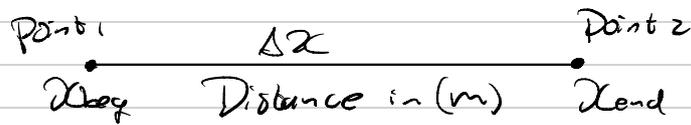


# Motion

Definition: When an object travels a distance over a time. An object is therefore in motion.



Depending on your velocity (speed), it takes a certain time  $\rightarrow \Delta t$

If we have a distance and a timeframe, we have a motion

## Velocity:

With the distance you need to travel and the time it takes, you can calculate the velocity (speed)

$$v = \frac{\Delta x}{\Delta t}$$

$$v = \frac{x_{end} - x_{beg}}{t_{end} - t_{beg}}$$

$v$  is the velocity in [m/s]  
 $x$  is the distance in [m]  
 $t$  is the time in [s]

It's the same for average velocity

$$v_{avg} = \frac{\Delta x}{\Delta t}$$

$$\frac{m}{s} = \frac{m}{s}$$

Rewrite:

$$\Delta x = 2$$

$$\Delta t = 1$$

$$v_{avg} = \frac{\Delta x}{\Delta t} \rightarrow 3 = \frac{6}{2}$$

$$\Delta x = v_{avg} \cdot \Delta t \rightarrow 6 = 3 \cdot 2$$

$$\Delta t = \frac{\Delta x}{v_{avg}} \rightarrow 2 = \frac{6}{3}$$

# Welcome back to physics!

Start with Question 1

Question 2:

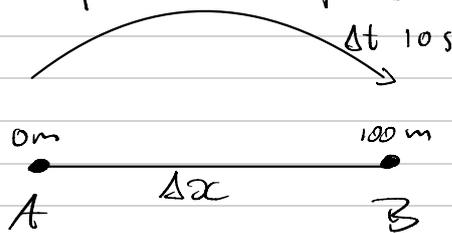
- a) Speed
- b) Velocity
- c) average velocity
- d) Displacement
- e) Acceleration
- f) Distance
- g) Time
- h) meter
- i) Seconds
- j) meters per second

Make Question 3, 4, 5

Motion: When an object is changing in a direction in a time period.

Important:

Always look from 2 points in space and time



$\Delta x$  is the difference in distance travelled [m]  
 $\Delta t$  is the difference in time [s]

$$V_{avg} = \frac{\Delta x}{\Delta t} = \frac{100 - 0}{10 - 0} = \frac{100}{10} = 10 \text{ m/s}$$

$$\Delta x = V \cdot t \quad 10 \cdot 10 = 100 \text{ m}$$

$$\Delta t = \frac{\Delta x}{\Delta V} = \frac{100}{10} = 10 \text{ s}$$

Homework: Questions 1-7 page 44-45

## Converting Velocity

$\overset{\times 3.6}{\curvearrowright}$   
m/s  $\leftrightarrow$  km/h

$\times 3.6$

$\overset{:1000}{\rightarrow}$   
m  $\rightarrow$  km

$\overset{:60}{\rightarrow}$   $\overset{:60}{\rightarrow}$   
s  $\rightarrow$  m  $\rightarrow$  h

$\overset{:3600}{\curvearrowright}$

$\overset{:1000}{\rightarrow}$   
 $\frac{m}{s} \rightarrow \frac{km}{h}$

$\overset{:3600}{\curvearrowright}$

$$\frac{1000}{3600} = 3.6$$

Therefore:  $\overset{\overset{:3.6}{\curvearrowright}}{m/s \leftrightarrow km/h}$   
 $\underset{\times 3.6}{\curvearrowleft}$

Acceleration: is the variable that indicates how fast you're increasing the velocity

$$a = \frac{V_{end} - V_{beg}}{t_{end} - t_{beg}}$$

$$a = \frac{\Delta V}{\Delta t}$$

$a$  is the acceleration in  $[m/s^2]$

A cyclist needs to accelerate to 30 m/s in the first 4 seconds of the race. What is his acceleration?

