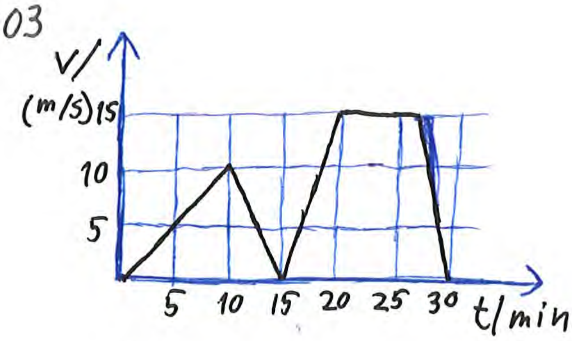
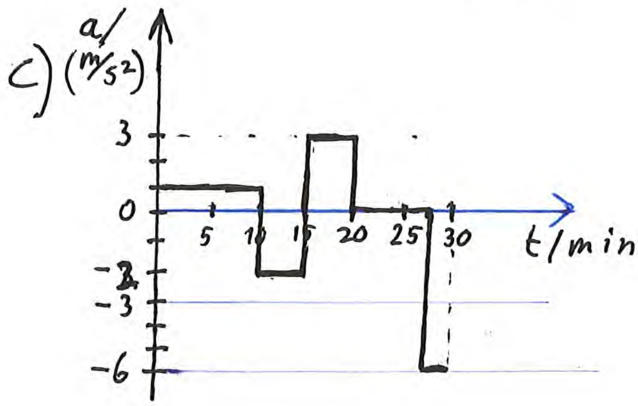
12.303



a) Fra $t = 20\,\text{min}$ til $t = 27{,}5\,\text{min}$

b) Fra $t = 10\,\text{min}$ til $t = 15\,\text{min}$ og fra $t = 27{,}5\,\text{min}$ til $t = 30\,\text{min}$

c)



$$a_1 = \frac{\Delta v_1}{\Delta t_1} = \frac{(10-0)\frac{m}{s}}{(10-0)\cdot 60\,s} = 1{,}0\,\frac{m}{s^2}$$

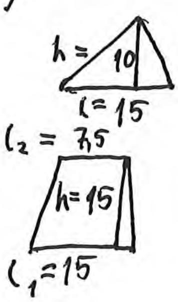
$$a_2 = \frac{\Delta v_2}{\Delta t_2} = \frac{(0-10)\frac{m}{s}}{(15-10)\cdot 60\,s} = -2{,}0\,\frac{m}{s^2}$$

$$a_3 = \frac{\Delta v_3}{\Delta t_3} = \frac{(15-0)\frac{m}{s}}{(20-15)\cdot 60\,s} = 3{,}0\,\frac{m}{s^2}$$

$$a_4 = \frac{\Delta v_4}{\Delta t_4} = \frac{(15-15)\frac{m}{s}}{(30-15)\cdot 60\,s} = 0$$

$$a_5 = \frac{\Delta v_5}{\Delta t_5} = \frac{(0-15)\frac{m}{s}}{(30-27{,}5)\cdot 60\,s} = -6{,}0\,\frac{m}{s^2}$$

d) $t = 30\,\text{min}$



$$A_1 = \tfrac{1}{2} l \cdot h = \tfrac{1}{2}\cdot 15\cdot 60\,s\cdot 10\,\frac{m}{s} = 4500\,m$$

$$A_2 = (l_1 + l_2)\cdot \tfrac{1}{2}\cdot h = (15 + 7{,}5)\cdot 60\,s\cdot \tfrac{1}{2}\cdot 15\,\frac{m}{s} = 10125\,m$$

$$A = A_1 + A_2 = (4500 + 10125)\,m = 14625\,m$$

$$\underline{s = 15\,km}$$

12.311 $s(t) = 9{,}75\,cm + 1{,}50\,\frac{cm}{s^3}\cdot t^3$

a) $[2{,}00\,s, 3{,}00\,s]$

$$s_1(2{,}00\,s) = 9{,}75\,cm + 1{,}50\,\frac{cm}{s^3}\cdot(2{,}00\,s)^3 = 21{,}75\,cm$$

$$s_2(3{,}00\,s) = 9{,}75\,cm + 1{,}50\,\frac{cm}{s^3}\cdot(3{,}00\,s)^3 = 50{,}25\,cm$$

$$\bar{v} = \frac{\Delta s}{\Delta t} = \frac{s_2 - s_1}{t_2 - t_1} = \frac{(50{,}25 - 21{,}75)\,cm}{(3{,}00 - 2{,}00)\,s} = \underline{28{,}5\,\frac{cm}{s}}$$

b) $v(t) = s'(t) = 0 + 3\cdot 1{,}50\,\frac{cm}{s^3}\cdot t^2 = 4{,}50\,\frac{cm}{s^3}\cdot t^2$

$t = 2{,}00\,s$: $v(2{,}00\,s) = 4{,}50\,\frac{cm}{s^3}\cdot(2{,}00\,s)^2 = \underline{18{,}0\,\frac{cm}{s}}$

$v(2{,}50\,s) = 4{,}50\,\frac{cm}{s^3}\cdot(2{,}50\,s)^2 = \underline{28{,}1\,\frac{cm}{s}}$

$v(3{,}00\,s) = 4{,}50\,\frac{cm}{s^3}\cdot(3{,}00\,s)^2 = \underline{40{,}5\,\frac{cm}{s}}$

12.311 c) $s = s_1 + \frac{(s_3 - s_2)}{2} = 21{,}75\,cm + \frac{(50{,}25 - 21{,}75)\,cm}{2}$

$= 36{,}00\,cm$

$36{,}00\,cm = 9{,}75\,cm + 1{,}50\,\frac{cm}{s^3} \cdot t^3$

$(36{,}00 - 9{,}75)\,cm = 1{,}50\,\frac{cm}{s^3} \cdot t^3$

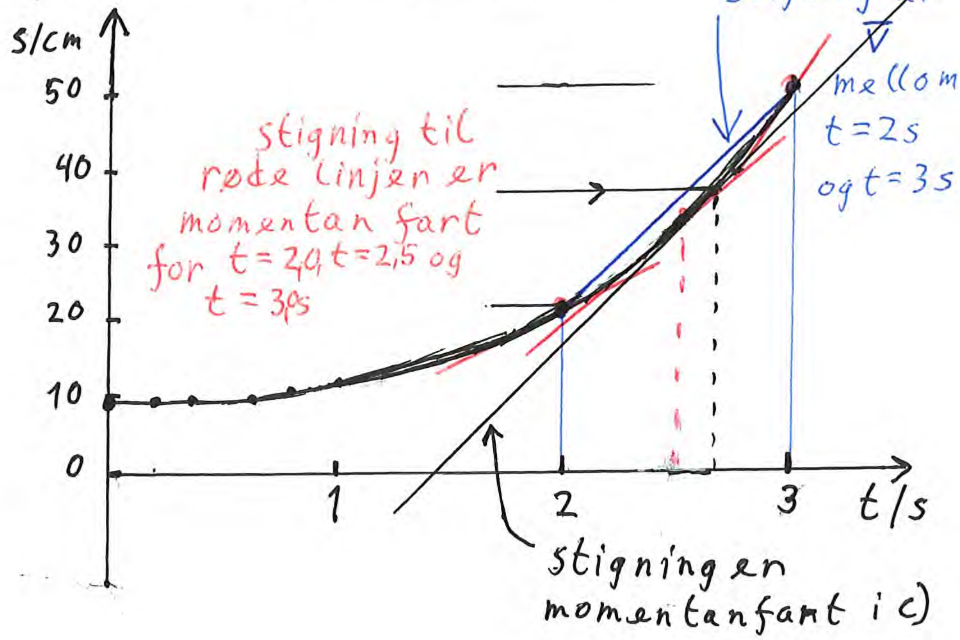
$\frac{26{,}25\,cm}{1{,}50\,\frac{cm}{s^3}} = t^3$

