1) $v = At \Rightarrow \frac{[L]}{[T]} = [A][T] \Rightarrow [A] = \frac{[L]}{[T]^2} = [L][T]^{-2}$

SIN È ADIMENSIONALE

2) $x^2 = A \sin(Bt) \qquad [L]^2 = [A]\,[\sin(Bt)] \overset{\downarrow}{=} [A] \Rightarrow$

$\Rightarrow [A] = [L]^2$

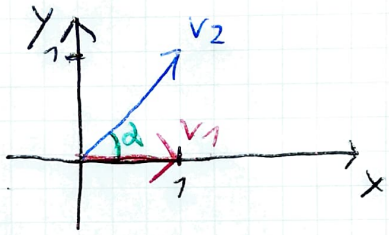
L'ARGOMENTO DEL SENO È ADIMENSIONALE $\Rightarrow [B][T] = \text{ADIM.}$

$\Rightarrow [B] = [T]^{-1}$

3) $V_1 = (1,0) \quad V_2 = (1,1)$

$|V_1| = \sqrt{1^2+0^2} = 1$

$|V_2| = \sqrt{1^2+1^2} = \sqrt{2}$



$V_1 \cdot V_2 = |V_1| \cdot |V_2| \cos\alpha = \sqrt{2}\cos\alpha$

$\parallel$

$1 \cdot 1 + 0 \cdot 1 = 1$

$\Rightarrow \cos\alpha = \frac{1}{\sqrt{2}} \Rightarrow \alpha = 45°$

4) $V_1 = 80\ \frac{km}{h} \quad t_1 = 1\,h \qquad V_2 = 110\ \frac{km}{h} \quad t_2 = 2\,h$

$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{v_1 \cdot t_1 + v_2 \cdot t_2}{t_1 + t_2} = \frac{(80+220)\,km}{3\,h} = 100\ \frac{km}{h} =$

2 CIFRE SIGNIFICATIVE

$= 27,\overline{7}\ \frac{m}{s} \cong 28\ \frac{m}{s}$

$1\ \frac{km}{h} = 1 \cdot \frac{1000\ m}{3600\ s} = \frac{1}{3,6}\ \frac{m}{s} = 0,2\overline{7}\ \frac{m}{s}$

5) $V_0 = 0\ \frac{m}{s} \qquad V_1 = 35\ \frac{m}{s} \qquad a = 4\ \frac{m}{s^2} \qquad X_0 = 0$

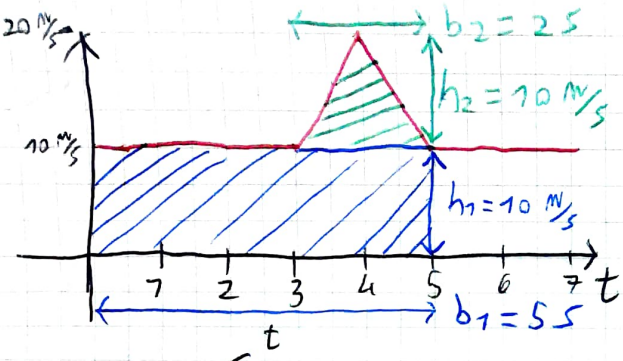
$V_0 = 0$

$v(t) = at + v_0 \overset{\downarrow}{=} at \Rightarrow t = \frac{v(t)}{a} \Rightarrow t_1 = \frac{v_1}{a} = 8,75\ s$

$x(t) = \frac{a}{2}t^2 + v_0 t + x_0$

$x(t_1) = \frac{a}{2}t_1^2 + 0 + 0 = \frac{a}{2}t_1^2 = 153,125\ m \cong 153\ m$

6)



$A_2 = h_2 \cdot b_2 \cdot \frac{1}{2} = 10\ m$

$A_1 = h_1 \cdot b_1 = 50\ m$

$$x(t) = \int_{t_0=0} dt'\, v(t') = \text{AREA SOTTESA ALLA CURVA} =$$

$$= A_1 + A_2 = 60\ m$$

7) 1) [$v_1 = 85\ km/h$ MOTO RETTILINEO UNIFORME $a = 0\ m/s^2$]

2) [$a_2 = 4\ m/s^2$ $v_2(0) = 0\ km/s$ MOTO UNIFORMEMENTE ACCELLERATO]

PONIAMO $t' = 0\,s$

$$x_1(t) = v_1 t + x_1(0) \overset{x_1(0)=0}{=} v_1 t$$

II ← QUANDO $x_1 = x_2$ LA MACCHINA DELLA POLIZIA RAGGIUNGE I LADRI

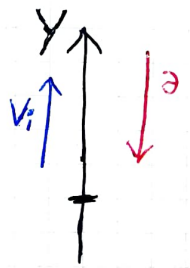
$$x_2(t) = \frac{a t^2}{2} + v_2(0)\, t + x_2(0) = \frac{a t^2}{2}$$

