Föreläsningspass 4:

* Intro. till dynamiken

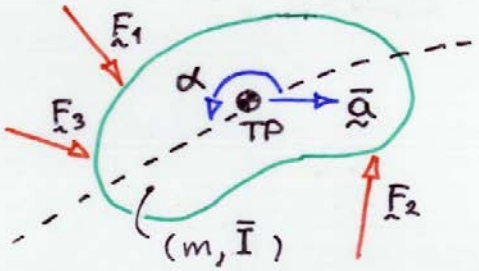
* Partikelkinematik 1D

Avsnitt i kursboken: 5.1

DYNAMIK - JÄMVIKT - STATIK

* DYNAMIK :

Stel kropp påverkad av krafter och moment (massa m , tröghets moment $\bar{I}$)



$\bar{a}$: TPs accelleration

α : vinkelaccelleration

Rörelse-ekvationerna :

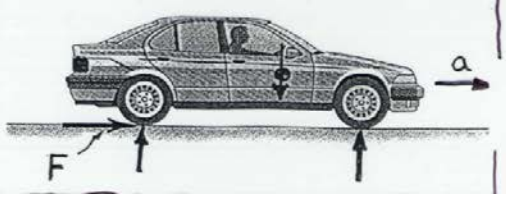
$$\sum \underset{\sim}{F}_i = m \cdot \bar{a}$$

$$\sum M_{i(TP)} = \bar{I} \cdot \alpha$$

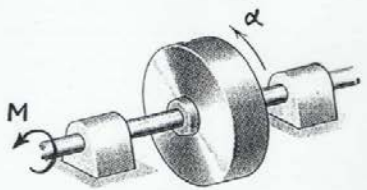
obalanserade krafter ⇨ accelleration $\bar{a}$

—"— moment ⇨ vinkelacc. α

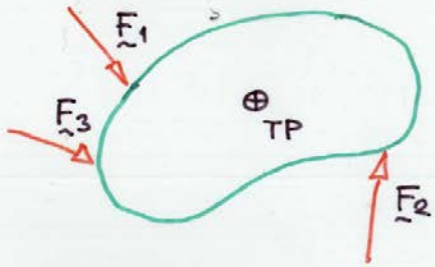
Massa m ger motstånd mot acc. $\bar{a}$



Tröghetsmom. $\bar{I}$ ger motstånd mot vinkelacc. α



* JÄMVIKT:



Krafter och moment i balans dvs

$$\begin{cases} \sum \underset{\sim}{F}_i = 0 \\ \sum M_i = 0 \end{cases}$$

Rörelse ekv. $\Rightarrow$ $\bar{a} = 0$ och $\alpha = 0$

Alltså $\begin{cases} \text{TPs hastighet} & \bar{v} = \text{konst.} \\ \text{Vinkel hastighet} & \omega = \text{konst.} \end{cases}$

* STATIK:

Behandlar kroppar i vila som uppfyller: $\begin{cases} \bar{v} = 0 \\ \omega = 0 \end{cases}$

Jämviktsekvationerna: $\begin{cases} \sum \underset{\sim}{F}_i = 0 \\ \sum M_i = 0 \end{cases}$

Anm. Momentpunkten är inte begränsad till TP i statiken.

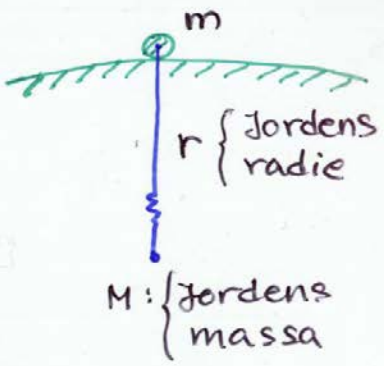
TYNGDKRAFT JÄMFÖRT MED "TRÖGHETSKRAFT"

Newton formulerade ett konsekvent kraftbegrepp:

a) Gravitationskraften vid jordytan

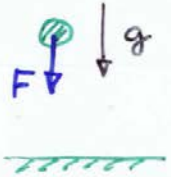
Gravitationslagen ⇒

$$F = G\frac{Mm}{r^2} = mg$$



b) Fallande massa vid jordytan

Massan får accelerationen $g = 9.81\ m/s^2$

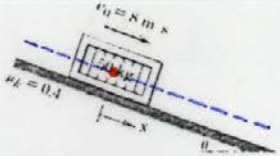


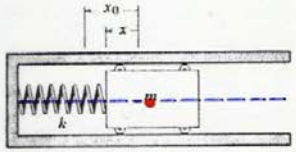
Newtons 2:a lag $F = ma$:

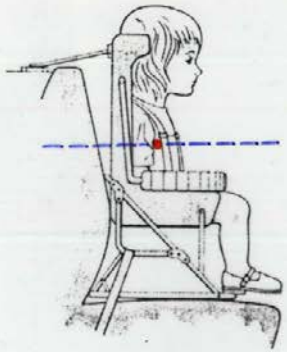
$a = g \Rightarrow F = mg$

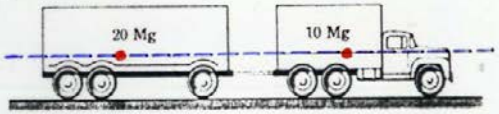
a) och b) ger samma kraft!

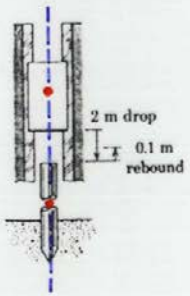
RÄTLINJIG RÖRELSE

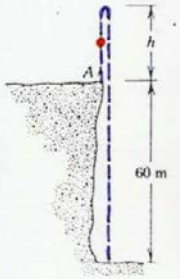




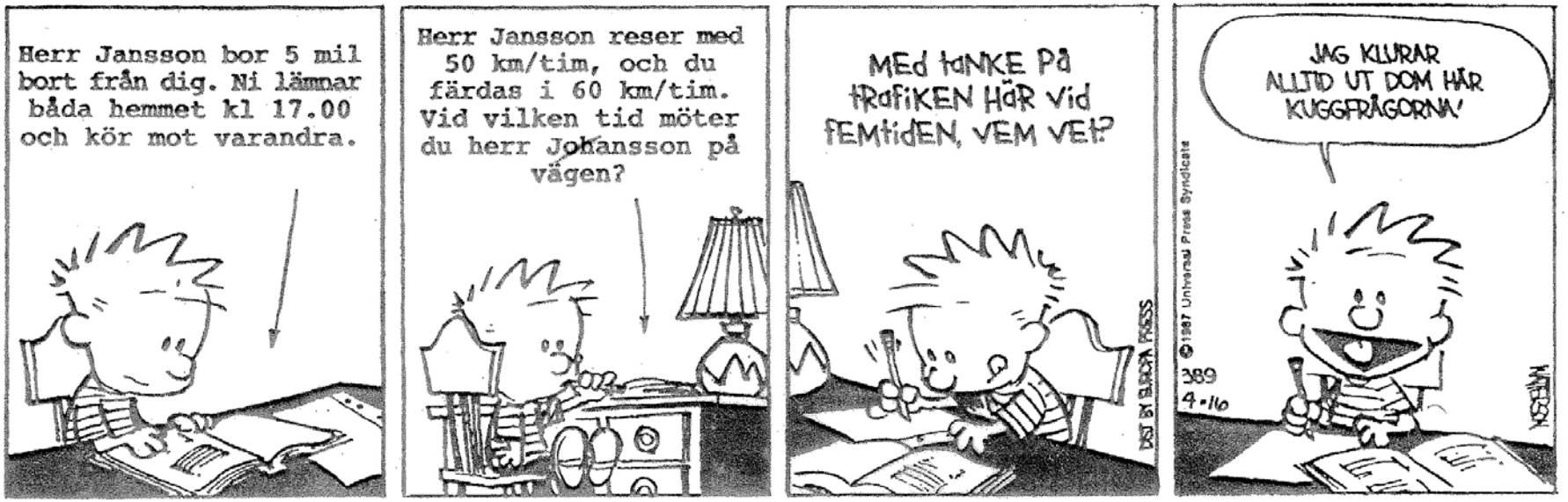


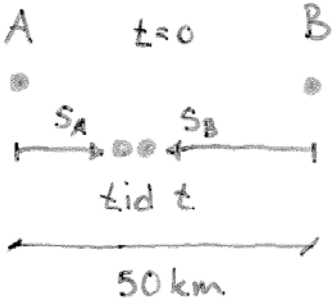






KALLE & HOBBE av Bill Watterson





$$s_A + s_B = 50\ \text{km}$$

$$\frac{s_A}{t} = 50\ \text{km/h}$$

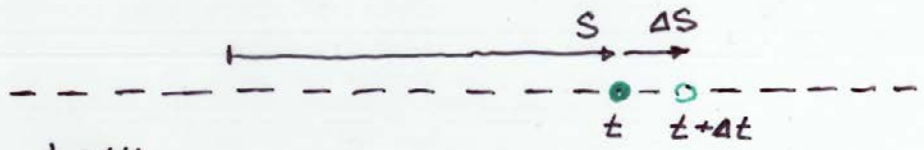
$$\frac{s_B}{t} = 60\ \text{km/h}$$

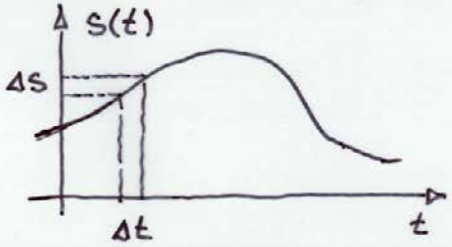
$$50t + 60t = 50; \quad t = \frac{50}{110} = 0.45\,\text{h}$$