$$\begin{aligned}v_e &= 30 \text{ m/s} \\v_b &= 0 \text{ m/s} \\t_e &= 4 \text{ s} \\t_b &= 0 \text{ s}\end{aligned}$$

$$a = \frac{\Delta v}{\Delta t} = \frac{30}{4} = 7,5 \text{ m/s}^2$$

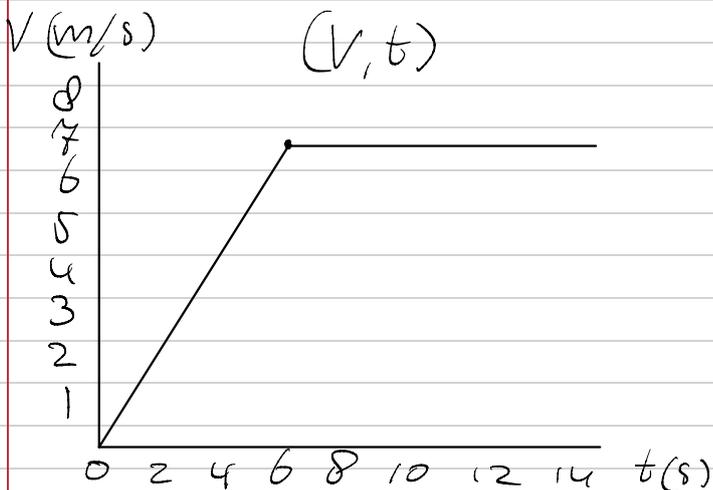
Calculate  $\Delta x$

$$\textcircled{1} \Delta x = v_{\text{avg}} \cdot \Delta t = 30 \cdot 4 = 120 \text{ m}$$

$$\textcircled{2} \textcircled{a} = \frac{\Delta v}{\Delta t}$$

$$\Delta v = a \cdot \Delta t = 7,5 \cdot 4 = 30 \text{ m/s}$$

Homework: 14, 15, 18, 20

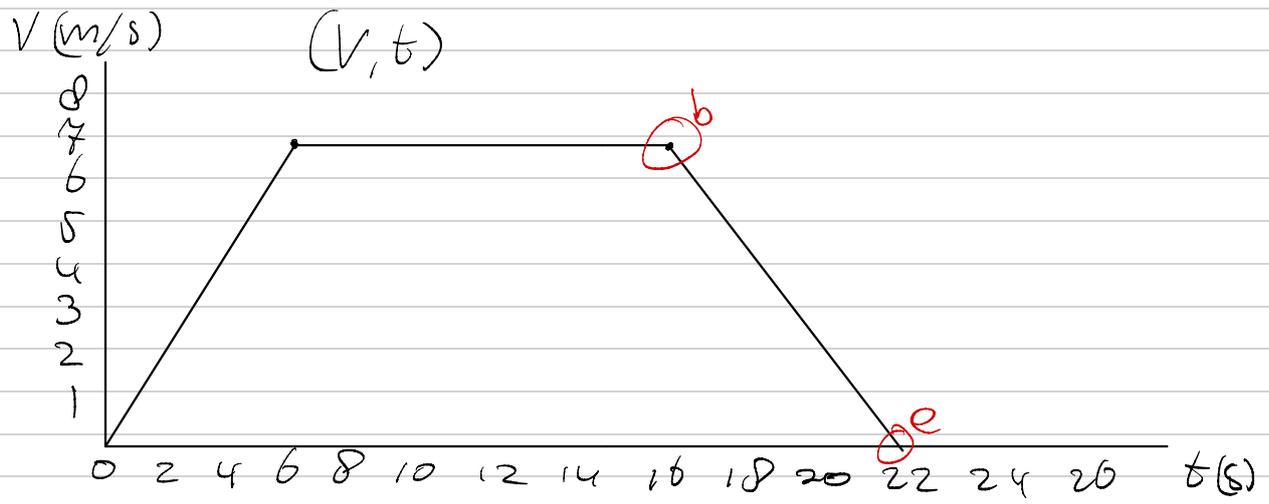


a) Calculate the acceleration of this motion.

b) What do you notice after 6 seconds?

$$\text{a) } a = \frac{\Delta v}{\Delta t} = \frac{7-0}{6-0} = \frac{7}{6} = 1,17 \text{ m/s}^2$$

b) The velocity is constant after 6 sec.

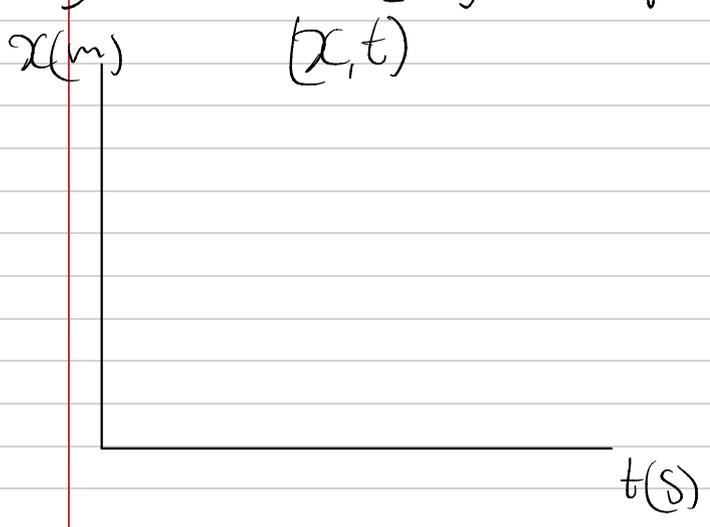


a.) Calculate the deceleration of the person.

