frac{v_0^2}{\omega^2}}$

Sirkulær SHM $\theta = \Theta\cos(\omega t + \varphi)$

$\omega = \sqrt{\frac{\kappa}{I}}$

$T = 2\pi\sqrt{\frac{I}{\kappa}}$

$f = \frac{1}{2\pi}\sqrt{\frac{\kappa}{I}}$



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For alle diff.lign. av typen $a\ddot{x} + bx = 0$ gjelder

$$\omega = \sqrt{\frac{b}{a}} \qquad T = \frac{2\pi}{\omega} \qquad f = \frac{1}{T} \qquad x = A\cos(\omega t + \varphi)$$

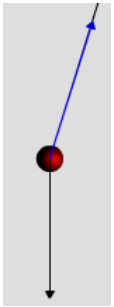
Enkel pendel

$$L\ddot{\theta} + g\theta = 0$$

$$\omega = \sqrt{\frac{g}{L}}$$

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

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$



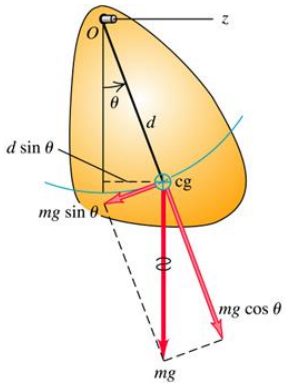
Fysisk pendel

$$I\ddot{\theta} + mgd\theta = 0$$

$$\omega = \sqrt{\frac{mgd}{I}}$$

$$T = 2\pi\sqrt{\frac{I}{mgd}}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{mgd}{I}}$$

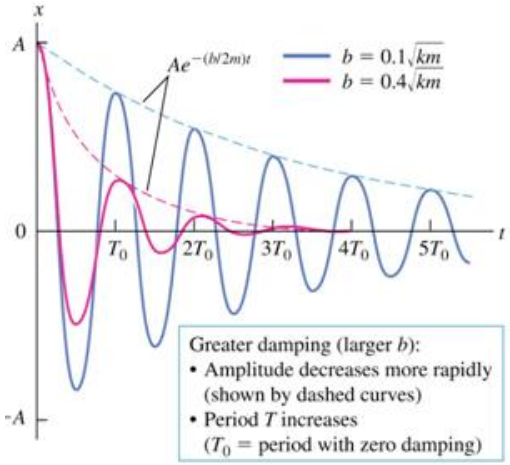



Dempede svingninger

$$m\ddot{x} + b\dot{x} + kx = 0$$

$$x = Ce^{\lambda t} \Rightarrow m\lambda^2 + b\lambda + k = 0 \Rightarrow \lambda = \frac{-b \pm \sqrt{b^2 - 4mk}}{2m}$$

$$x = \begin{cases} c_1 e^{\lambda_1 t} + c_2 e^{\lambda_2 t} & b^2 > 4mk \quad \text{Overdempet} \\ (c_1 + c_2 t)e^{\lambda t} & b^2 = 4mk \quad \text{Kritisk dempet} \\ Ce^{-\frac{b}{2m}t}\cos(\omega' t + \varphi) & b^2 < 4mk \quad \text{Underdempet} \quad \omega = \sqrt{\omega_0^2 - \frac{b^2}{4m^2}} \end{cases}$$




Tvungne svingninge r

$$m\ddot{x} + b\dot{x} + kx = F_0\cos\omega t$$

$$x = x_0 + x_p = x_0 + A\cos(\omega t - \eta)$$

$$A = \frac{F_0}{\sqrt{(k - m\omega^2)^2 + b^2\omega^2}}$$