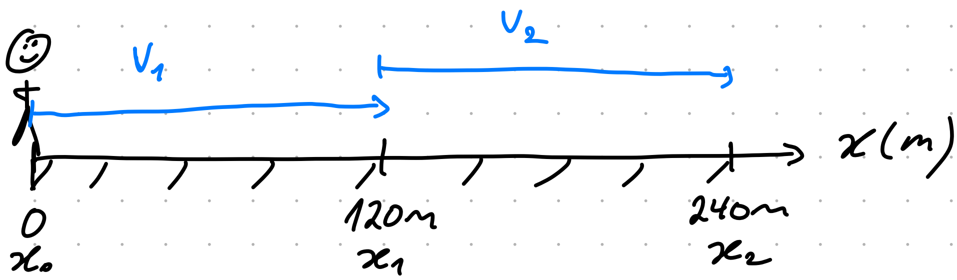
1.1



Gjennomsnittsfarten beregner vi utfra total tilbakelagt distanse delt på total tid.
Dersom man løper med to ulike hastigheter over to tidsrom som er like store, vil snittfarten være midt mellom de to hastighetene.
I dette tilfellet bruker vi lengre tid på de første 120 meterne enn de siste siden $v_1 < v_2$.
Snittfarten vil derfor ligge nærmere v_1 enn v_2, dvs. mindre enn 4,00 m/s.

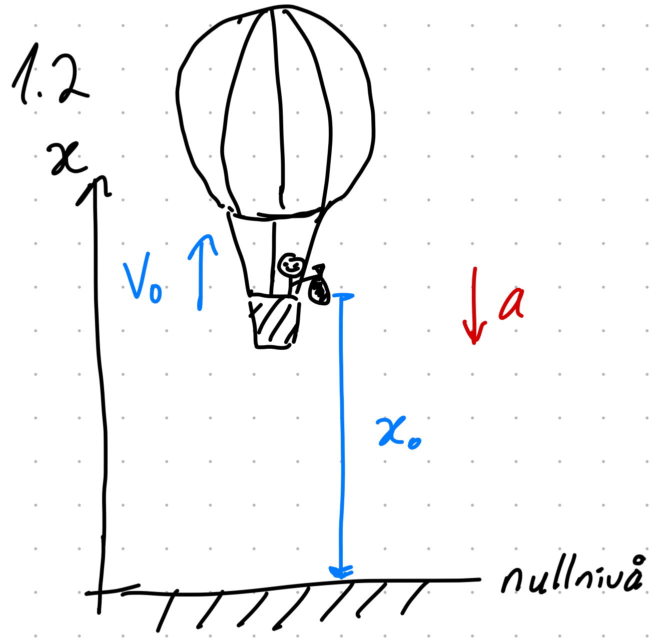
Oppgaven kan også løses ved utregning:

$$t_1 = \frac{120\,m}{3{,}00\,\frac{m}{s}} = 40\,s$$

$$t_2 = \frac{120\,m}{5{,}00\,\frac{m}{s}} = 24\,s$$

$$\underline{\bar{v}} = \frac{240\,m}{64\,s} = \underline{3{,}75\,\frac{m}{s}}$$

1.2



$V_0 = 5{,}00\ m/s$

$x_0 = 40{,}0\ m$

$a = -g = -9{,}81 \frac{m}{s^2}$

a) Konstant akselerasjon:

$x(t) = x_0 + V_0 t + \frac{1}{2} a t^2$

$v(t) = V_0 + at$

$\underline{\underline{x(0{,}250\,s)}} = 40m + 5\frac{m}{s} \cdot 0{,}25\,s - \frac{1}{2} \cdot 9{,}81 \frac{m}{s^2} \cdot (0{,}25\,s)^2 = \underline{\underline{40{,}9m}}$

$\underline{\underline{x(1{,}00s)}} = 40m + 5\frac{m}{s} \cdot 1s - \frac{1}{2} \cdot 9{,}81 \frac{m}{s^2} \cdot (1s)^2 = \underline{\underline{40{,}1m}}$

$\underline{\underline{v(0{,}250\,s)}} = 5\frac{m}{s} - 9{,}81 \frac{m}{s^2} \cdot 0{,}25\,s = \underline{\underline{2{,}55 \frac{m}{s}}}$