$v_2(0) = 0\ m/s$

$x_2(0) = 0\ m$

$$\Rightarrow t\left(\frac{at}{2} - v_1\right) = 0 \quad \begin{cases} t = 0 & \text{POCO UTILE} \\ t = \frac{2v_1}{a} = 11{,}8\,s \end{cases}$$

8) $v_i = 9.8\ m/s$ $\quad a = -g = -9.81\ m/s^2$



$$v(t) = at + v_i = -gt + v_i = 0$$

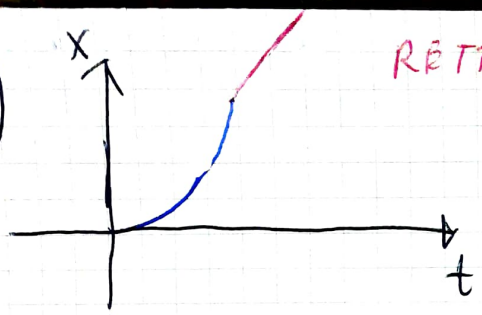
NEL PUNTO DI ALTEZZA MASSIMA LA VELOCITÀ È NULLA

$$\Rightarrow t = \frac{v_i}{g} = 1\,s$$

PONIAMO $y_0 = 0$

$$y(t) = \frac{at^2}{2} + v_i t + y_0 \overset{!}{=} -\frac{gt^2}{2} + v_i t = 4{,}9\ m$$

9)



RETTA ⇒ MOTO UNIFORME

PARABOLA ⇒ MOTO UNIFORMEMENTE ACCELLERATO

10) $x_1 = 3,91\ m \quad v_1 = 3,12\ m/s \quad$ PONIAMO $t_1 = 0\ s$

$x_2 = 8,16\ m \quad v_2 = 6,6\ m/s$

$a = ? \qquad v(t) = at + v_1 \Rightarrow v_2 = v(t_2) = at_2 + v_1 \Rightarrow at_2 = v_2 - v_1$

$x(t) = \frac{1}{2} a t^2 + v_1 t + x_1 \Rightarrow x_2 = x(t_2) = \frac{1}{2} a t_2^2 + v_1 t_2 + x_1 =$

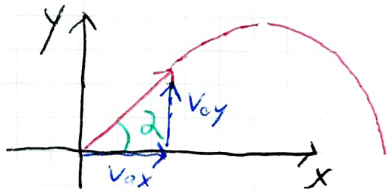
$= \frac{1}{2}(v_2 - v_1) t_2 + v_1 \cdot t_2 + x_1$

$\Rightarrow t_2 \left[\frac{1}{2}(v_2 - v_1) + v_1 \right] = x_2 - x_1 \Rightarrow$

$\Rightarrow \frac{t_2}{2} \left[v_2 + v_1 \right] = x_2 - x_1 \Rightarrow t_2 = \frac{x_2 - x_1}{v_2 + v_1} \cdot 2 = 0,8745\ s$

$at_2 = v_2 - v_1 \Rightarrow a = \frac{v_2 - v_1}{t_2} = 3,98\ m/s^2$

11) $y_0 = 0\ m \quad v_0 = 15\ m/s \quad \alpha = 45°$



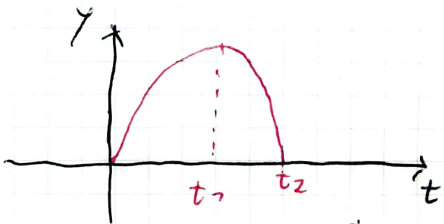
$v_{0y} = v_0 \cdot \sin\alpha = \frac{v_0}{\sqrt{2}} = 10,6\ m/s$

$v_{0x} = v_0 \cdot \cos\alpha = \frac{v_0}{\sqrt{2}} = 10,6\ m/s$

SULLE Y ABBIAMO UN MOTO UNIFORMEMENTE ACCELLERATO ⇒ $y(t) = \frac{1}{2} a t^2 + v_{0y} t + y_0$

