



1.3: Toepassing 7: Vryval teen lugweerstand (bl 22)

1.3: Application 7: Free-fall against air resistance (p 22)



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SONDER LUGWEERSTAND / WITHOUT AIR RESISTANCE

Laat afwaartse rigting positief wees...

Verplasing: $y(t)$

Snelheid: $v(t)$

Let downward direction be positive...

Displacement: $y(t)$

Velocity: $v(t)$



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Moontlike scenario: Persoon val uit vliegtuig...

Possible scenario: Person falls from airplane...

⇒ **Vanuit rus** / From rest: $y(0) = y_0 = 0$

$v(0) = v_0 = 0$



Newton II: Resulterende krag = massa \times versnelling ($F = ma$)

Newton II: Resultant force = mass \times acceleration ($F = ma$)



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$\Rightarrow v = gt + v_0 \Rightarrow \boxed{v(t) = gt} \Rightarrow \frac{dy}{dt} = gt$

$\Rightarrow y = \frac{1}{2}gt^2 + y_0 \Rightarrow \boxed{y(t) = \frac{1}{2}gt^2}$



MET LUGWEERSTAND / WITH AIR RESISTANCE

Neem aan: lugweerstand \propto snelheid

Assume: air resistance \propto velocity

Newton se 2de wet: Massa \times versnelling = resulterende krag ($ma = F$)

Newton's 2nd law: Mass \times acceleration = resulting force ($ma = F$)

Dus / Therefore $m \frac{dv}{dt} = mg - kv$ **met / with** $v(0) = v_0 = 0$



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Standaardvorm / Standard form: $\frac{dv}{dt} + \frac{k}{m}v = g$

Integrasiefaktor / Integration factor: $I = e^{kt/m}$



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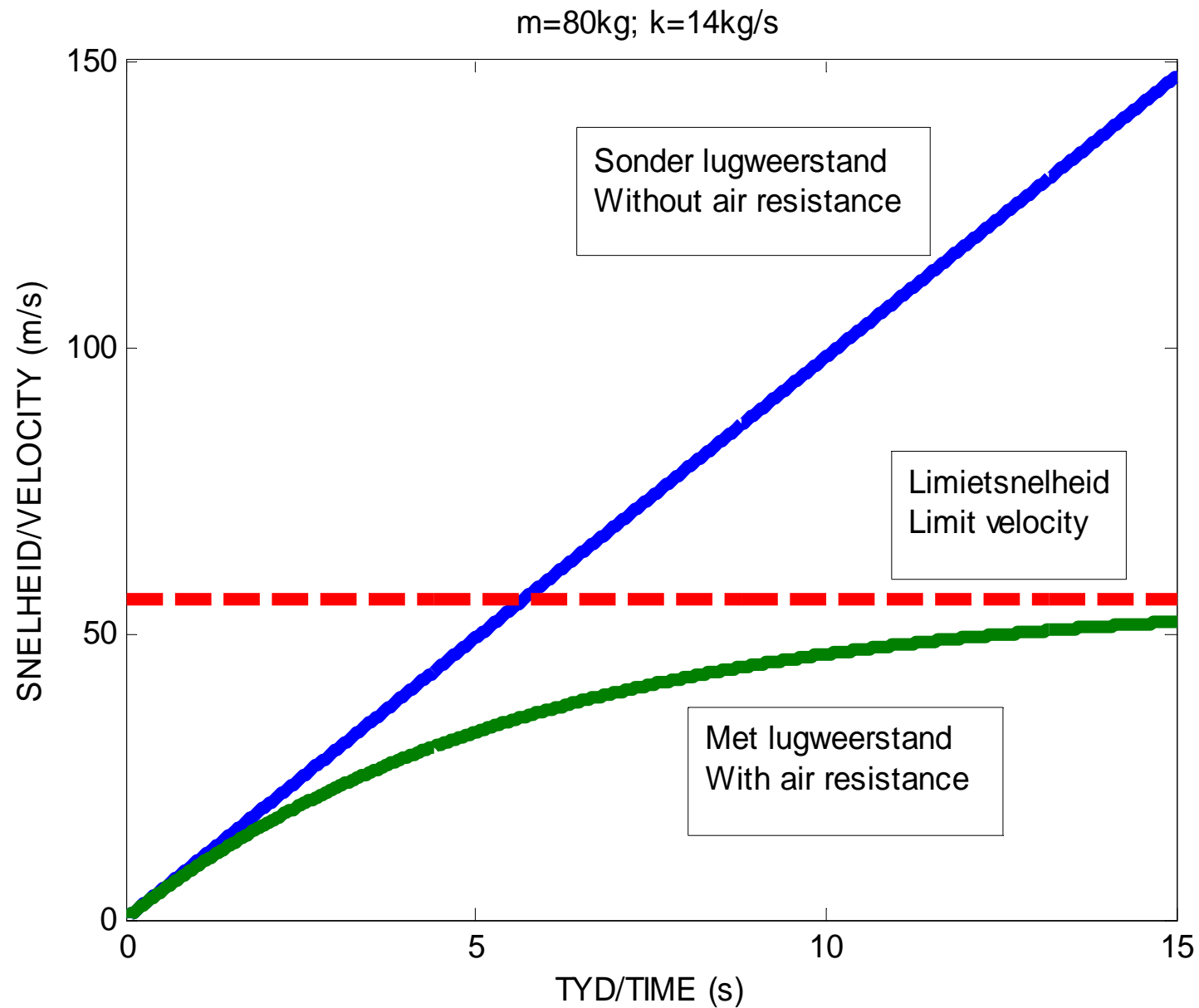
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Toon dan aan dat / Then show that: $y(t) = \frac{mg}{k} \left(t + \frac{m}{k} e^{-kt/m} - \frac{m}{k} \right)$





Voorbeeld: 'n Man in 'n valskerm val vanuit rus en bereik 'n limietsnelheid van 4.9 m/s . Hoe lank sal dit neem om 2.45 m/s te bereik? Aanvaar dat lugweerstand direk eweredig is aan die snelheid en neem $g = 9.8 \text{ m/s}^2$.

Example: A man in a parachute falls from rest and reaches a limit velocity of 4.9 m/s . How long will it take him to reach 2.45 m/s ? Assume that air resistance is directly proportional to the velocity and take $g = 9.8 \text{ m/s}^2$.



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Antwoord / Answer: 0.3466 sekondes / seconds