$t = \sqrt[3]{17{,}5\,s^3} = 2{,}5962\,s$

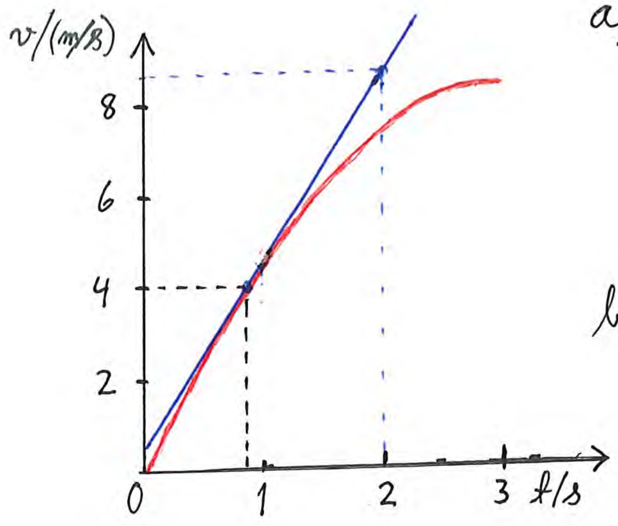
$v(2{,}5962\,s) = 4{,}50\,\frac{cm}{s^3} \cdot (2{,}5962\,s)^2 = \underline{30{,}3\,\frac{cm}{s}}$

d)

t/s	s/cm
0	9,75
0,2	9,762
0,4	9,846
0,6	10,074
0,8	10,518
1,0	11,25
1,2	12,342
1,4	13,866
1,6	15,894
1,8	18,498
2,0	21,75
2,2	25,722
2,4	30,486
2,6	36,114
2,8	42,678
3,0	50,25



12.313+



a)

$$a = \frac{(8{,}6 - 4{,}0)\,\frac{m}{s}}{(2{,}0 - 0{,}80)\,s} \approx \underline{3{,}8\,\frac{m}{s^2}}$$

b)

list1	0	0.25	0.5	0.75	1	1.25	1.5	1.75 osv
list2	0	1.3	2.5	3.5	4.5	5.3	6	6.6

Casio: Sett listeverdiene inn i LIST og bruk STAT til å tegne punktene og funksjonen. Velg GRPH, GPH1 og X^2

$a = -0{,}866$

$b = 5{,}28$

$c = 0{,}03$

$y = ax^2 + bx + c$

$v(t) = -0{,}866 \cdot t^2 + 5{,}28 \cdot t + 0{,}03$

$\underline{a(t) = v'(t) = -0{,}866 \cdot 2 \cdot t + 5{,}28}$

altså er aks. en lineær funksjon av tiden.

$v'(t) = a(t) = 0$ ved størst fart

$0 = -0{,}866 \cdot 2 \cdot t + 5{,}28$

$1{,}732 \cdot t = 5{,}28$

$t = \frac{5{,}28}{1{,}732} = 3{,}048$

og $v(3{,}048) =$

$-0{,}866 \cdot 3{,}048^2 + 5{,}28 \cdot 3{,}048 + 0{,}03$

$= 8{,}078$

Dvs $\underline{v = 8{,}1\,\frac{m}{s}}$

c) $s_{tot} = 100\,m$ og $s_2 = s_{tot} - s_1$

$$s_1 = \int_0^{3{,}048} v(t)\,dt = \int_0^{3{,}048} \left[-0{,}866 \cdot t^2 + 5{,}28 \cdot t + 0{,}03\right] dt$$

$$= \left[-0{,}866 \cdot \tfrac{1}{3} t^3 + 5{,}28 \cdot \tfrac{1}{2} t^2 + 0{,}03t\right]_0^{3{,}048}$$

$$= \left[-0{,}866 \cdot \tfrac{1}{3} \cdot 3{,}048^3 + 5{,}28 \cdot \tfrac{1}{2} \cdot 3{,}048^2 + 0{,}03 \cdot 3{,}048\right] - 0$$

$= 16{,}44$ som gir $s_2 = 100 - 16{,}44 = 83{,}56$

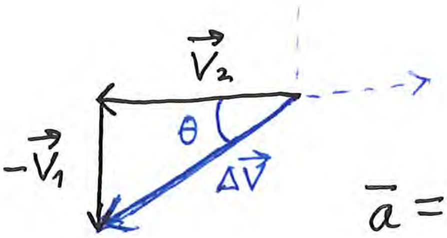
og $s_2 = v_2 \cdot t_2 \Rightarrow t_2 = \frac{s_2}{v_2} = \frac{83{,}56\,m}{8{,}1\,\frac{m}{s}} = 10{,}316\,s$

og $t_{tot} = 3{,}048\,s + 10{,}316\,s = 13{,}364\,s = \underline{13\,s}$

12.316

$t = 8{,}0\,s \qquad \vec{V}_1 = 12\,\frac{m}{s}$ nord

$\vec{V}_2 = 16\,\frac{m}{s}$ vest



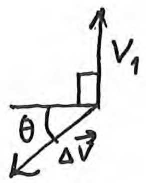
$$\Delta V = \sqrt{V_1^2 + V_2^2} = \sqrt{12^2 + 16^2}\,\frac{m}{s} = \underline{20\,\frac{m}{s}}$$

$$\bar{a} = \frac{\Delta V}{t} = \frac{20\,\frac{m}{s}}{8{,}0\,s} = \underline{2{,}5\,\frac{m}{s^2}}$$

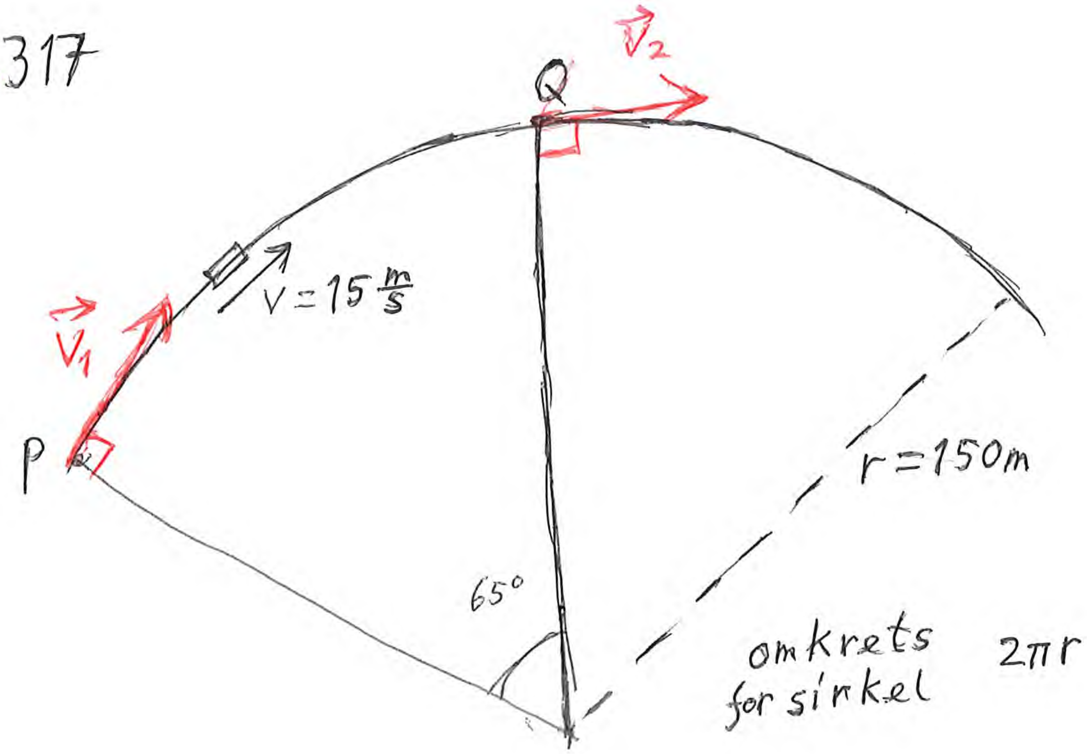
$$\tan\theta = \frac{V_1}{V_2}$$

$$\theta = \tan^{-1}\left(\frac{V_1}{V_2}\right) = \tan^{-1}\left(\frac{12\,\frac{m}{s}}{16\,\frac{m}{s}}\right) = \underline{37^\circ}$$ i sørvestlig retning

Det vil si $90^\circ + 37^\circ$ = 127° med den opprinnelige fartsretningen.