$= -\frac{1}{2} g t_1^2 + v_{0y} t_1 + 0\ m = 5,73\ m < 7\ m$

$t_2 = 2 \cdot t_1 = 2,16\ s$



$v_y(t) = at + v_{0y} = -gt + v_{0y}$

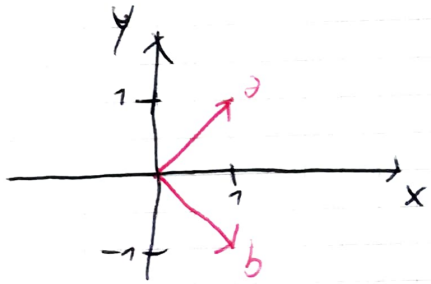
$v_y(t_1) = -gt_1 + v_{0y} = 0 \Rightarrow t_1 = \frac{v_{0y}}{g}$

SULLE X ABBIAMO UN MOTO RETTILINEO UNIFORME: $x(t) = v_{0x} t + x_0$

$x(t_2) = x_{MAX} = v_{0x} t_2 + 0\ m = 22,886\ m > 22\ m$

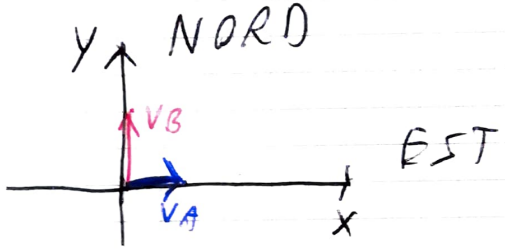
12) $a = (1, 1) \quad b = (1, -1)$

$a \cdot b = 1 \cdot 1 + 1 \cdot (-1) = 1 - 1 = 0$



13) $V_A = 15 \text{ Km/h}$ PONIAMO $t_0 = 0$

$V_B = 30 \text{ Km/h} \qquad t = 40 \text{ min} = \frac{2}{3} \text{ h}$

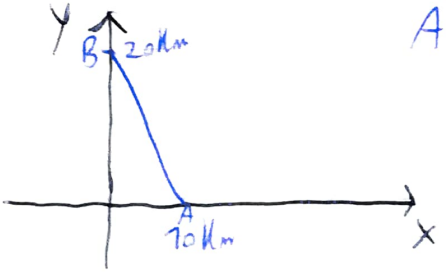


$y_A(t) = 0 \cdot t + y_0 = 0 \text{ m} \qquad x_A(t) = V_{Ax} t + x_0 = 10 \text{ Km}$

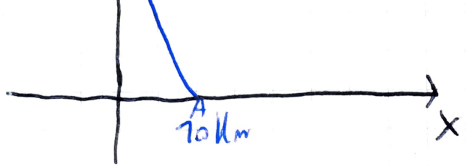
$V_{Ay} = 0 \text{ m/s}$, $y_0 = 0 \text{ m}$; $V_{Ax} = V_A$, $x_0 = 0 \text{ m}$

$x_B(t) = 0 \cdot t + x_0 = 0 \text{ m} \qquad y_B(t) = V_{By} t + y_0 = 20 \text{ Km}$

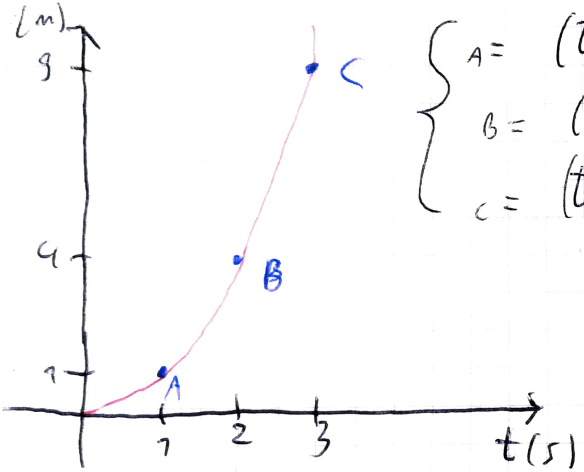
$V_{Bx} = 0 \text{ m/s}$, $x_0 = 0 \text{ m}$; $V = V_B$, $y_0 = 0 \text{ m}$



$\overline{AB} = \sqrt{(10 \text{ Km})^2 + (20 \text{ Km})^2} = \sqrt{500} \text{ Km} = 22{,}4 \text{ Km}$



14) MOTO UNIFORMEMENTE ACCELLERATO : $(t) = \frac{1}{2} a t^2 + v_0 t + x_0$

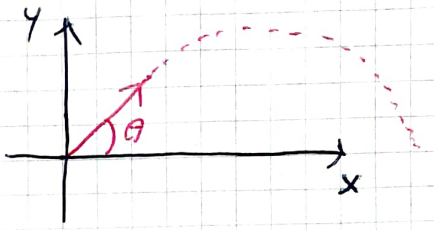


$$\begin{cases} A = (t_A) = \frac{1}{2} a t_A^2 + v_0 t_A + 0 \\ B = (t_B) = \frac{1}{2} a t_B^2 + v_0 t_B + 0 \\ C = (t_C) = \frac{1}{2} a t_C^2 + v_0 t_C + 0 \end{cases} \Rightarrow \begin{cases} 1m = \frac{1}{2} a\, 1s^2 + v_0 1s + x_0 \quad (1) \\ 4m = \frac{1}{2} a\, 4s^2 + v_0 2s + x_0 \quad (2) \\ 9m = \frac{1}{2} a\, 9s^2 + v_0 3s + x_0 \quad (3) \end{cases}$$

