Lesson 2

Read Chapter 2

Coordinate systems

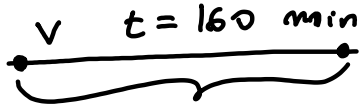
Distance formula

Rectilinear motion

Sarah can bicycle around a path, with constant speed, in two hours and 40 min. If she decreases her speed by 1 km/hr her time increases by 4 min. How long is the path ?

d

$d = vt$



day 1

$d = v \cdot 160$

day 2

$d = \left(v - 1 \frac{km}{60\,min}\right) 164\ min$

$$\begin{cases} d = 160\,v \\ d = 164\left(v - \frac{1}{60}\right) \end{cases}$$

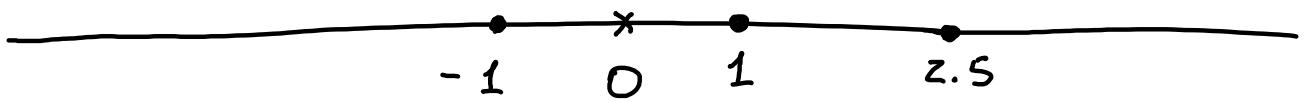
$\rightarrow 160v = 164v - \frac{164}{60} \rightarrow \frac{164}{60} = 164v - 160v$

$\frac{164}{60} = 4v \rightarrow v = \frac{164}{60 \cdot 4}$

$d = 160 \cdot \frac{164}{60 \cdot 4}$ km

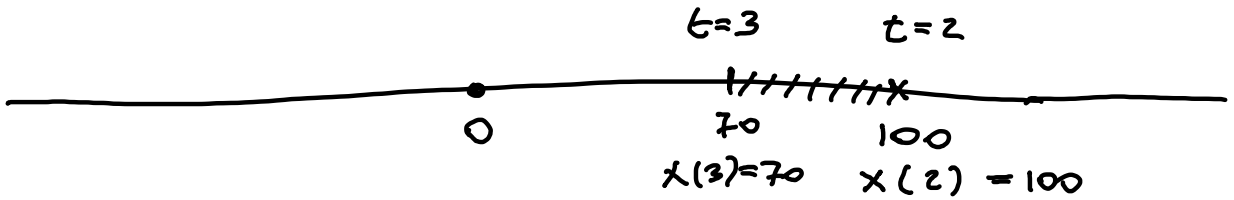
In order to set up a 1D coordinate system you need:

- Origin
- Unit ⟼



$d = v\,t$ choose $t = 0$

t in hrs distance are in miles



velocity $= -30$ mph speed $= 30$ mph speed $= |$ velocity $|$

$d = v\,t$

$30 = 30 \cdot (3-2)$

$-30 = -30\,(3-2)$

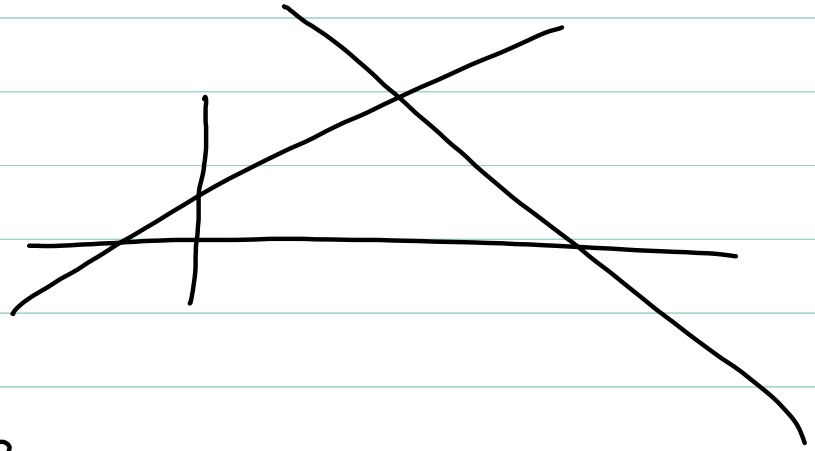
$x(3) - x(2) = -30 \cdot (3-2)$

$x(t_2) - x(t_1) = v\,(t_2 - t_1)$

↓

velocity

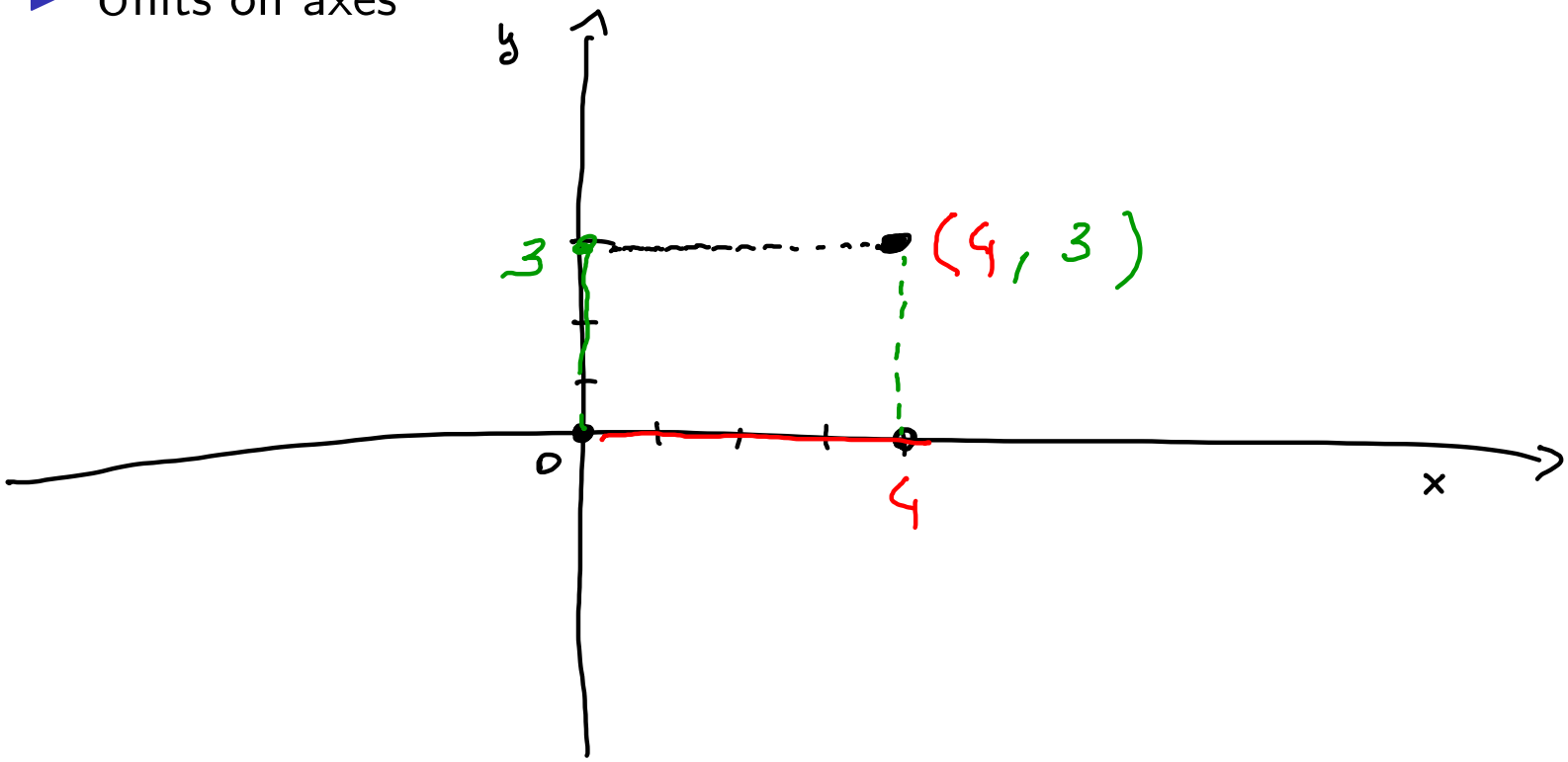
Goal



plane
straight line
velocity constent

In order to set up a 2D coordinate system you need:

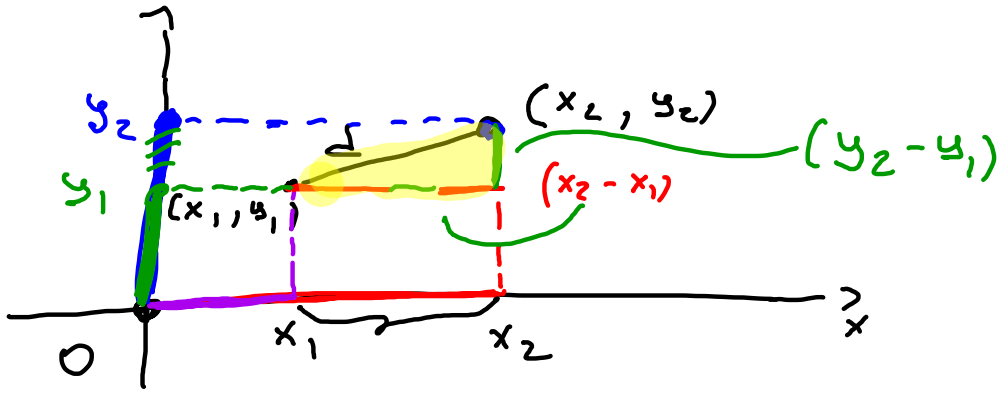
- Origin
- Axes
- Units on axes



Distance formula

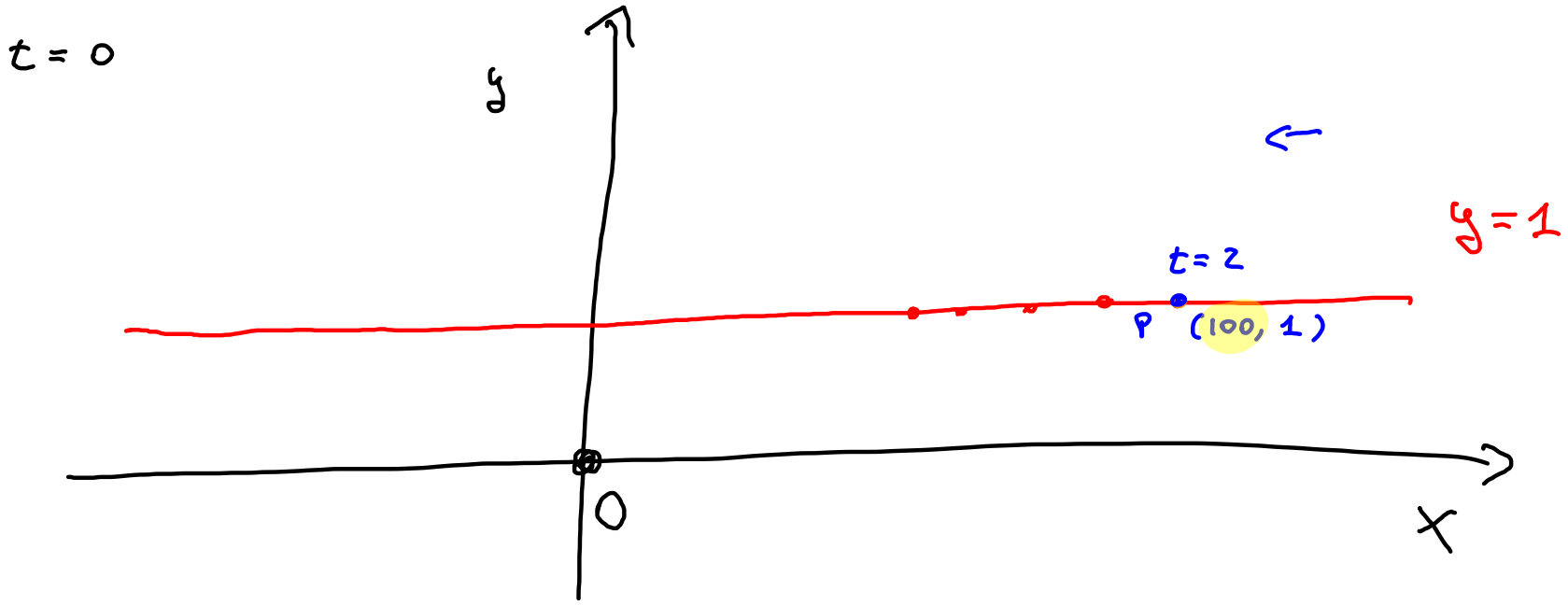
The distance between $P(x_1, y_1)$ and $Q(x_2, y_2)$ is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$



$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Suppose at time $t = 2$ hrs an object starts moving from $P(100, 1)$ with velocity -30mph along the horizontal line $y = 1$; its x and y coordinate at time t are:



$$x(t) = 100 - 30(t-2)$$
$$y(t) = 1$$

for times t when the object is moving

$$x(t) - x(2) = -30(t-2)$$
$$x(t) = x(2) - 30(t-2)$$

What is position at $t = 10$?

$$x(10) = 100 - 30(10-2) = -140$$
$$y(10) = 1$$

Suppose at time t_1 ~~an object starts moving from~~ $P(a, b)$ ~~with~~ velocity v_x along the horizontal line $y = b$; its x coordinate at time t is:

$$x(t) = a + v_x(t - t_1)$$

Suppose at time t_1 an object ~~starts moving from~~ $P(a, b)$ with velocity v_y along a vertical line $x = a$; its y coordinate at time t is:

$$y(t) = b + v_y(t - t_1)$$