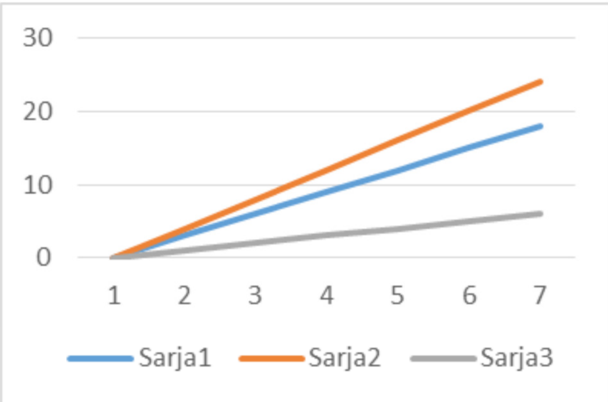
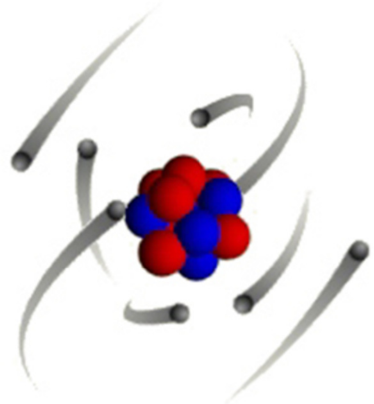
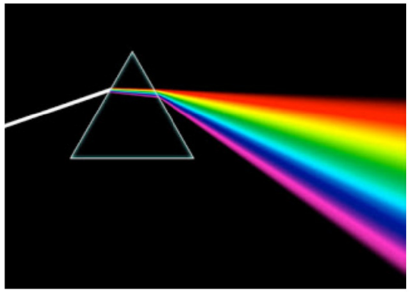
Physics 1

Model

F=ma







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Graphical model

- used in visualizing the measured values
  - Coordinate system (the following are equal)
    - (t,d)- co-ordinate
    - td- co-ordinate
    - Distance as a function of time t
    - Draw a graph d=d(t)

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Graphical representation

- Choose the coordinate and the digits of the axis. Take care of the outer limits. Give names and units to the axis.
  - X and Y-axis: digits, limit, name, unit
- Put the measuring results in the coordinate.
- Approximate (graphical approxitation) and combine the dots by line or curve.
  - Line = linear dependency
    - **y=kx+b** (linear equation),
      - k= slope, b=constant, the height where the line touches y-axis
    - **y=kx** line goes through origo
- **Interpolate** values can be defined from the graph **inside** the measured values
- **Extrapolate** values can be defined from the graph **outside** the measured values

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Mathematical model

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  - y=kx+b (linear equation),
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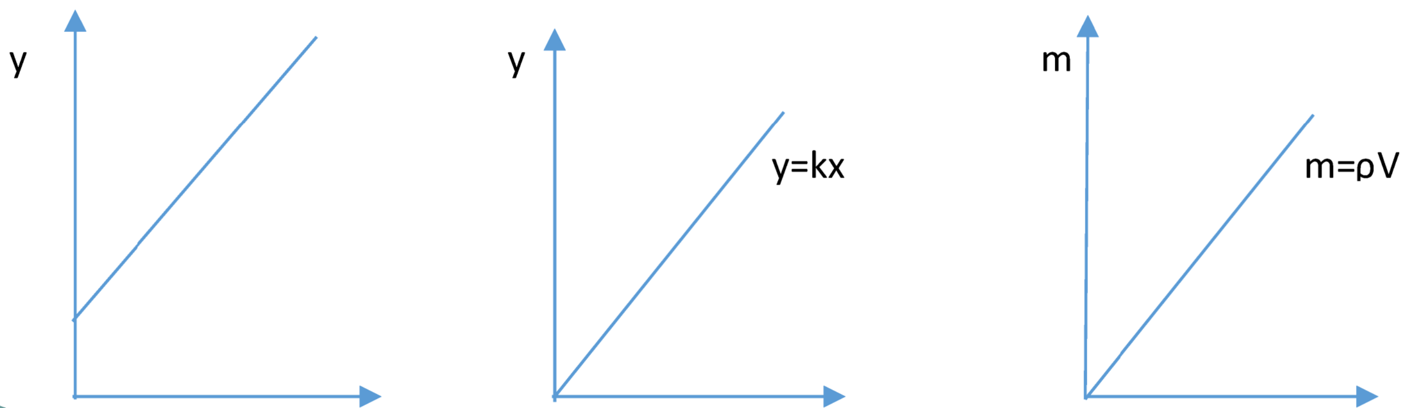