$$a = \frac{\Delta v}{\Delta t} = \frac{v_e - v_b}{t_e - t_b} = \frac{0 - 7}{22 - 16} = \frac{-7}{6}$$

$$a = -1.17 \text{ m/s}^2$$

b.) Draw a  $(x, t)$  - diagram from this motion



$$a) v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_{end} - x_{beg}}{t_{end} - t_{beg}}$$

$$v_{avg} = \frac{400 - 50}{45 - 10} = \frac{350}{35} = 10 \text{ m/s}$$

b) Constant velocity - motion

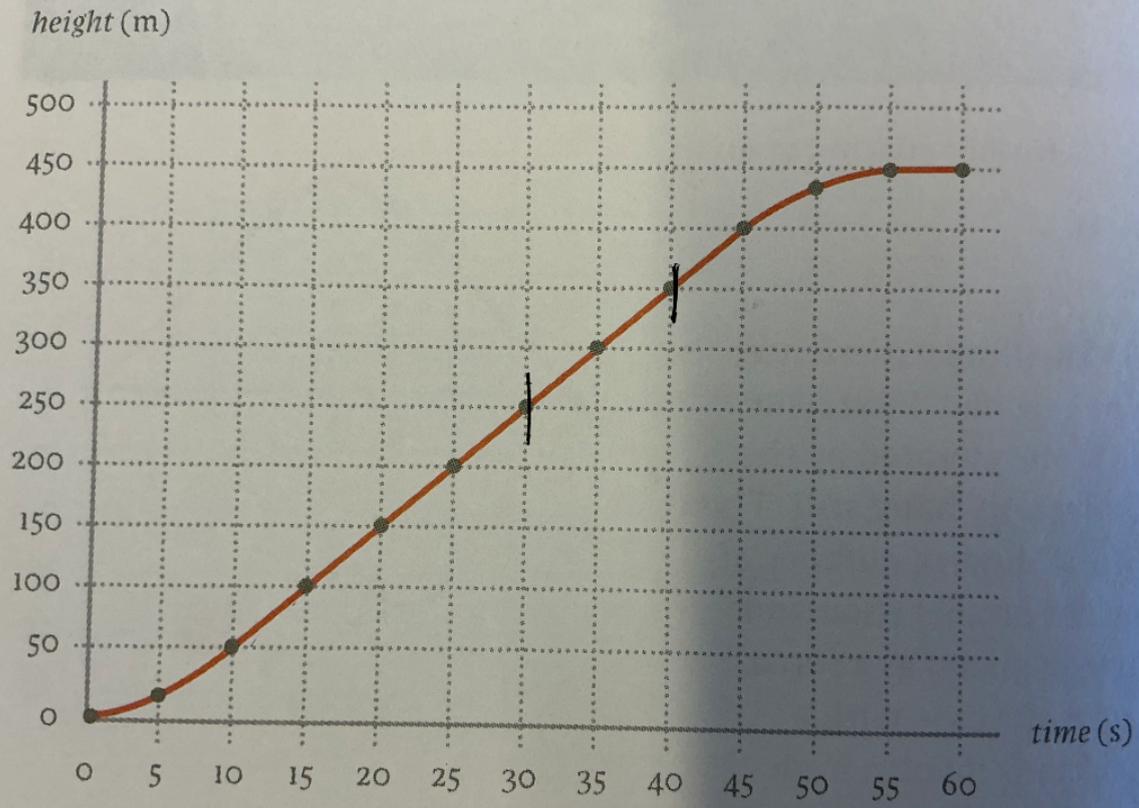
c) First 15 s, accelerating and last 15 s, decelerating

$$d) a = \frac{\Delta v}{\Delta t} = \frac{v_{end} - v_{beg}}{t_{end} - t_{beg}}$$

$$a = \frac{10}{10} = 1 \text{ m/s}^2$$

Homework: 35, 36, 38, 40

stationary, the line is horizontal. This happens after 55 seconds.



**2.10** Distance-time graph of the movement of a lift in the Burj Khalifa