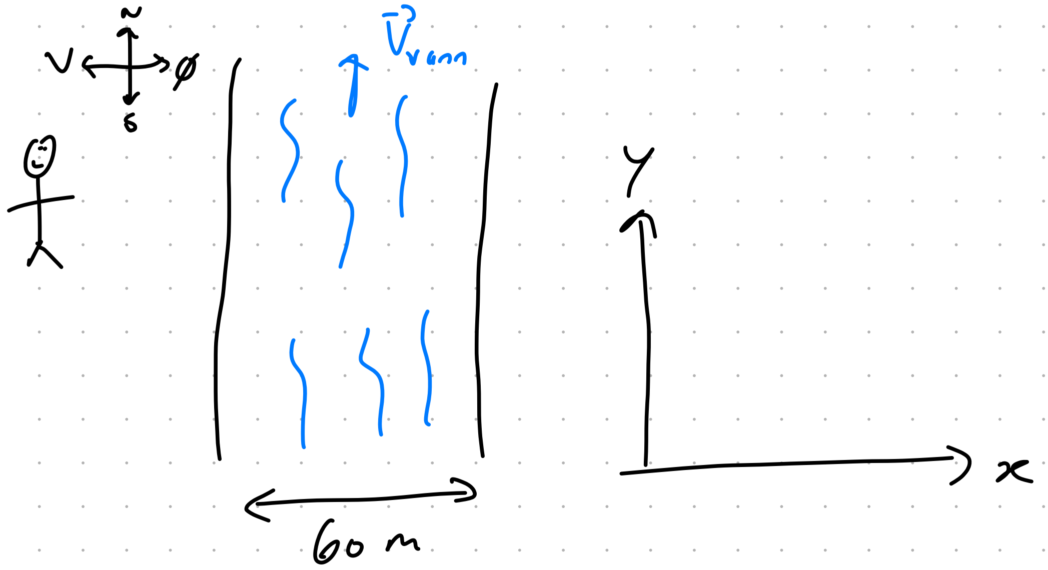
2.1



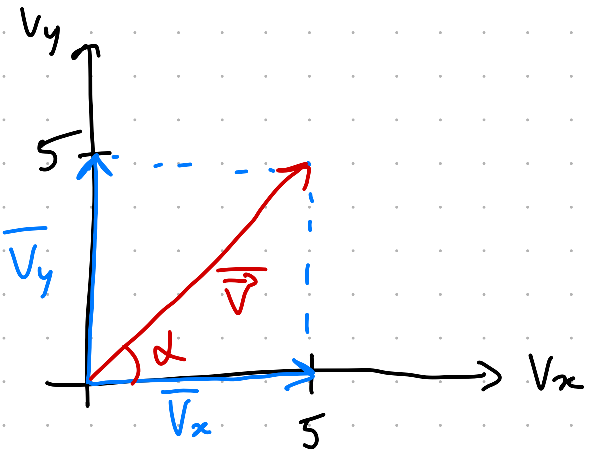
For å krysse elven på kortest mulig tid må fartsvektoren peke rett mot øst, dvs. i x-retning.
Dette er uavhengig av hvilken retning og fart vannet har.
Distansen man beveger seg i vannet blir lengre enn 60m.

2.2 $\vec{r}(t) = \left[4{,}0\ \text{cm} + \left(2{,}5\ \frac{\text{cm}}{\text{s}^2}\right)\cdot t^2,\ \left(5{,}0\ \frac{\text{cm}}{\text{s}}\right)\cdot t\right]$

a) $$\overline{\vec{v}} = \frac{\vec{r}(2{,}0\,\text{s}) - \vec{r}(0\,\text{s})}{2{,}0\,\text{s} - 0}$$

$$= \frac{[14\ \text{cm},\ 10\ \text{cm}] - [4{,}0\ \text{cm},\ 0]}{2{,}0\,\text{s}}$$