12.317



12,317.

a) $s = v \cdot t$

$$\frac{65^\circ}{360^\circ} \cdot 2\pi r = 15\tfrac{m}{s} \cdot t$$

$$\frac{65 \cdot 2\pi \cdot 150\,m}{360 \cdot 15\,\frac{m}{s}} = t$$

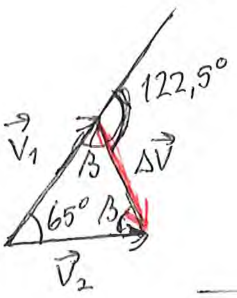
$$\frac{13\cancel{0}\,\pi \cdot \cancel{15} \cdot 10\,m}{36\cancel{0} \cdot \cancel{15}\,\frac{m}{s}} = t$$

$$\frac{130\pi}{36}\,s = t$$

$$t = 11{,}34\,s$$

$$\underline{t = 11\,s}$$

$$s = \frac{65}{360} \cdot 2\pi r$$



$$180^\circ = 65^\circ + 2 \cdot \beta$$

$$115^\circ = 2 \cdot \beta$$

$$\beta = \frac{115^\circ}{2}$$

$$\beta = 57{,}5^\circ$$

$$\angle(\Delta\vec{V}, \vec{V}_1) = 180^\circ - \beta$$

$$= \underline{122{,}5^\circ}$$ målt i forhold til $\vec{V}_1$ sin retning

b) $$\bar{a} = \frac{\Delta\vec{V}}{\Delta t} = \frac{16{,}118\,\frac{m}{s}}{11{,}34\,s}$$

$$= 1{,}421\,\frac{m}{s^2}$$

$$= \underline{1{,}4\,\frac{m}{s^2}}$$

cosinussetningen

$$(\Delta V)^2 = V_1^2 + V_2^2 - 2V_1 \cdot V_2 \cdot \cos\alpha$$

$$\Delta V = \sqrt{V_1^2 + V_2^2 - 2V_1 \cdot V_2 \cdot \cos 65^\circ}$$

$$= \sqrt{(15\tfrac{m}{s})^2 + (15\tfrac{m}{s})^2 - 2 \cdot (15\tfrac{m}{s})^2 \cdot \cos 65^\circ}$$

$$= 15\tfrac{m}{s}\sqrt{1 + 1 - 2 \cdot \cos 65^\circ}$$

$$= 15\tfrac{m}{s}\sqrt{2 - 2 \cdot \cos 65^\circ} = 16{,}118\,\frac{m}{s}$$

c)

$$a_{gammel} = \frac{\Delta V}{\Delta t}$$

$$a_{ny} = \frac{2\Delta V}{\frac{1}{2}\Delta t} = 4\frac{\Delta V}{\Delta t} = \underline{4a_{gammel}}$$

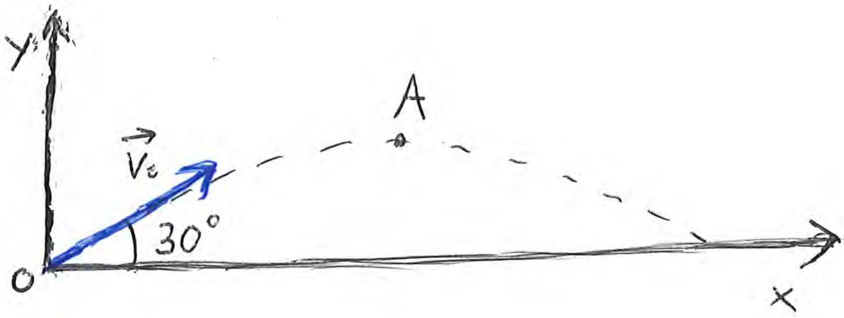
d) $v = 15\frac{m}{s}$ $\qquad r_{ny} = \frac{1}{2} \cdot r$

$$\Delta t_{ny} = \frac{1}{2}\Delta t$$

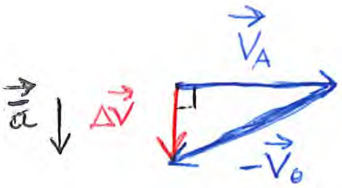
$$a_{ny} = \frac{\Delta V}{\frac{1}{2}\Delta t} = 2 \cdot \frac{\Delta V}{\Delta t} = 2 \cdot a_{gammel}$$

$$= 2 \cdot 1{,}421\,\frac{m}{s} = \underline{2{,}8\,\frac{m}{s^2}}$$

12.318



a) $\Delta\vec{v} = ?$ $\qquad v_A = v_{0x} = v_0 \cdot \cos 30^\circ = \frac{\sqrt{3}}{2} \cdot v_0$



$$\Delta\vec{v} = \vec{v}_A - \vec{v}_0$$

$$|\Delta v| = \sqrt{v_0^2 - v_A^2} = \sqrt{v_0^2 - \left(\frac{\sqrt{3}}{2} v_0\right)^2}$$

$$= v_0 \cdot \sqrt{1 - \frac{3}{4}} = v_0 \cdot \sqrt{\frac{1}{4}} = \frac{v_0}{2}$$

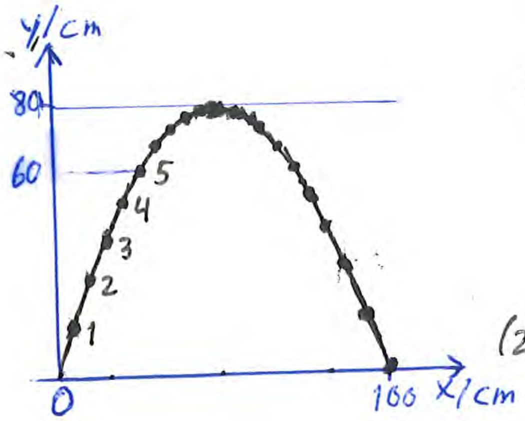
$$= \frac{1}{2} \cdot 21{,}7 \, \frac{m}{s} = 10{,}85 \, \frac{m}{s}$$

$|\Delta\vec{v}| = 10{,}9 \, \frac{m}{s}$ dvs $\underline{11 \, \frac{m}{s}}$ med to siffers nøyaktighet som i 30°

Retningen er rett nedover (se tegning)

b) $t = 1{,}1 \, s$ $\qquad \bar{a} = \frac{\Delta v}{\Delta t} = \frac{10{,}85}{1{,}1} \, \frac{m}{s^2} = \underline{9{,}9 \, \frac{m}{s^2}}$ rett nedover

12.319



a) Det går $\Delta t = 40 \cdot 10^{-3}$ s mellom hvert punkt.

Total tid t for kastet blir da $t = 20 \cdot \Delta t = 0{,}80$ s

(20 punktforflyningen fra start til slutt.)

Total strekning i x-retning er $S_x = 1{,}00$ m

Farten $V_x = \frac{S_x}{t} = \frac{1{,}00\,m}{0{,}80\,s}$

$= 1{,}25 \frac{m}{s}$

$= \underline{\underline{1{,}3 \frac{m}{s}}}$

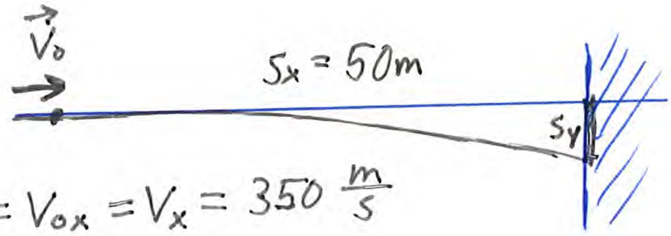
b) $y = 60$ cm for

$t_1 = 5 \cdot \Delta t = \underline{0{,}20\,s}$

og for $t_2 = 15 \cdot \Delta t = \underline{0{,}60\,s}$

(Vi teller antall punktforflytninger)

12.322



$V_0 = V_{0x} = V_x = 350 \frac{m}{s}$

$S_x = V_x \cdot t$

$t = \frac{S_x}{V_x} = \frac{50\,m}{350 \frac{m}{s}} = 0{,}1428\,s$

$S_y = V_{0y} \cdot t + \frac{1}{2} a_y t^2$ og $V_{0y} = 0$

$+\Downarrow$ $S_y = \frac{1}{2} g t^2 = \frac{1}{2} \cdot 9{,}81 \frac{m}{s^2} \cdot (0{,}1428\,s)^2 = \underline{0{,}10\,m}$

12,325 $V_x = V_0 = 8{,}0 \cdot 10^6 \frac{m}{s}$

$V_y = V_{0y} + at$

$S_x = V_{0x} \cdot t$

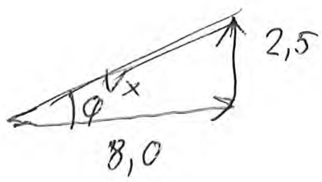
$\frac{S_x}{V_{0x}} = t$

$t = \frac{20 \cdot 10^{-3} m}{8{,}0 \cdot 10^6 \frac{m}{s}} = 2{,}5 \cdot 10^{-9} s$