$\underline{\underline{v(1{,}00\,s)}} = 5\frac{m}{s} - 9{,}81 \frac{m}{s^2} \cdot 1s = \underline{\underline{-4{,}81 \frac{m}{s}}}$

b) Sandsekken treffer bakken når $x(t) = 0$

$$0 = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$-\frac{9{,}81 \frac{\cancel{m}}{s^2}}{2} t^2 + 5{,}00 \frac{\cancel{m}}{s} \cdot t + 40 \cancel{m} = 0$$

$$-4{,}905 \left(\frac{t}{s}\right)^2 + 5{,}00 \cdot \left(\frac{t}{s}\right) + 40 = 0$$

Løser 2. gradslignign:

$$\frac{t_1}{s} = -2{,}39 \quad \Rightarrow \quad t_1 = -2{,}39\,s$$

$$\frac{t_2}{s} = 3{,}41 \quad \Rightarrow \quad t_2 = 3{,}41\,s$$

Riktig svar er den positive tiden. Sandsekken treffer bakken etter 3,41 s.

c) $v(3{,}41\,s) = v_0 + at$

$$= 5{,}00\,\frac{m}{s} - 9{,}81 \cdot 3{,}41\,s$$

$$\underline{\underline{v(3{,}41\,s) = -28{,}5\,\frac{m}{s}}}$$ (nedover; gir mening)

d) Maksimal høyde når $v(t) = 0$

Kan bruke tidlees ligning:

$$2a(x - x_0) = \underset{=0}{v^2} - v_0^2$$

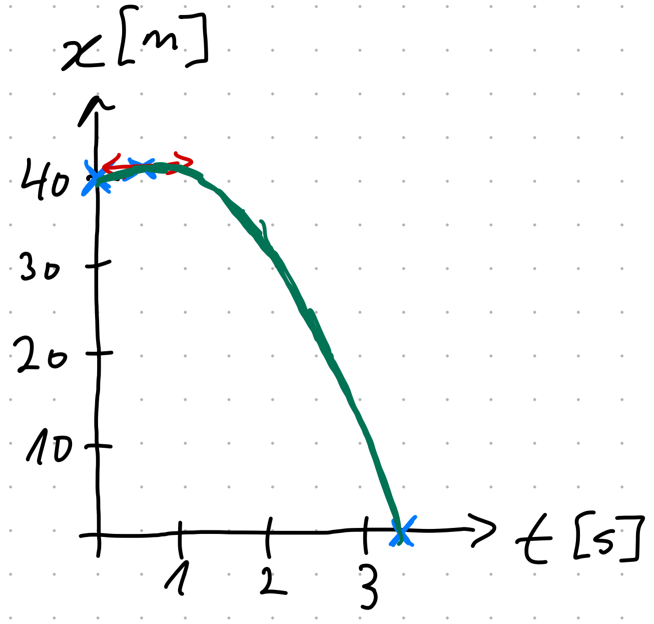
$$x - x_0 = -\frac{v_0^2}{2a}$$

$$x = -\frac{v_0^2}{2a} + x_0 = \frac{v_0^2}{2g} + x_0$$

$$= \frac{\left(5\,\frac{m}{s}\right)^2}{2 \cdot 9{,}81\,\frac{m}{s^2}} + 40\,m = 41{,}27\,m$$

Maksimal høyde over bakken e 41,3 m.

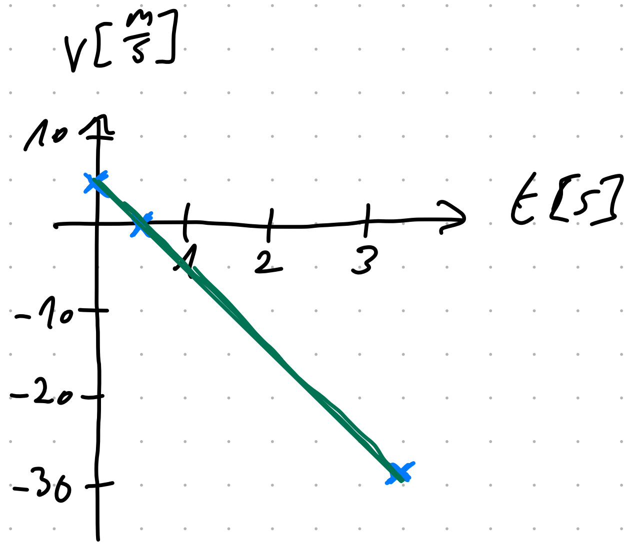
e)