$$\overline{\vec{v}} = \left[5{,}0\ \frac{\text{cm}}{\text{s}},\ 5{,}0\ \frac{\text{cm}}{\text{s}}\right]$$



$$\overline{v} = \sqrt{\overline{v}_x^{\,2} + \overline{v}_y^{\,2}} = \sqrt{50}\ \frac{\text{cm}}{\text{s}}$$

$$\underline{\overline{v} = 7{,}1\ \frac{\text{cm}}{\text{s}}}$$

$$\tan\alpha = \frac{\overline{v}_y}{\overline{v}_x} = 1$$

$$\underline{\alpha = 45°}$$

b) $\vec{v}(t) = \frac{d\vec{r}(t)}{dt} = \left[\left(5{,}0\,\frac{cm}{s^2}\right)\cdot t\ ,\ 5{,}0\,\frac{cm}{s}\right]$

$t = 0$:

$v_x = 0 \quad v_y = 5{,}0\,\frac{cm}{s} \quad \underline{v = 5{,}0\,\frac{cm}{s}} \quad \underline{\alpha = 90°}$

$t = 1{,}0\,s$:

$v_x = 5{,}0\,\frac{cm}{s} \quad v_y = 5{,}0\,\frac{cm}{s} \quad \underline{v = 7{,}1\,\frac{cm}{s}} \quad \underline{\alpha = 45°}$

$t = 2{,}0\,s$:

$v_x = 10\,\frac{cm}{s} \quad v_y = 5{,}0\,\frac{cm}{s}$

$v = \sqrt{10^2 + 5^2}\,\frac{cm}{s} = \sqrt{125}\,\frac{cm}{s} = 11{,}18\,\frac{m}{s}$

$\underline{v = 11\,\frac{m}{s}}$

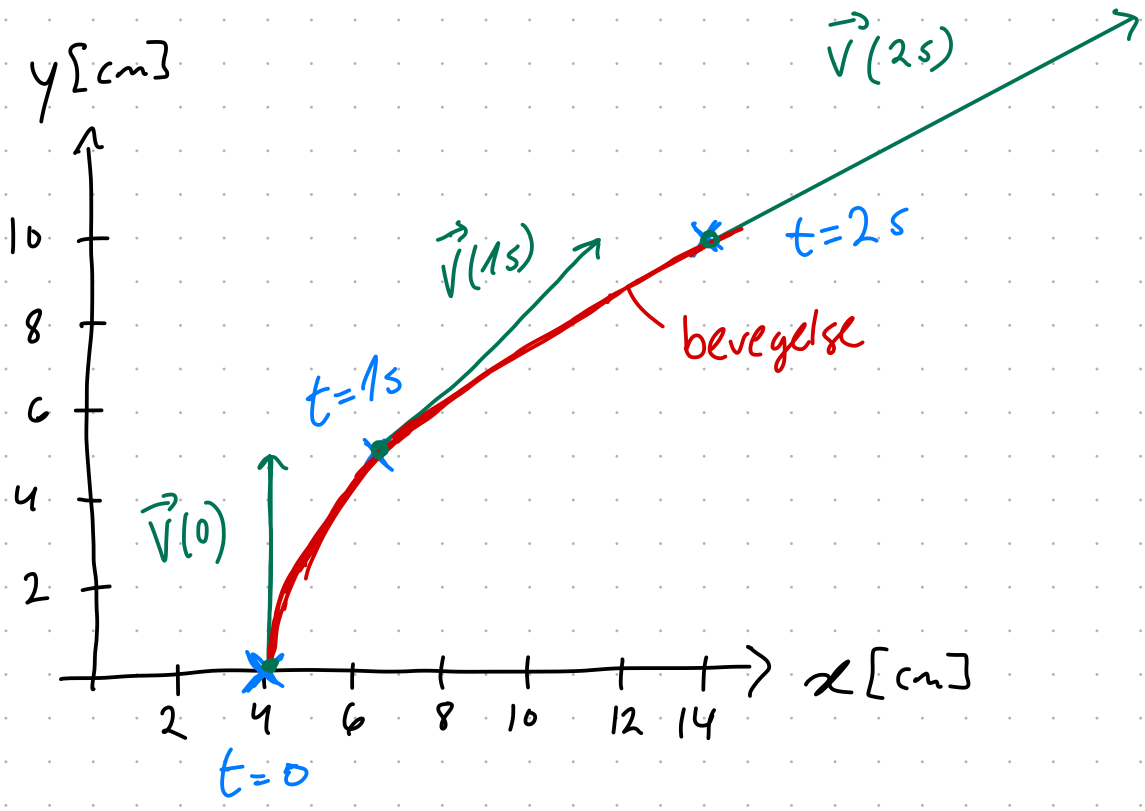
$\tan\alpha = \frac{5}{10} = \frac{1}{2}$