$V_y = 0 + 1{,}0 \cdot 10^{15} \frac{m}{s^2} \cdot 2{,}5 \cdot 10^{-9} s = 2{,}5 \cdot 10^6 \frac{m}{s}$

$V = \sqrt{V_x^2 + V_y^2}$

$= \sqrt{8{,}0^2 + 2{,}5^2} \cdot 10^6 \frac{m}{s} = \underline{8{,}4 \cdot 10^6 \frac{m}{s}}$



$\tan\varphi = \frac{2{,}5}{8{,}0}$

$\varphi = \tan^{-1}\left(\frac{2{,}5}{8{,}0}\right) = \underline{17^\circ}$

12,327 $V_0 = 180 \frac{km}{h} = 180 \frac{1000 m}{3600 s} = 50 \frac{m}{s}$

$h = 45 m$

$S_x = V_x \cdot t = V_0 \cdot t$

$= 50 \frac{m}{s} \cdot 3{,}028 s$

$= 151 m = \underline{0{,}15 km}$

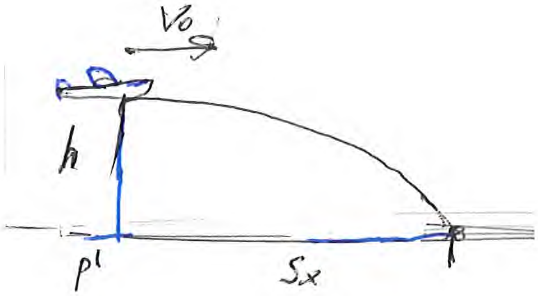
$S_y = \cancel{V_{0y} t} + \frac{1}{2} g_y t^2$ $\Downarrow +$

$h = \frac{1}{2} g t^2$

$2h = g t^2$

$\frac{2h}{g} = t^2$

$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \cdot 45 m}{9{,}81 \frac{m}{s^2}}} = 3{,}028 s$



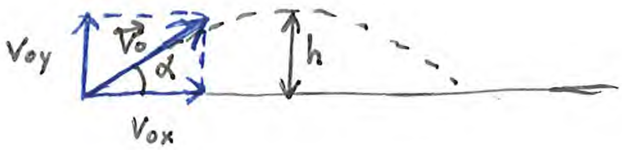
12,328 $2 g s_y = \cancel{V^2} - V_{0y}^2$

$s_y = \frac{-V_{0y}^2}{2g}$

$V_{0y} = V_0 \cdot \sin 52^\circ$

osv.

12.329 $v_0 = 40\,\frac{m}{s}$ $\alpha = 35^\circ$



a) $v_{ox} = v_0 \cdot \cos\alpha$
$= 40\,\frac{m}{s} \cdot \cos 35^\circ$
$= \underline{33\,\frac{m}{s}}$ $\left(32{,}76\,\frac{m}{s}\right)$

b) $v_{oy} = v_0 \cdot \sin\alpha$
$= 40\,\frac{m}{s} \cdot \sin 35^\circ$
$= \underline{23\,\frac{m}{s}}$ $\left(22{,}94\,\frac{m}{s}\right)$

c) $v_y = 0$ i toppen

$v_y = v_{oy} + a_y \cdot t$

$+\Uparrow$ $0 = v_{oy} - gt$ der $g = 9{,}81\,\frac{m}{s^2}$

$gt = v_{oy}$

$t = \frac{v_{oy}}{g} = \frac{22{,}94\,\frac{m}{s}}{9{,}81\,\frac{m}{s^2}} = \underline{2{,}3\,s}$ $(2{,}338\,s)$

d) $v_x = v_{ox} = \underline{33\,\frac{m}{s}}$

e) $s_y = v_{oy} \cdot t + \frac{1}{2} a_y \cdot t^2$

$s_y = 22{,}94\,\frac{m}{s} \cdot 2{,}338\,s + \frac{1}{2} \cdot \left(-9{,}81\,\frac{m}{s^2}\right) \cdot (2{,}338\,s)^2 = \underline{27\,m}$
$(26{,}82\,m)$

f) $s_y = 0$ der ballen lander.

og $s_y = v_{oy} \cdot t + \frac{1}{2} a_y \cdot t^2$

$0 = v_{oy} \cdot t + \frac{1}{2} a_y \cdot t^2$

$0 = t \cdot \left(v_{oy} + \frac{1}{2} a_y \cdot t\right)$ og $t \neq 0$

Dette betyr at $v_{oy} + \frac{1}{2} a_y \cdot t = 0$

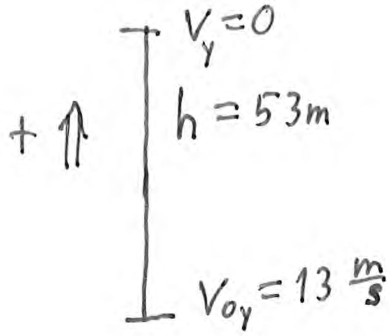
$\frac{1}{2} a_y \cdot t = -v_{oy}$

$t = \frac{-2 v_{oy}}{a_y} = \frac{-2 \cdot 22{,}94\,\frac{m}{s}}{-9{,}81\,\frac{m}{s^2}}$

$= 4{,}676\,s$

$s_x = v_{ox} \cdot t = 32{,}76\,\frac{m}{s} \cdot 4{,}676\,s = \underline{0{,}15\,km}$ $(153\,m)$

12.330 a)



$$2a_y \cdot s_y = v_y^2 - v_{0y}^2$$

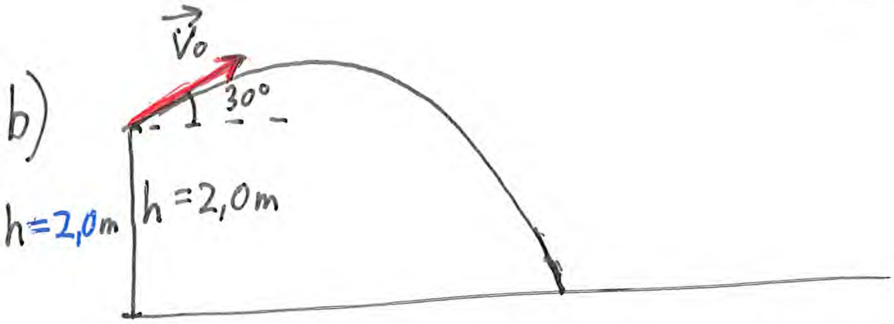
$$2a_y \cdot h = -v_{0y}^2$$

$$a_y = \frac{-v_{0y}^2}{2h} = \frac{-(13\frac{m}{s})^2}{2 \cdot 53m}$$

$$a_y = -1{,}594\frac{m}{s^2}$$

dvs. $\underline{g_M = 1{,}6\frac{m}{s^2}}$

b)



$$v_{0y} = v_0 \cdot \sin 30° = 13\frac{m}{s} \cdot \sin 30° = 6{,}500\frac{m}{s}$$

og $v_y = 0$ i toppen

$+\Uparrow$

$$2a_y \cdot s_y = \cancel{v_y^2} - v_{0y}^2$$

$$s_y = \frac{-v_{0y}^2}{2a_y} = \frac{-(6{,}500\frac{m}{s})^2}{2 \cdot (-1{,}594\frac{m}{s^2})} = 13{,}25m$$