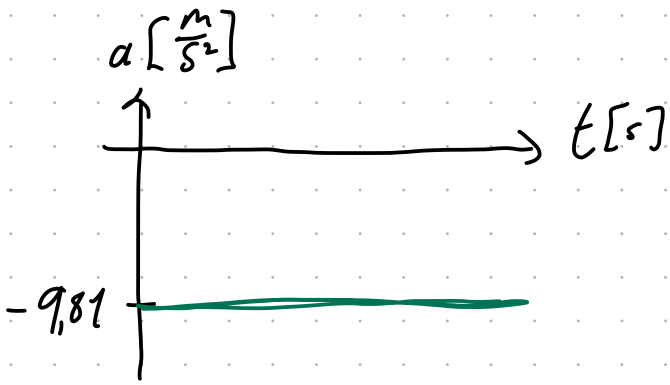


$$v(t) = v_0 + at = 0$$

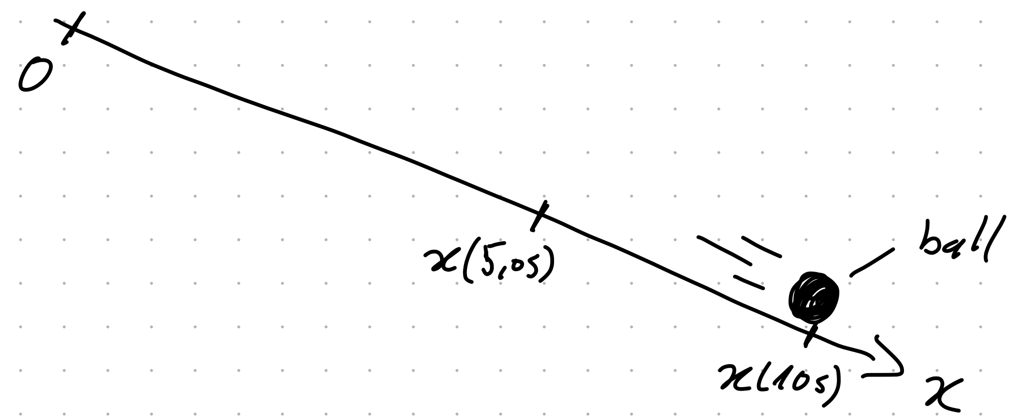
$$\Rightarrow t = -\frac{v_0}{a} = \frac{v_0}{g} = \frac{5\,\frac{m}{s}}{9{,}81\,\frac{m}{s^2}}$$

$$t = 0{,}510\ s$$





1.3



$$x(10s) - x(5{,}0\,s) = 200\ m$$

Konstant akselerasjon:

$$x(t) = \underbrace{x_0}_{=0} + \underbrace{v_0 t}_{=0} + \frac{1}{2}at^2 = \frac{1}{2}at^2$$

$$t = 5{,}0s \Rightarrow x(2t) - x(t) = 200m$$

$$\frac{1}{2}a(2t)^2 - \frac{1}{2}at^2 = 200m$$

$$4\cdot\frac{1}{2}at^2 - \frac{1}{2}at^2 = 200m$$

$$3\cdot\frac{1}{2}at^2 = 200m$$

$$3\cdot x(t) = 200m$$

$$x(t) = \frac{200m}{3} = 67m$$

Ballen trillet 67 m i løpet av de første 5,0 sekundene.

(det finnes sikkert flere måter å løse denne på!)

1.4 $v(t) = \alpha - \beta t^2$

$\alpha = 4{,}00\ m/s$

$\beta = 2{,}00\ m/s^3$

$x(0) = 0$

a) $x(t) = \underbrace{x_0}_{=0} + \int_0^t v(t)\,dt$

$= \int_0^t \alpha - \beta t'^2\, dt' = \left[\alpha t' - \frac{1}{3}\beta t'^3\right]_0^t$

$$\underline{\underline{x(t) = \alpha t - \frac{1}{3}\beta t^3}}$$

$$\underline{\underline{a(t)}} = \frac{dv(t)}{dt} = \underline{\underline{-2\beta t}}$$

b) Maks. x når $v(t) = 0$

$v(t) = \alpha - \beta t^2 = 4{,}00\,\frac{m}{s} - 2{,}00\,\frac{m}{s^3}\cdot t^2 = 0$

$2\,\frac{t^2}{s^2} = 4$

$t^2 = 2s^2$

$t = \sqrt{2}\,s = 1{,}41\,s$ (vil ha positiv verdi av t)

$x(1{,}41s) = 4\frac{m}{s}\cdot 1{,}41s - \frac{1}{3}\cdot 2\,\frac{m}{s^3}\,(1{,}41\,s)^3 = 3{,}77m$

Maksimal positiv forflytning er $3{,}77m$.