Svar: 17^{27}

DEFINITION AV HASTIGHET OCH ACCELERATION

Partikel i rätlinjig rörelse:

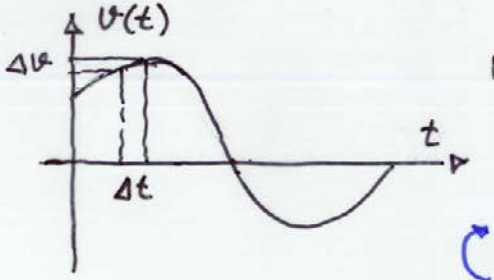




Medelhastighet: $\frac{\Delta s}{\Delta t}$

$$v = \lim_{\Delta t \to 0} \frac{\Delta s}{\Delta t} = \frac{ds}{dt} \quad \ldots (1)$$

Momentan hastighet



Medelacceleration: $\frac{\Delta v}{\Delta t}$

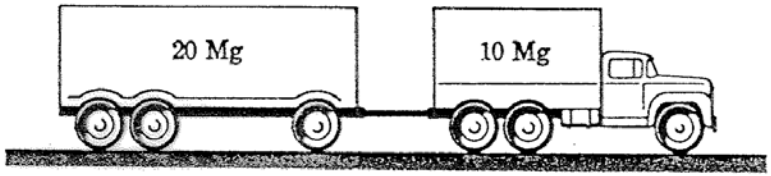
$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} \quad \ldots (2)$$

Momentan acceleration

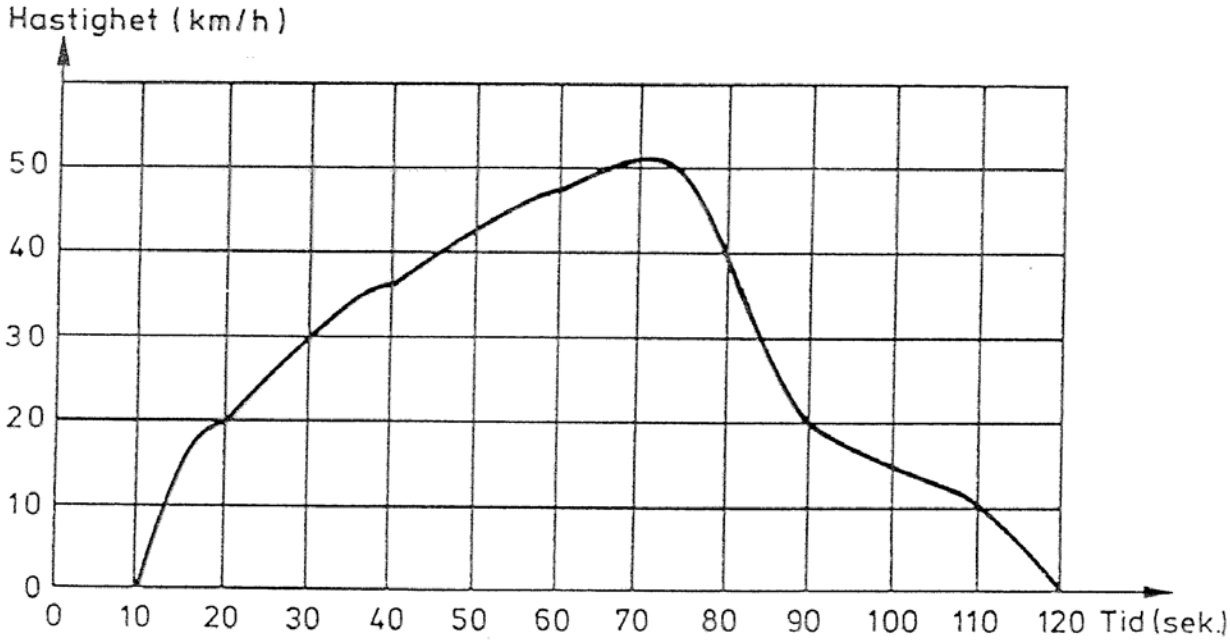
Dessutom (1) i (2) $\Rightarrow$ $a = \frac{d^2 s}{dt^2}$