Total høyde: $s = h + s_y = 2{,}0m + 13{,}25m = \underline{15m}$

c) $s_y = v_{0y} \cdot t + \frac{1}{2}a_y \cdot t^2$

$$-2{,}0m = 6{,}500\frac{m}{s} \cdot t + \frac{1}{2} \cdot (-1{,}594\frac{m}{s^2}) \cdot t^2$$

$$-2{,}0 = 6{,}500 \cdot t - 0{,}797 \cdot t^2$$

$$0{,}797 \cdot t^2 - 6{,}500 \cdot t - 2{,}0 = 0$$

$$t = 8{,}452s \vee \cancel{t = -0{,}296s}$$

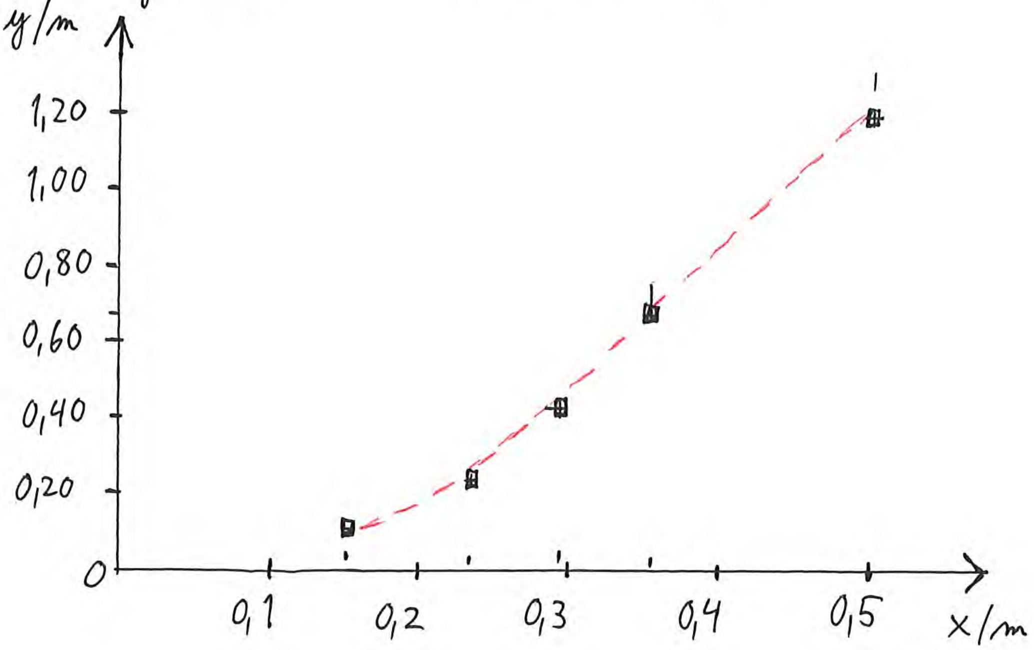
$$s_x = v_{0x} \cdot t = v_0 \cdot (\cos 30°) t = 13\frac{m}{s} \cdot (\cos 30°) \cdot 8{,}452s$$

$$= \underline{95m}$$

12.331+

x/m	0,151	0,232	0,295	0,361	0,498
y/m	0,11	0,22	0,41	0,66	1,20

$y = kx^n$ n et heltall



$y = kx^2$ med $k = 4{,}8$ passer godt
$n = 2$

$y = 4{,}8x^2$ $y = \frac{1}{2}at^2$ er en mulighet

Hvis vi tar med punktet $x=0, y=0$ vil vi få

$y = 5{,}0x^2$. Det ser dermed ut til å være et fritt fall med $y = \frac{1}{2} \cdot 9{,}81 \frac{m}{s^2} \cdot t^2 = 4{,}9 \cdot 5 \cdot t^2$ som er forsøket.

12.332+

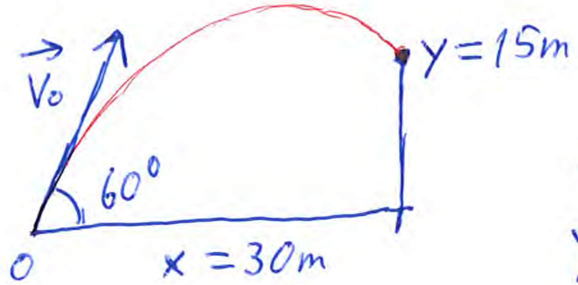
B blir truffet først ettersom maks høyde under et fritt fall avgjør tiden for fallet/kastet.
Bevegelsen i x-retning er som kjent uavhengig av bevegelsen i y-retning i et kast.

12.333+

$V_0 = ?$ $\quad a_y = -9{,}81\,\frac{m}{s^2}$

$V_{0y} = V_0 \cdot \sin 60^\circ = V_0 \cdot \frac{\sqrt{3}}{2}$

$V_{0x} = V_0 \cdot \cos 60^\circ = V_0 \cdot \frac{1}{2}$



$x = V_{0x} \cdot t \Rightarrow t = \frac{x}{V_{0x}}$

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

$$y = V_{0y} \cdot \left(\frac{x}{V_{0x}}\right) + \frac{1}{2} a_y \cdot \left(\frac{x}{V_{0x}}\right)^2$$

$$15 = \frac{\cancel{V_0} \cdot \frac{\sqrt{3}}{2} \cdot 30}{\cancel{V_0} \cdot \frac{1}{2}} + \frac{1}{2} \cdot (-9{,}81) \cdot \frac{30^2}{V_0^2 \cdot \left(\frac{1}{2}\right)^2}$$

$$15 = 30 \cdot \sqrt{3} - 4{,}905 \cdot \frac{900 \cdot 4}{V_0^2} \quad \Big| \cdot V_0^2$$

$$15 \cdot V_0^2 = 30\sqrt{3} \cdot V_0^2 - 4{,}905 \cdot 3600$$

$$4{,}905 \cdot 3600 = (30 \cdot \sqrt{3} - 15) \cdot V_0^2$$

$$\frac{4{,}905 \cdot 3600}{(30 \cdot \sqrt{3} - 15)} = V_0^2$$

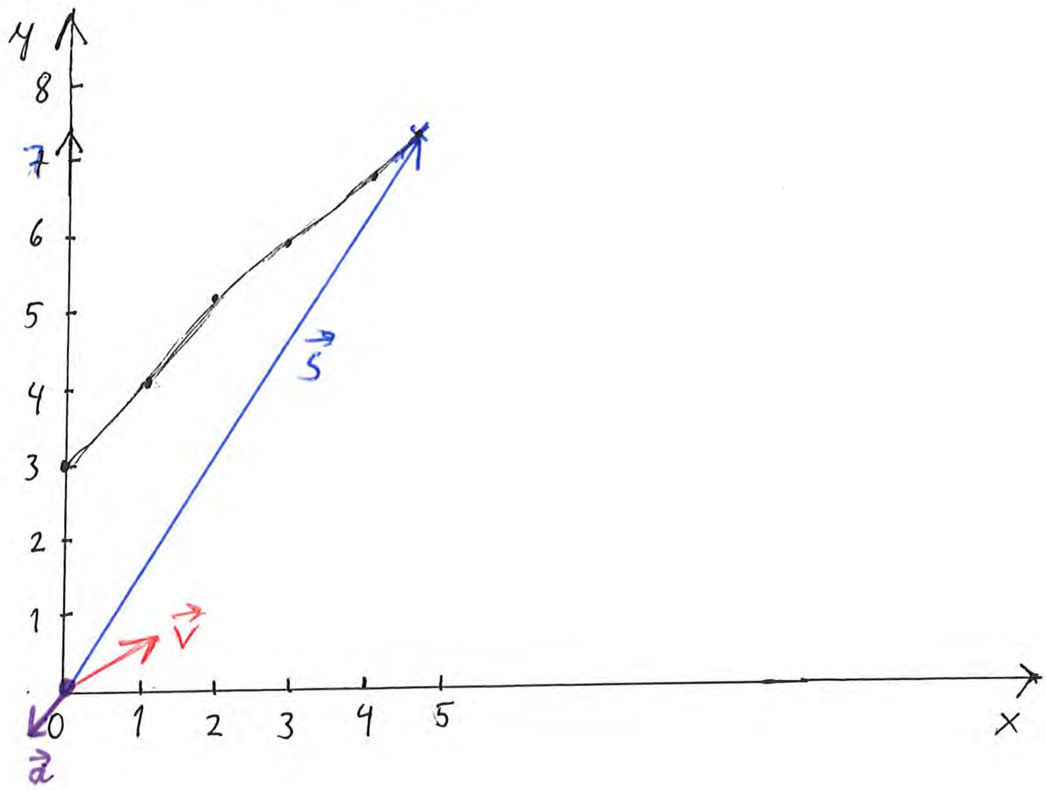
$$V_0 = \sqrt{\frac{4{,}905 \cdot 3600}{(30 \cdot \sqrt{3} - 15)}} = 21{,}857$$

dvs. $\underline{V_0 = 22\,\frac{m}{s}}$

12.334 $x(t) = -0{,}10 \cdot t^2 + 1{,}8 \cdot t$
$y(t) = -0{,}20 \cdot t^2 + 2{,}0 \cdot t + 3{,}0$ } SI-enheter

a)

t	x	y
0,0	0	3
0,2	0,356	3,392
0,4	0,704	3,768
0,6	1,044	4,128
0,8	1,376	4,472
1,0	1,7	4,8
1,2	2,016	5,112
1,4	2,324	5,408
1,6	2,624	5,688
1,8	2,916	5,952
2,0	3,2	6,2
2,2	3,476	6,432
2,4	3,744	6,648
2,6	4,004	6,848
2,8	4,256	7,032
3,0	4,5	7,2
3,2	4,736	7,352



b)
$x(3{,}0) = 4{,}5\,m$ $\quad \vec{s} = \boxed{[4{,}5\,m, 7{,}2\,m]}$
$y(3{,}0) = 7{,}2\,m$