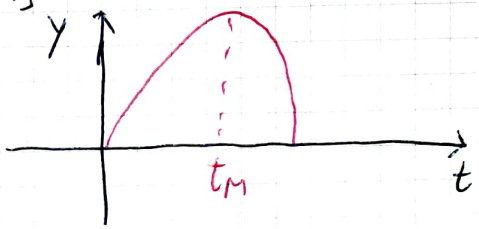
$$\Rightarrow \begin{cases} (1)-(2) \Rightarrow -3m = \frac{1}{2} a (-3) s^2 - v_0 s \Rightarrow v_0 = -\frac{3}{2} a s + 3 m/s \\ \text{SOSTITUISCO } v_0 \quad 4m = \frac{1}{2} a\, 4s^2 - 3 a s^2 + 6m + x_0 \\ \text{SOSTITUISCO } v_0 \quad 9m = \frac{1}{2} a\, 9s^2 - \frac{3}{2} a s^2 + 9m + x_0 \end{cases}$$

$$\begin{cases} v_0 = -\frac{3}{2} a s + 3 m/s \\ (2)-(3) \Rightarrow -5m = -\frac{5}{2} a s^2 + \frac{3}{2} a s^2 - 3m \Rightarrow -2m = -\frac{2}{2} a s^2 \Rightarrow \end{cases} \boxed{a = +2\ m/s^2}$$

15) $V_0 = 4\ m/s \quad \theta = 45°$



NEL PUNTO DI MASSIMA ALTEZZA V_y È NULLA $\Rightarrow V_y(t_M) = 0\ m/s$



16) $\theta = 30° \quad V_0 = 300\ m/s \quad V_{0y} = V_0 \sin\theta = \frac{V_0}{2} = 150\ m/s$

$V_{0x} = V_0 \cos\theta = V_0 \frac{\sqrt{3}}{2} = 259{,}8\ m/s \quad a_y = -g \quad a_x = 0\ m/s^2$

SULLE Y ABBIAMO UN MOTO UNIFORMEMENTE ACCELLERATO.

SULLE X ABBIAMO UN MOTO UNIFORME. t_M = TEMPO DI PICCO, t_C = TEMPO DI CADUTA

$v_y(t) = -gt + V_{0y} \qquad v_y(t_M) = -g t_M + V_{0y} = 0 \Rightarrow t_M = \frac{V_{0y}}{g} = 15{,}35$

$t_C = 2 t_M = 30{,}6\ s$

$y_M = y(t_M) = -\frac{1}{2} g t_M^2 + v_{0y} t_M + y_0 \overset{y_0 = 0\ m}{=} 1{,}147\ Km \cong 1{,}15\ Km$

$x_C = x(t_C) = v_{0x} t_C + x_0 \overset{x_0 = 0\ m}{=} 7{,}95\ Km$

17) $R = 1\ m \quad T = 2\ s \qquad T = \frac{2\pi}{\omega} \Rightarrow \omega = \frac{2\pi}{T}$

$v = \omega \cdot R = \frac{2\pi}{T} R = \pi\ m/s$

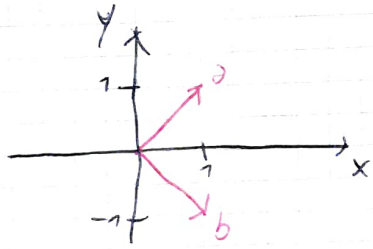
18) $T = 24\ h = \frac{2\pi}{\omega} \Rightarrow \omega = \frac{2\pi}{24\ h} = \frac{2\pi}{24} \frac{1}{3600} \frac{1}{s}$

$R = 6400\ Km \qquad a_c = \omega^2 R = \left(\frac{2\pi}{24}\right)^2 \left(\frac{1}{3{,}6}\right)^2 \left(\frac{1}{10^3}\right)^2 \frac{1}{s^2} 6{,}4 \cdot 10^3 \cdot 10^3\ m =$

