Rotationsmekanik

Jun 23, 2026, 2 min read

#fysik #rotation #kinematik

> **Kurs:** F0006T **Förkunskaper:** Kinematik, Rotation

> **Påminnelse av Elfgren**
>
> Rita alltid bild när du använder Arbete och kinetisk energi.

En stel kropp är odeformerbar — den töjer eller böjer sig inte.

1. Vinkelhastighet och vinkelacceleration

Vinkeln definieras utifrån ett fixt koordinatsystem; kroppen roterar kring z-axeln.

Definition, vinkelhastighet:

$\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt} = \dot{\theta}$

Jämför med linjär hastighet: $v = \dfrac{dx}{dt} = \dot{x}$.

Definition, vinkelacceleration:

$\alpha = \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t} = \frac{d\omega}{dt} = \dot{\omega} = \ddot{\theta}$

Jämför med linjär acceleration: $a = \dfrac{dv}{dt} = \dot{v} = \ddot{x}$.

$\alpha \, d\theta = \omega \, d\omega \qquad \textbf{(Fysika FB2)}$

---

2. Konstant vinkelacceleration

$\omega = \omega_0 + \alpha t \; \theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2 \; \omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

⚠ **Förutsättningar**

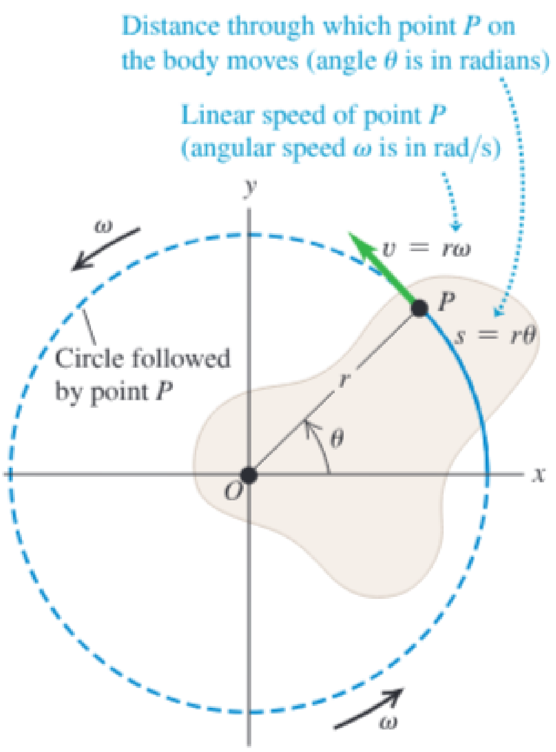
- Vinklar i radianer.
- $\alpha = \text{konstant}$ – annars fungerar inte formlerna.

---

3. Förhållande linjär-rotationskinematik

Varje punkt i en roterande stel kropp går i en cirkelbana runt rotationsaxeln. Elfgren kallar vinkeln $\Delta\theta$, båglängden ΔS och radien r.

Figure 9.9 A rigid body rotating about a fixed axis through point O.



EXAMPLE 9.4 Throwing a discus — WITH VARIATION PROBLEMS

An athlete whirls a discus in a circle of radius 80.0 cm. At a certain instant, the athlete is rotating at 10.0 rad/s and the angular speed is increasing at 50.0 rad/s^2. For this instant, find the tangential and centripetal components of the acceleration of the discus and the magnitude of the acceleration.

IDENTIFY and SET UP We treat the discus as a particle traveling in a circular path (**Fig. 9.12a**), so we can use the ideas developed in this section. We are given $r = 0.800$ m, $\omega = 10.0$ rad/s, and $\alpha = 50.0$ rad/s^2 (Fig. 9.12b). We'll use Eqs. (9.14) and (9.15) to find the acceleration components a_{tan} and a_{rad}, respectively; we'll then find the magnitude a by using the Pythagorean theorem.

EXECUTE From Eqs. (9.14) and (9.15),

$$a_{tan} = r\alpha = (0.800\ \text{m})(50.0\ \text{rad/s}^2) = 40.0\ \text{m/s}^2$$

$$a_{rad} = \omega^2 r = (10.0\ \text{rad/s})^2(0.800\ \text{m}) = 80.0\ \text{m/s}^2$$

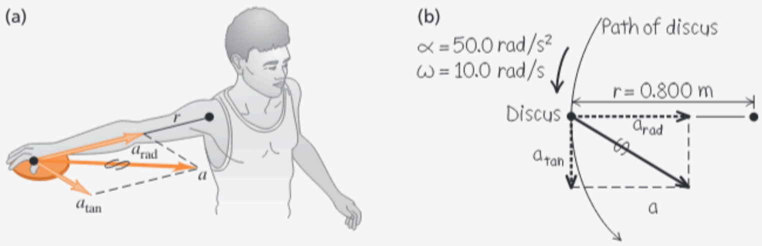
Then

$$a = \sqrt{a_{tan}{}^2 + a_{rad}{}^2} = 89.4\ \text{m/s}^2$$

EVALUATE Note that we dropped the unit "radian" from our results for a_{tan}, a_{rad}, and a. We can do this because "radian" is a dimensionless quantity. Can you show that if the angular speed doubles to 20.0 rad/s while α remains the same, the acceleration magnitude a increases to 322 m/s^2?

KEYCONCEPT Points on a rigid body have a *centripetal* (radial) acceleration component $a_{rad} = \omega^2 r$ whenever the rigid body is rotating; they have a *tangential* acceleration component $a_{tan} = r\alpha$ *only* if the angular speed ω is changing. These two acceleration components are perpendicular, so you can use the Pythagorean theorem to relate them to the magnitude of the acceleration.

Figure 9.12 (a) Whirling a discus in a circle. (b) Our sketch showing the acceleration components for the discus.



Formelblad **FB2** (Fysika):

	Allmänt			Konstant vinkelacceleration			Båglängd:
Rotation	$\omega = \frac{d\theta}{dt}$	$\alpha = \frac{d\omega}{dt}$	$\alpha\ d\theta = \omega\ d\omega$	$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$	$\omega = \omega_0 + \alpha t$	$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$	$s = r \cdot \theta$

FB2 — beteckningar >

Läsning

- Chapter 9 Rotation of Rigid Bodies
- Chapter 10 Dynamics of Rotational Motion

Se även

- Rotation
- Newtons lagar

- Momentekvationen
- Masströghetsmoment