Anm. Fart: Belopp av hastighet $|v|$

Ex. Färdskrivare



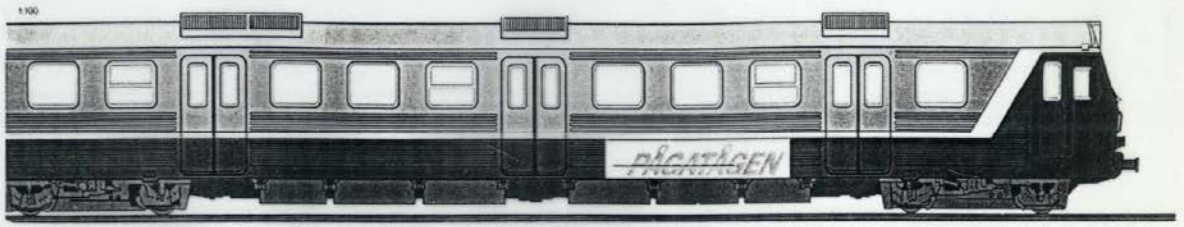
Problem 3/2

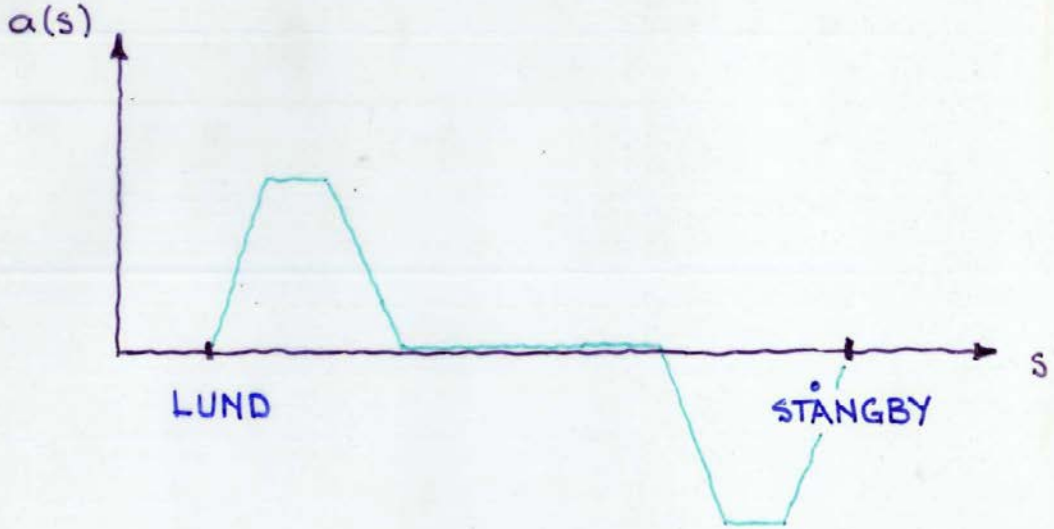


Ex. Usain Bolt; 100m-lopp

Topphastighet?

ACCELERATION SOM FUNKTION AV STRÄCKA





ALTERNATIVT UTTRYCK FÖR ACCELERATION

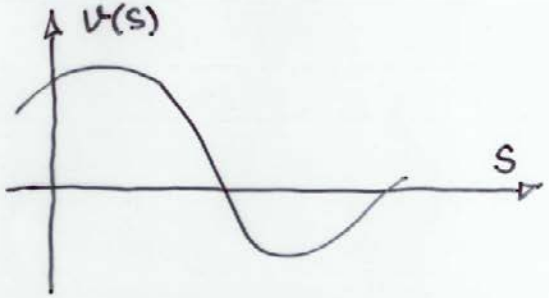
Användning av kjedjeregeln i definitionen av acceleration:

$$a = \frac{dv}{dt} = \frac{dv}{ds}\frac{ds}{dt} = \frac{dv}{ds}v$$

dvs tidsvariabeln har eliminerats

Alltså $\boxed{a = v\frac{dv}{ds}}$

Hastigheten betraktas nu som en funktion av läget:



Anm. a kan vara en funktion av s eller v.