$\underline{\alpha = 27°}$

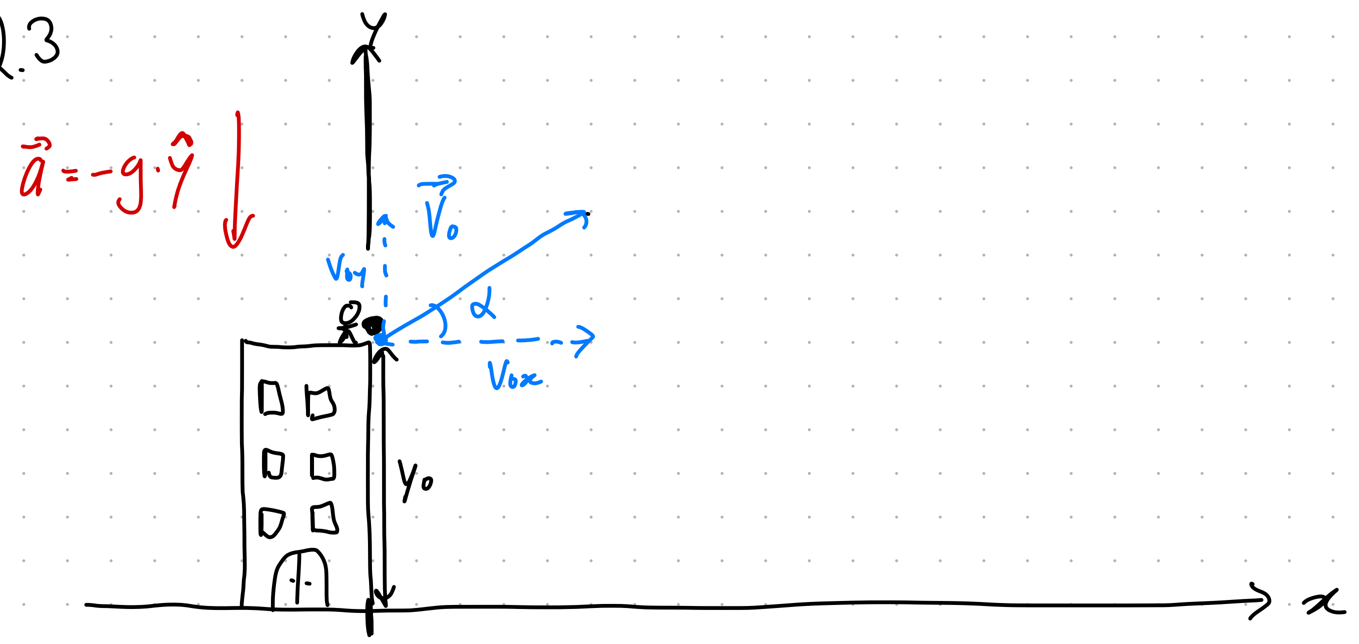
c) $\vec{r}(0) = [4{,}0\text{ cm}, 0]$

$\vec{r}(1s) = [6{,}5\text{ cm}, 5{,}0\text{ cm}]$

$\vec{r}(2s) = [14\text{ cm}, 10\text{ cm}]$



2.3



$y_0 = 15{,}0\,m$

$V_0 = 30{,}0\,\frac{m}{s}$

$\alpha = 33{,}0^\circ$

a) Maks høyde når $V_y = 0$.
Behøver ikke ta hensyn til x.
Kan bruke tidløs formel.