$= 0{,}0338\ m/s^2 = 3{,}38\ \frac{cm}{s^2} \cong 3{,}4\ \frac{cm}{s^2}$

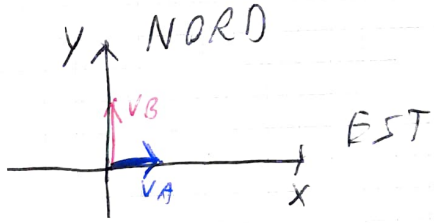
12) $a = (1, 1) \quad b = (1, -1)$

$a \cdot b = 1 \cdot 1 + 1 \cdot (-1) = 1 - 1 = 0$



13) $V_A = 15 \text{ km/h}$ PONIAMO $t_0 = 0$

$V_B = 30 \text{ km/h}$ $t = 40 \text{ min} = \frac{2}{3} \text{ h}$

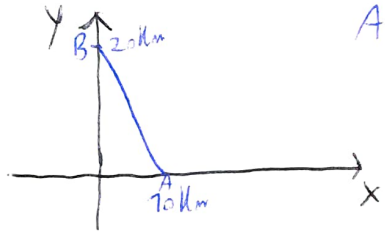


$y_A(t) = 0 \cdot t + y_0 = 0 \text{ m}$ $\quad x_A(t) = V_{Ax} t + x_0 = 10 \text{ km}$

$V_{Ay} = 0 \text{ m/s}$, $y_0 = 0 \text{ m}$ $\quad V_{Ax} = V_A$, $x_0 = 0 \text{ m}$

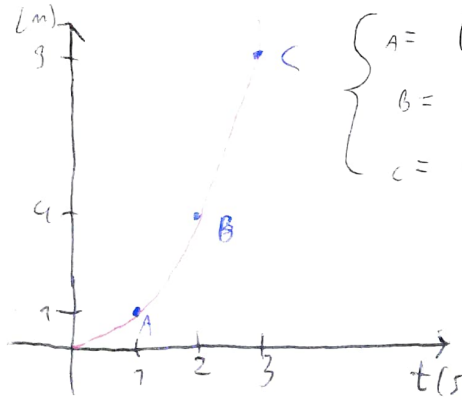
$x_B(t) = 0 \cdot t + x_0 = 0 \text{ m}$ $\quad y_B(t) = V_{By} t + y_0 = 20 \text{ km}$

$V_{Bx} = 0 \text{ m/s}$, $x_0 = 0 \text{ m}$ $\quad V = V_B$, $y_0 = 0 \text{ m}$



$\overline{AB} = \sqrt{(10 \text{ km})^2 + (20 \text{ km})^2} = \sqrt{500} \text{ km} = 22{,}4 \text{ km}$

14) MOTO UNIFORMEMENTE ACCELERATO : $(t) = \frac{1}{2} a t^2 + v_0 t + x_0$



$$\begin{cases} A = (t_A) = \frac{1}{2} a t_A^2 + v_0 t_A + 0 \\ B = (t_B) = \frac{1}{2} a t_B^2 + v_0 t_B + 0 \\ C = (t_C) = \frac{1}{2} a t_C^2 + v_0 t_C + 0 \end{cases} \Rightarrow \begin{cases} 1 \text{ m} = \frac{1}{2} a \, 1^2 + v_0 \, 1 + x_0 \quad (1) \\ 4 \text{ m} = \frac{1}{2} a \, 4^2 + v_0 \, 2 + x_0 \quad (2) \\ 9 \text{ m} = \frac{1}{2} a \, 3^2 + v_0 \, 3 + x_0 \quad (3) \end{cases}$$

$$\Rightarrow \begin{cases} (1) - (2) \Rightarrow -3 \text{ m} = \frac{1}{2} a (-3) 1^2 - v_0 \, 1 \Rightarrow v_0 = -\frac{3}{2} a \, 1 + 3 \text{ m/s} \\ \text{SOSTITUISCO } v_0 \quad 4 \text{ m} = \frac{1}{2} a \, 4^2 - 3 a \, 2^2 + 6 \text{ m} + x_0 \\ \text{SOSTITUISCO } v_0 \quad 9 \text{ m} = \frac{1}{2} a \, 3^2 - \frac{3}{2} a \, 3^2 + 9 \text{ m} + x_0 \end{cases}$$

$$\begin{cases} v_0 = -\frac{3}{2} a \, 1 + 3 \text{ m/s} \\ (2) - (3) \Rightarrow -5 \text{ m} = -\frac{5}{2} a \, 1^2 + \frac{3}{2} a \, 2^2 - 3 \text{ m} \Rightarrow -2 \text{ m} = -\frac{2}{2} a \, 1^2 \Rightarrow \end{cases} \boxed{a = +2 \text{ m/s}^2}$$