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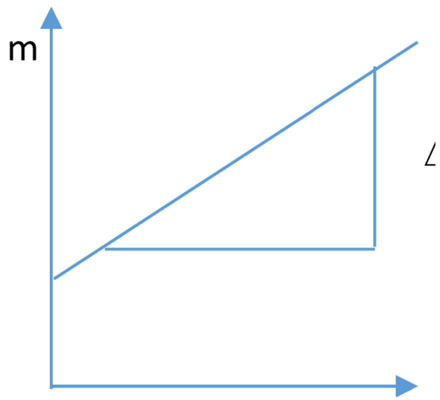
Mathematical model

- Physical slope, how to order gradient
- y=kx+b



Δ means change

$\Delta m = m_2 - m_1$ = change of mass
= value at the end – value at the beginning

$\Delta V = V_2 - V_1$ = change of volume

$\rho = \Delta m / \Delta V$

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Motion

- Motion is normally combination of several types: linear motion, rotation, wave motion, oscillation, …
- Motion can be one, two or three (maybe 4) dimensional
  - Linear motion: for instance lift (↑ or ↓)
    - Constant linear motion: speed and direction are the same all the time
    - One dimensional
  - Two dimensional, on a plane puck on ice
  - Three dimensional (in the space, diving)
- Motion is always <u>proportional</u>

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Speed and velocity

- Speed: direction is not considered
- Velocity: when we must know also the direction of the motion

1. **Average speed**

   $v_k = s/t$

   where s = distance traveled (m)
   t = time elapsed (s)

   $[v_k] = 1 m/s$

Examples

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2. Velocity and average velocity

Average Velocity = Displacement/ Used time

$v_k = \Delta x / \Delta t$

where $\Delta x = x_2 - x_1$ (x_1=starting point, x_2=ending point)

$\Delta t = t_2 - t_1$

Average velocity can be negative (if displacement is <0) if the object is moving towards the observer.

- Away from observer >0, back to observer <0

Example:

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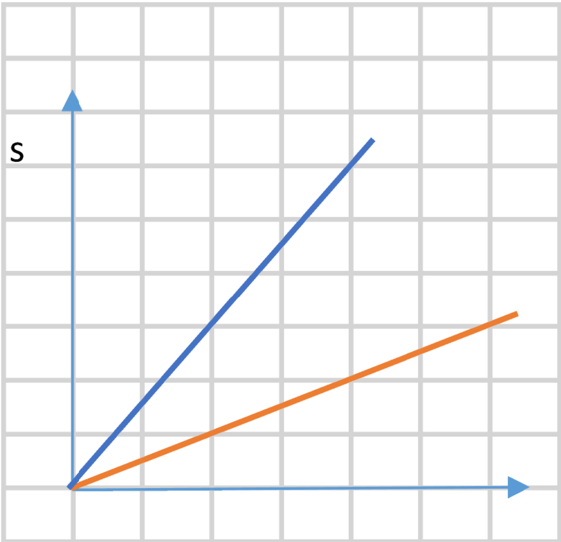
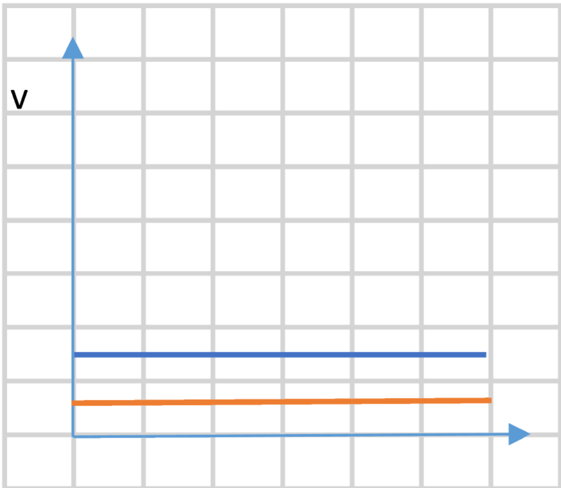
Constant motion

- if the <u>speed</u> is <u>constant</u> and the <u>direction</u> of the motion is <u>not changing</u>, the motion is called to be Constant motion

<u>Ex1</u> Graph of constant motion in (t,s)- and in (t,v)- coordinate
Transition in t,v -co-ordinate





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Velocity is a vector quantity

- It has 1. direction and 2. size (=speed)
- Scalar quantities have only size

Ex: Tell an example of scalar quantities

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Tasks in Physics

1. Draw a picture
2. Write down the values of the quantities
3. Find the formula
4. Solve the wanted quantity from the formula
5. Put the values of the quantities to the formula
6. Count and give the answer within the rules of approximation

Ex 1

A fisherman uses echosounder in finding fish flocks.
The sound waves from the echosounder are refleting from the fish flock and return back after 0,036 s. How deep swims the fish flock?