$$2a_y(y - y_0) = V_y^2 - V_{0y}^2$$

$a_y = -g$, $y = ?$, $V_{0y} = V_0 \sin\alpha$, $y_0 = 0$

utgangsposisjon

$$-2gy = -V_0^2 \sin^2\alpha$$

$$y = \frac{V_0^2 \sin^2\alpha}{2g} = \frac{(30\,\frac{m}{s})^2 \cdot \sin^2 33^\circ}{2 \cdot 9{,}81\,\frac{m}{s^2}} = 13{,}61\,m$$

$\underline{y_{maks} = 13{,}6\ m \text{ over utgansposisjonen}}$

b) Stein treffer bakken når $y=0$.
Det spørres ikke etter tid → tidløs formel

$$2a_y(y-y_0) = v_y^2 - v_{0y}^2$$

$$a_y = -g \;,\; y=0 \;,\; v_{0y} = v_0 \sin\alpha \,,\; y_0 = 15\,m$$

$$2gy_0 = v_y^2 - v_{0y}^2$$

$$v_y = \sqrt{2gy_0 + (v_0 \cdot \sin\alpha)^2}$$

$$= \sqrt{2 \cdot 9{,}81\,\frac{m}{s^2} \cdot 15\,m + \left(30\,\frac{m}{s} \cdot \sin 33^\circ\right)^2}$$

$$v_y = 23{,}7\,\frac{m}{s}$$

$$v_x = v_{0x} = 30\,\frac{m}{s} \cdot \cos 33^\circ = 25{,}2\,\frac{m}{s}$$

(ingen akselerasjon i x-retning)

$$\underline{v} = \sqrt{v_x + v_y} = \sqrt{25{,}2^2 + 23{,}7^2}\,\frac{m}{s} = \underline{34{,}6\,\frac{m}{s}}$$

c) Vi bruker vertikal bevegelse for å finne tiden steinen er i luften.

$$y = y_0 + V_{0y} \cdot t + \frac{1}{2} a t^2$$

$y = 0$, $y_0 = 15\,m$, $V_{0y} = V_0 \cdot \sin \alpha$, $a = -g$

$$-\frac{g}{2} t^2 + V_0 \cdot \sin \alpha \cdot t + y_0 = 0$$

$$-4{,}905 \frac{m}{s^2} \cdot t^2 + 30 \frac{m}{s} \cdot \sin 33° \cdot t + 15\,m = 0$$

$$t = 4{,}081\,s$$

Nå kan vi finne x.