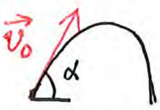
$x'(t) = -0{,}20 \cdot t + 1{,}8$
$y'(t) = -0{,}40 \cdot t + 2{,}0$

$x'(3{,}0) = -0{,}20 \cdot 3{,}0 + 1{,}8 = 1{,}2$
$y'(3{,}0) = -0{,}40 \cdot 3{,}0 + 2{,}0 = 0{,}8$
$\vec{v} = \left[1{,}2\,\frac{m}{s}, 0{,}80\,\frac{m}{s}\right]$

$x''(t) = -0{,}20$
$y''(t) = -0{,}40$
$\vec{a} = \left[-0{,}20\,\frac{m}{s^2}, -0{,}40\,\frac{m}{s^2}\right]$

c) Kravet er $y = 0$ for den andre veggen
$0 = -0{,}20 \cdot t^2 + 2{,}0 \cdot t + 3{,}0$ gir $t = 11{,}3\,s$ og ~~$t = -1{,}3\,s$~~

12.335 +



$t = 2{,}9\,s \qquad X = 58\,m$

$X = v_{0x} \cdot t \qquad y = v_{0y} \cdot t + \frac{1}{2} a_y t^2$

$x = v_0 \cdot (\cos\alpha) \cdot t \qquad 0 = v_{0y} \cdot t + \frac{1}{2} a_y t^2$

$v_0 \cos\alpha = \frac{X}{t} = \frac{58\,m}{2{,}9\,s} = 20\,\frac{m}{s} \qquad 0 = t \cdot \left(v_{0y} + \frac{1}{2} a_y t \right)$

$\cancel{t = 0}$ eller $v_{0y} = -\frac{1}{2} a_y t$

$v_{0y} = -\frac{1}{2} \cdot \left(-9{,}81\,\frac{m}{s^2}\right) \cdot 2{,}9\,s$

$v_0 \sin\alpha = 14{,}224\,\frac{m}{s}$

$\frac{v_0 \sin\alpha}{v_0 \cos\alpha} = \frac{14{,}224\,\frac{m}{s}}{20\,\frac{m}{s}}$

$\tan\alpha = 0{,}7112$

$\alpha = \tan^{-1} 0{,}7112$

$\alpha = 35{,}42^\circ$ som gir $\approx \underline{35^\circ}$ med horisontalen

$v_0 = \frac{14{,}224\,\frac{m}{s}}{\sin 35{,}42^\circ} = 24{,}542\,\frac{m}{s} = \underline{25\,\frac{m}{s}}$

12.336 $r = 40\,m \qquad v_b = 20\,\frac{m}{s}$

$a = \frac{v_b^2}{r} = \frac{\left(20\,\frac{m}{s}\right)^2}{40\,m} = \underline{10\,\frac{m}{s^2}}$

inn mot sentrum i sirkelen

12.339+

a) $a = \frac{4\pi^2 r}{T^2}$ fordi $a = \frac{v^2}{r}$ og $v = \frac{\text{omkrets}}{\text{periode}} = \frac{2\pi r}{T}$

som gir

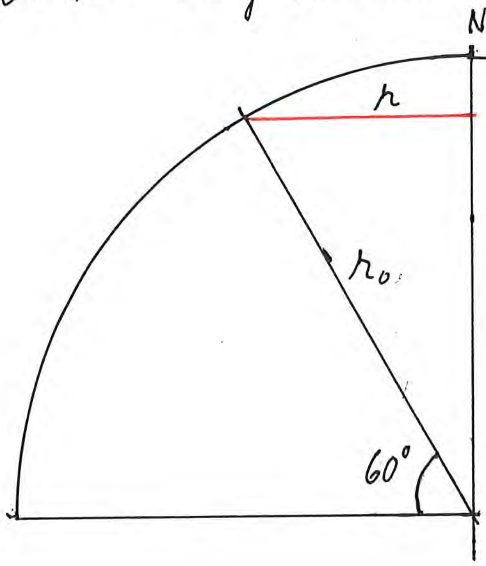
$$a = \frac{\left(\frac{2\pi r}{T}\right)^2}{r} = \frac{\frac{4\pi^2 r^2}{T^2}}{r} = \frac{4\pi^2 r}{T^2}$$

b) $T = 24h = 24 \cdot 3600\,s$

$r = 6378\,km = 6378 \cdot 10^3\,m$

$$a = \frac{4\pi^2 r}{T^2} = \frac{4\pi^2 \cdot 6{,}378 \cdot 10^6\,m}{(24 \cdot 3600\,s)^2} = \underline{0{,}03373\,\frac{m}{s^2}} \left(= 0{,}034\,\frac{m}{s^2}\right)$$

c) 60° nordlig bredde



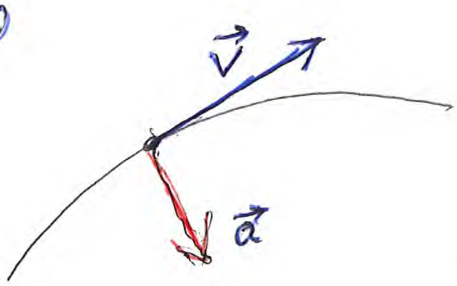
$r = r_0 \cdot \cos 60°$

$= r_0 \cdot \frac{1}{2}$

$$a = \frac{4\pi^2 r}{T^2} = \frac{4\pi^2 \cdot \frac{1}{2} \cdot 6{,}378 \cdot 10^6\,m}{(24 \cdot 3600\,s)^2}$$

$$= \underline{0{,}01686\,\frac{m}{s^2}} \left(= 0{,}017\,\frac{m}{s^2}\right)$$

12.340



1) Ja

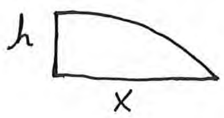
2) v_b = konst. og sirkel så Ja, ellers ikke

3) Nei →  v_b konst $|v_b|$

4) Nei ○ stein $v_0 = 0$ i toppunkt ↓

5) Nei, kan ha økende banefart,

12.341+ $h = 1{,}8\,m \quad r = 1{,}6\,m \quad x = 12\,m$



$$y = \frac{1}{2} a_y t^2$$

$$\frac{2y}{a_y} = t^2$$

$$t = \sqrt{\frac{2y}{a_y}} = \sqrt{\frac{2\cdot(-1{,}8\,m)}{-9{,}81\,\frac{m}{s^2}}} = 0{,}60578\,s$$