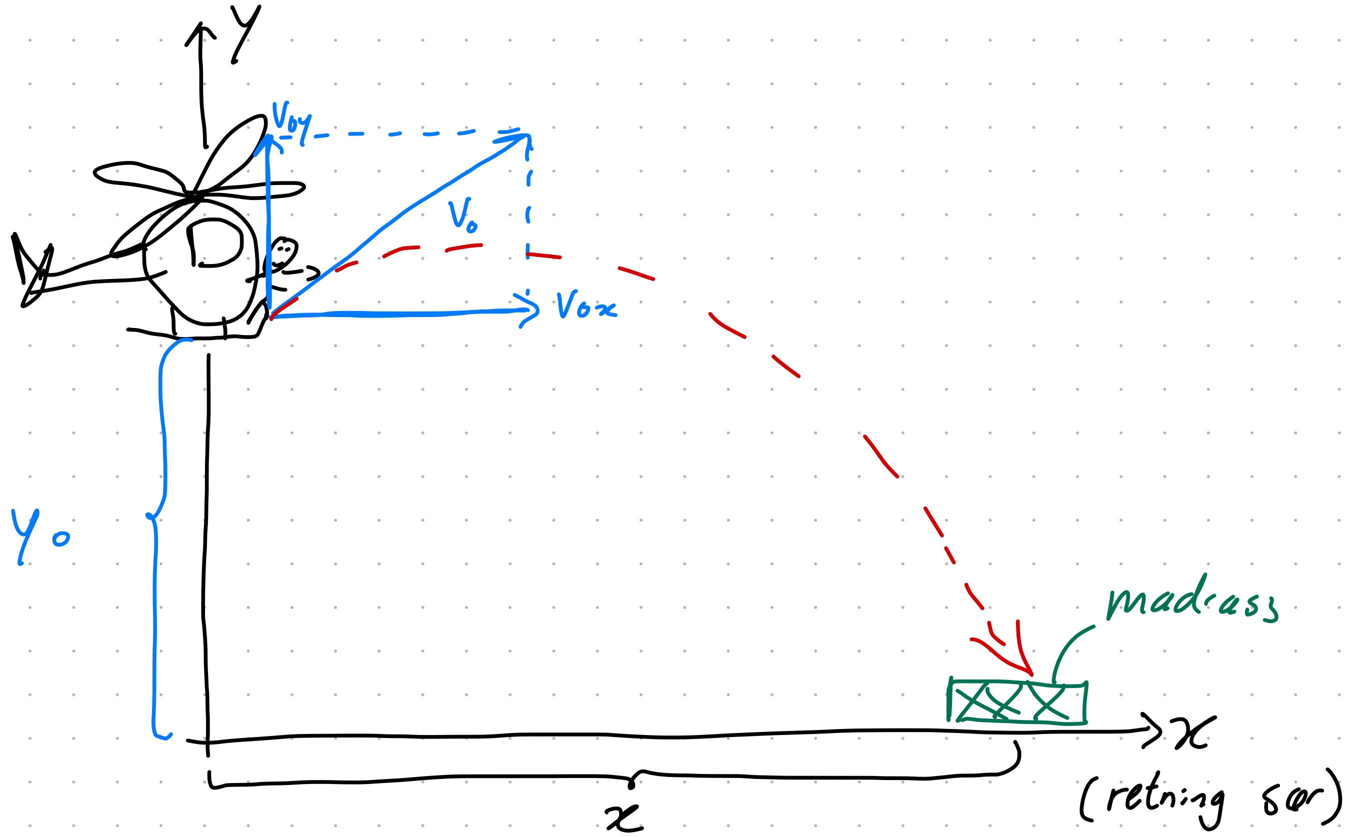
$$x = x_0 + V_{0x} t + \frac{1}{2} a t^2$$

$x_0 = 0$, $a = 0$

$$x = V_{0x} \cdot t = 30 \frac{m}{s} \cdot \cos 33° \cdot 4{,}081\,s = 102{,}7\,m$$

$$\underline{x = 103\,m}$$

2.4



a) Dette er samme bevegelse som skrått kast.
Personens startfart er farten til helikopteret.
Vi finner tiden v.h.a vertikal bevegelse.

$$y = y_0 + v_{0y} \cdot t + \frac{1}{2}at^2$$

$$y = 0 \;,\; y_0 = 30\,m \;,\; v_{0y} = 10\,\frac{m}{s} \;,\; a = -g$$

$$-\frac{g}{2}t^2 + v_{0y} \cdot t + y_0 = 0$$

$$-4{,}905\,\frac{m}{s^2}\,t^2 + 10\,\frac{m}{s} \cdot t + 30\,m = 0$$

$$t = 3{,}6943\,s$$

Nå kan vi finne x:

$$x = x_0 + v_{0x}t + \frac{1}{2}at^2 = 0 + 15\,\frac{m}{s} \cdot 3{,}6943\,s + 0 = 55{,}4\,m$$

Madrassen bør ligge 55,4 m sør for helikopteret.

b)

y_{maks} når $V_y = 0$

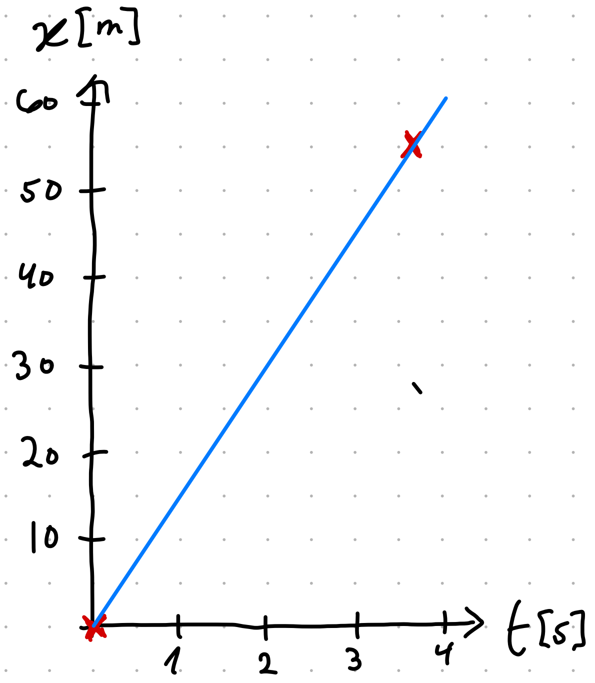
$$V_y = V_{0y} + at = V_{0y} - gt$$

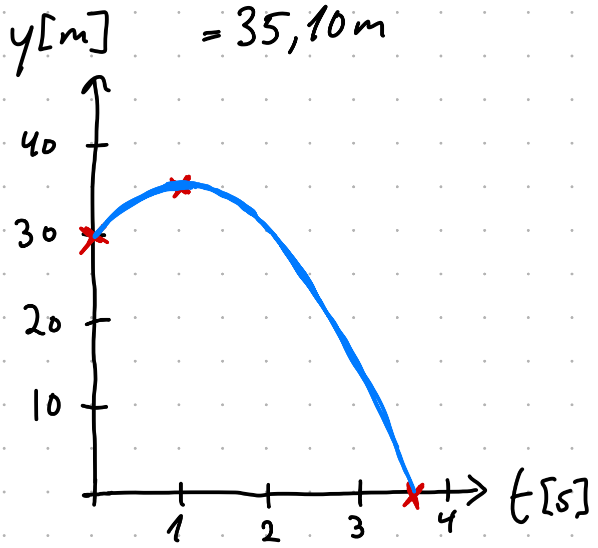
$$t = \frac{10\frac{m}{s}}{9{,}81\frac{m}{s^2}} = 1{,}019s$$

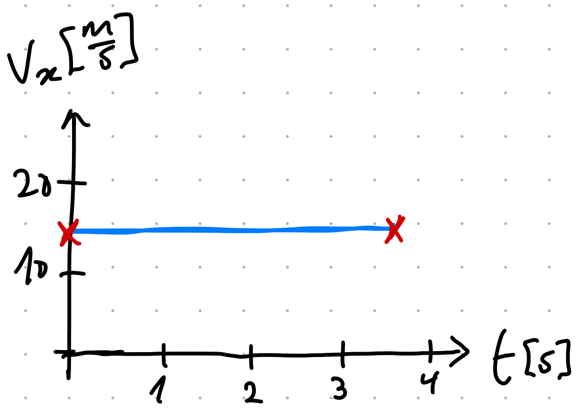
$$y_{maks} = y_0 + V_{0y} \cdot t + \frac{1}{2}at^2$$

$$= 30m + 10\frac{m}{s} \cdot 1{,}019s - \frac{9{,}81\frac{m}{s^2}}{2}(1{,}019s)^2$$

$$= 35{,}10m$$







$$V_y(3{,}6943s) = 10\frac{m}{s} - 9{,}81\frac{m}{s^2} \cdot 3{,}6943s$$

$$= -26{,}2\frac{m}{s}$$