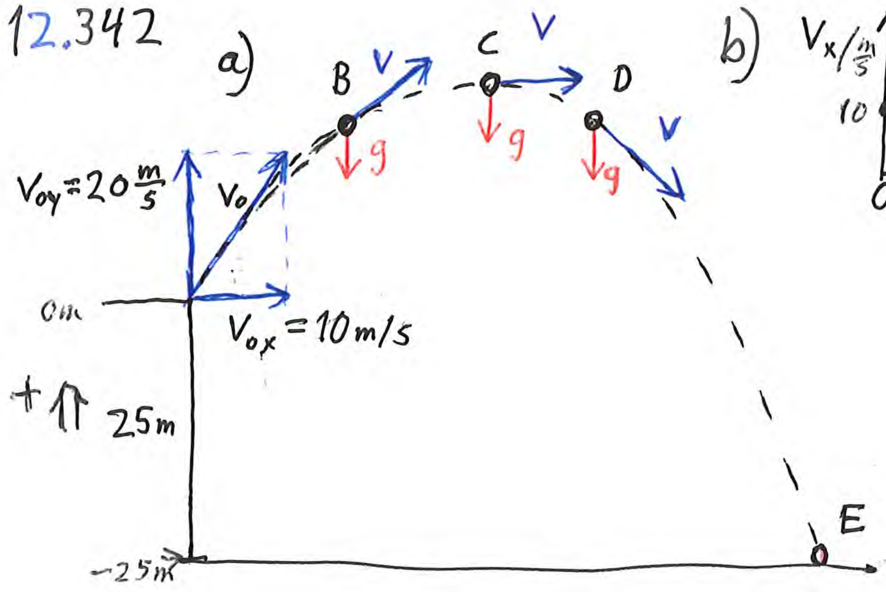
$$x = v_{0x} \cdot t$$

$$v_{0x} = \frac{x}{t} = \frac{12\,m}{0{,}60578\,s} = 19{,}809\,\frac{m}{s}$$

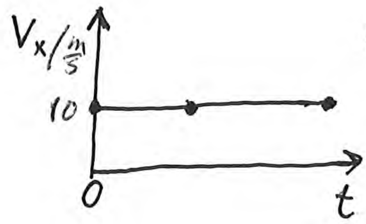
$$a = \frac{v^2}{r} = \frac{(19{,}809\,\frac{m}{s})^2}{1{,}6\,m} = 245{,}2\,\frac{m}{s^2} \approx \underline{0{,}25\,\frac{km}{s^2}}$$

12.342

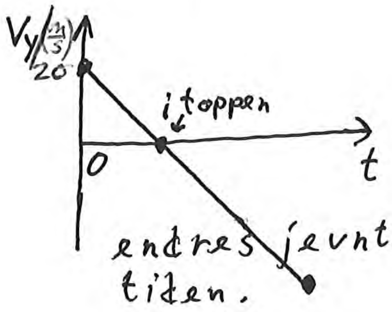
a)



b)



uendret under bevegelsen.



endres jevnt med tiden.

c) $\Uparrow +$

$$s_y = V_{0y} \cdot t + \frac{1}{2} a_y \cdot t^2$$

$$-25 = 20 \cdot t + \frac{1}{2} \cdot (-9{,}81) \cdot t^2$$

$$4{,}905 \cdot t^2 - 20t - 25 = 0$$

$$t = 5{,}080 \text{ dvs } \underline{t = 5{,}1\,s}$$

$Ax^2 + Bx + C = 0$

12.342 d) $s_x = v_x \cdot t = v_{0x} \cdot t = 10\,\frac{m}{s} \cdot 5{,}080\,s = \underline{51\,m}$

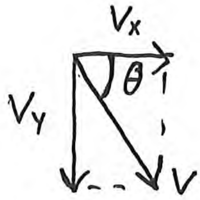
$v_x = v_{0x} = 10\,\frac{m}{s}$

$v_y = v_{0y} + a_y t = 20\,\frac{m}{s} - 9{,}81\,\frac{m}{s^2} \cdot 5{,}080\,s = -29{,}83\,\frac{m}{s}$

$= -30\,\frac{m}{s}$

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{10^2 + 29{,}83^2}\,\frac{m}{s}$

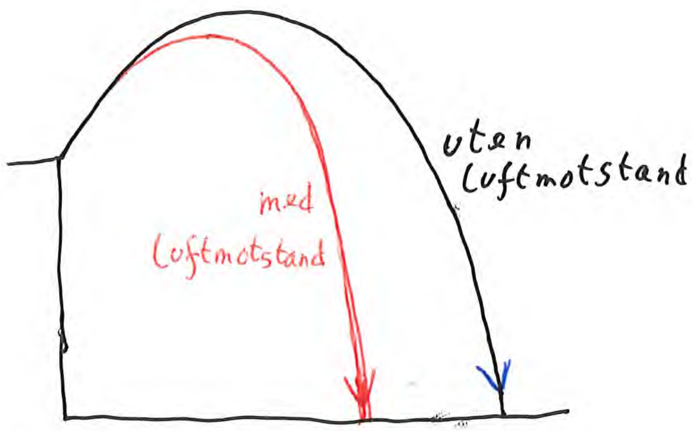
$= 31{,}46\,\frac{m}{s}$ dvs $v = \underline{31\,\frac{m}{s}}$



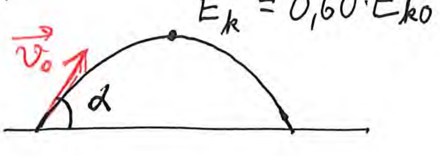
$\tan\theta = \frac{v_y}{v_x}$

$\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right) = \tan^{-1}\left(\frac{-29{,}83}{10}\right) = \underline{-71^\circ}$

e)



12.343+



$\cancel{\frac{1}{2}} \cancel{m} v_{0x}^2 = 0{,}60 \cdot \cancel{\frac{1}{2}} \cancel{m} v_0^2$

$v_{0x}^2 = 0{,}60\, v_0^2$

$\cancel{v_0^2} \cdot \cos^2\alpha = 0{,}60 \cdot \cancel{v_0^2}$

$\cos\alpha = \sqrt{0{,}60}$

$\alpha = \cos^{-1}\sqrt{0{,}60} = \underline{39^\circ}$

12.345 a) $V_0 = 0 \qquad t = 2{,}0\,s \qquad V = 9{,}5\,\frac{m}{s} \qquad a = ?$

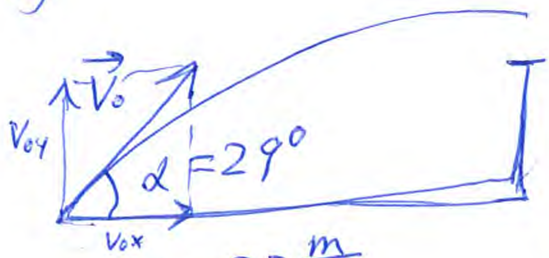
$$V = V_0 + at$$

$$V - V_0 = at$$

$$a = \frac{V - V_0}{t} = \frac{9{,}5\,\frac{m}{s} - 0}{2{,}0\,s} = 4{,}750\,\frac{m}{s^2}$$

$$\underline{a = 4{,}8\,\frac{m}{s^2}}$$

b)



$t = ?$

$V_{0x} = ?$

$V_0 = 23\,\frac{m}{s}$

$$V_{0x} = V_0 \cdot \cos\alpha$$

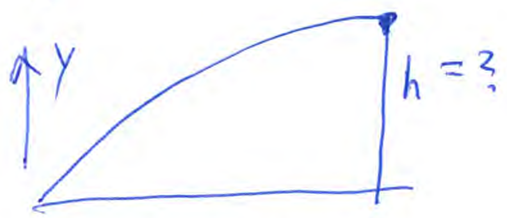
$$V_{0x} = 23\,\frac{m}{s} \cdot \cos 29^0 = 20{,}11\,\frac{m}{s}$$

$S_x = V_{0x} \cdot t$ fordi $a_x = 0$

$$\frac{S_x}{V_{0x}} = t$$

$$t = \frac{38\,m}{20{,}11\,\frac{m}{s}} = 1{,}889\,s \quad \text{dvs } \underline{t = 1{,}9\,s}$$

c)



$$S_y = V_{0y} \cdot t + \tfrac{1}{2} a_y \cdot t^2 \qquad a_y = -g$$

$$S_y = 11{,}15\,\frac{m}{s} \cdot 1{,}889\,s + \tfrac{1}{2} \cdot \left(-9{,}81\,\frac{m}{s^2}\right) \cdot (1{,}889\,s)^2$$

$$= 21{,}06\,m - 17{,}50\,m$$

$$= 3{,}557\,m$$

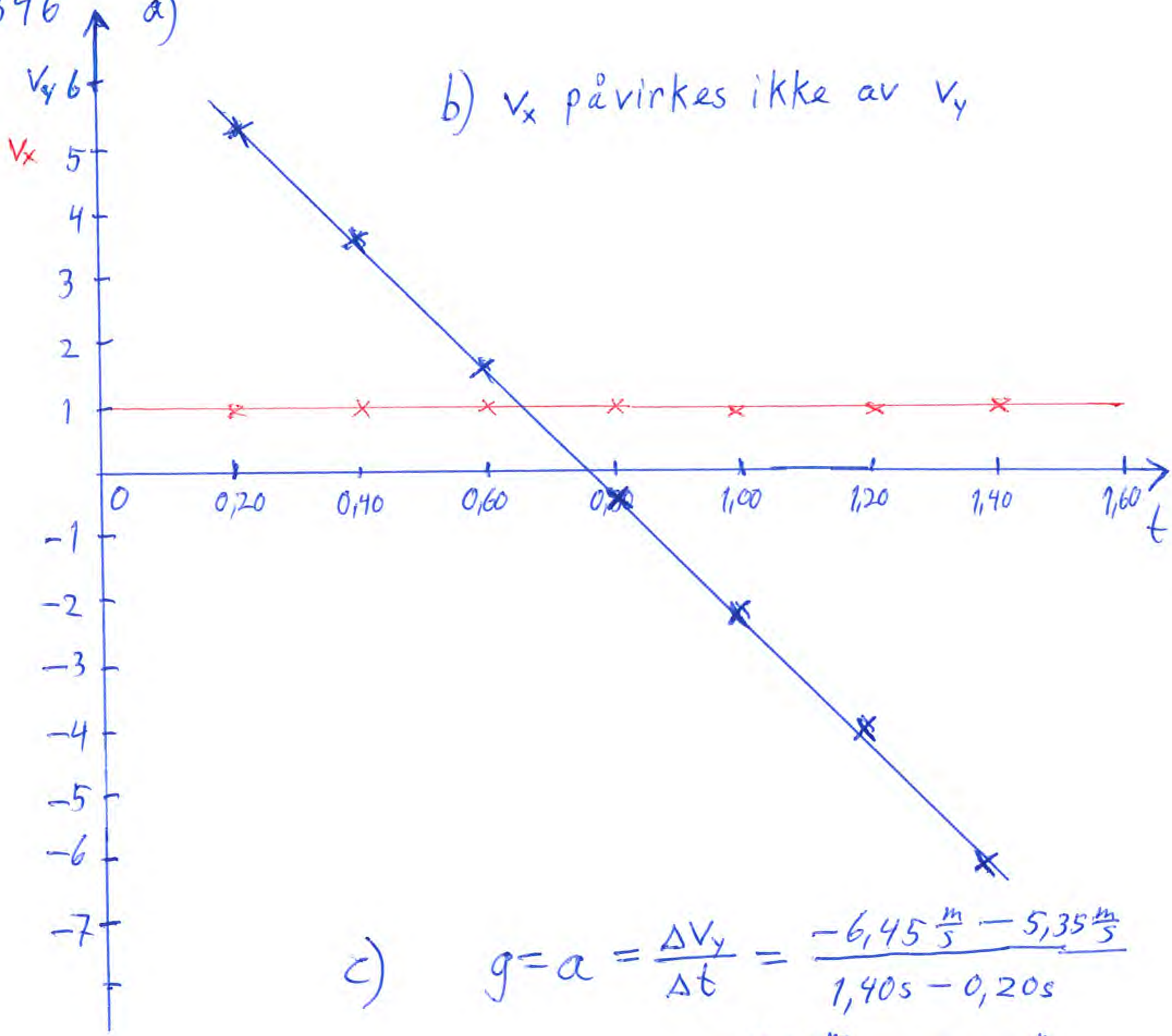
$$\underline{S_y = 3{,}6\,m}$$

$$V_{0y} = V_0 \cdot \sin\alpha$$

$$= 23\,\frac{m}{s} \cdot \sin 29^0$$

$$= 11{,}15\,\frac{m}{s}$$

12.346 a)



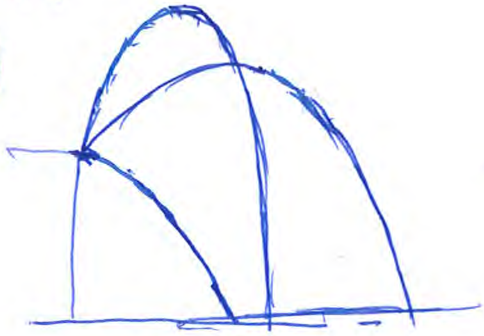
b) v_x påvirkes ikke av v_y

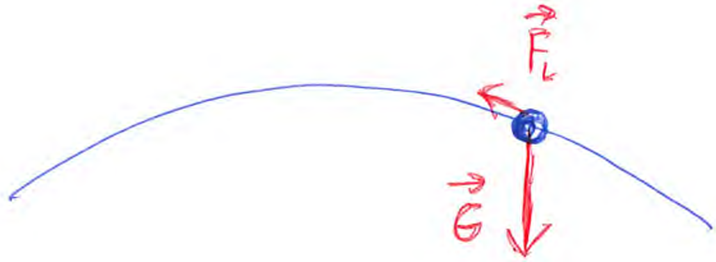
c) $$g = a = \frac{\Delta v_y}{\Delta t} = \frac{-6{,}45\,\frac{m}{s} - 5{,}35\,\frac{m}{s}}{1{,}40\,s - 0{,}20\,s}$$

$$= \frac{-11{,}80\,\frac{m}{s}}{1{,}20\,s} = \underline{-9{,}83\,\frac{m}{s^2}}$$

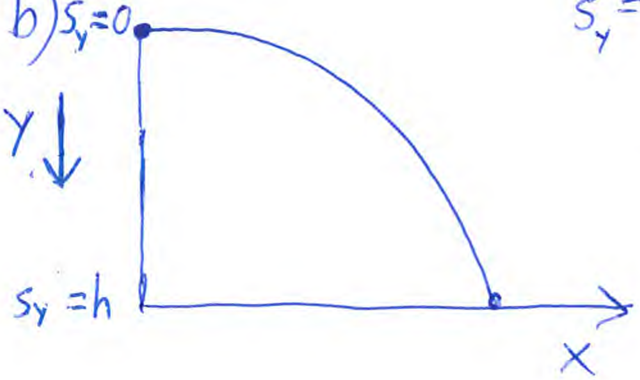
12.349

a)





b)



$$s_y = v_{0y} t + \frac{1}{2} a_y t^2 \qquad v_{0y} = 0$$

$$a_y = g$$

$$s_y = \frac{1}{2} g t^2$$

$$h = \frac{1}{2} g t^2$$

$$2h = g t^2$$

$$\frac{2h}{g} = t^2$$

$$\underline{t = \sqrt{\frac{2h}{g}}}$$

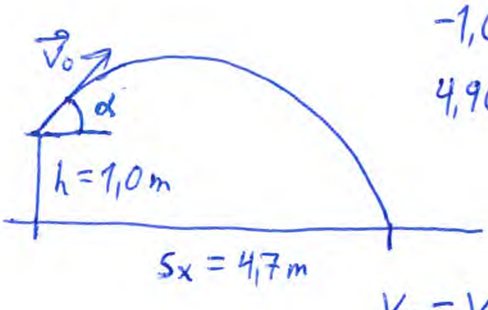
c)

$$s_x = v_{0x} \cdot t + \frac{1}{2} a_x t^2 \quad \text{og} \quad a_x = 0$$

$$s_x = v_{0x} \cdot t = v_0 \cdot t = \underline{v_0 \cdot \sqrt{\frac{2h}{g}}}$$

$$s_x = 6{,}7 \tfrac{m}{s} \cdot \sqrt{\frac{2 \cdot 1{,}0\,m}{9{,}81 \frac{m}{s^2}}} = 3{,}025\,m \quad \text{dvs} \quad \underline{s_x = 3{,}0\,m}$$

d) $\alpha = 32^\circ$



$$s_y = v_{0y} \cdot t + \frac{1}{2} a_y t^2$$

$$v_{0y} = v_0 \cdot \sin\alpha = 6{,}7 \tfrac{m}{s} \cdot \sin 32^\circ = 3{,}550 \tfrac{m}{s}$$

$$-1{,}0 = 3{,}55 \cdot t + \tfrac{1}{2}(-9{,}81) \cdot t^2$$

$$4{,}905 \cdot t^2 - 3{,}55 t - 1{,}0 = 0$$

$$t = 0{,}9405 \lor \cancel{t = -0{,}216}$$

$$\text{dvs. } t = 0{,}9405\,s$$

$$v_x = v_{0x} = v_0 \cdot \cos\alpha = 6{,}7 \tfrac{m}{s} \cdot \cos 32^\circ = 5{,}681 \tfrac{m}{s}$$

$$s_x = v_x \cdot t = 5{,}681 \tfrac{m}{s} \cdot 0{,}9405\,s = \underline{5{,}3\,m \text{ dvs. bom uten luftmotstand.}}$$