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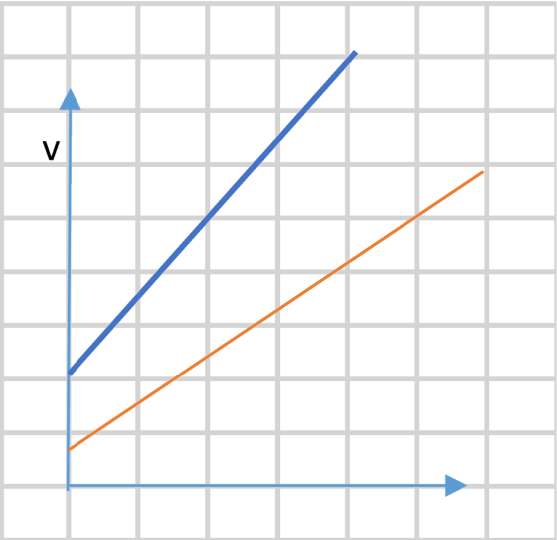
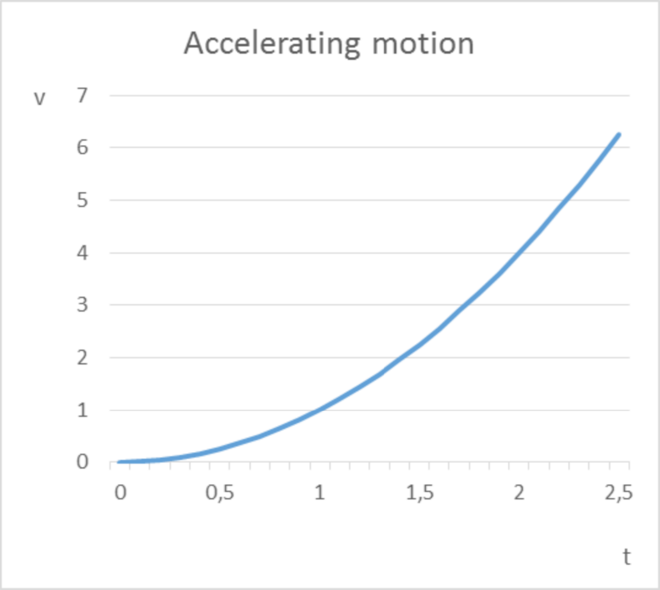
Acceleration

An object whose velocity is changing (increasing or decreasing) is said to be accelerating.

- **A car whose velocity is changing from 0 km/h to 80 km/h is accelerating. If another car is changing velocity in less time, this car has a greater acceleration.**

Constant Acceleration





Physics 1

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1. Constant Acceleration

- The velocity of the particle is changing the same amount at the same time intervals
- The graph of the motion in (t,v) – coordinate is a straight line
- The angle coefficient of the line is called the acceleration

Ex1. A Graph of a constantly accelerating

motion in a co-ordinate (t, s) and (t,v).

Ex 2. Acceleration in (t,v) – coordinate.

Interprete the motion in different time-intervals?
What is the acceleration in different time-intervals?

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2. Average acceleration

Average acceleration = Change in velocity : Time elapsed

a = Δv : Δt

where

Δv = v_2-v_1 (velocity at the end – v at the beginning)

Δt = t_2-t_1 (time at the end – t at the beginning)

Unit:

[a]= (1m/s):1s=1m/s^2

If the object is slowing down, meaning that the final velocity is less than the initial velocity, the acceleration is negative. When the object is increasing its velocity, the acceleration is positive.

Ex1. A car accelerates along a straight road from rest to 75 km/h in 5,0s. What is the average acceleration?

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3. Free Falling

One of the most common examples of uniformly accelerated motion if that of an object allowed to fall freely near the Earth's surface.

Galileo Galilei (1564-1642) found, after experiments in Pisa Tower, that all objects fall with the same constant acceleration in the absence of air or other resistance at a given location on the Earth.

This is called **the acceleration due to the gravity** and we use for it the **symbol g**. Its magnitude on the Earth is approximately

$$g = 9{,}81\ m/s^2$$

The magnitude of g varies slightly according to latitude and elevation (the height from the sea level). At the Poles its appx 9,83 and at the Equator its appx. 9,78.

Example 1.

A ball is dropped from a tower. What is the velocity of the ball after 1,0s, 2,0s and 3,0s of free fall?

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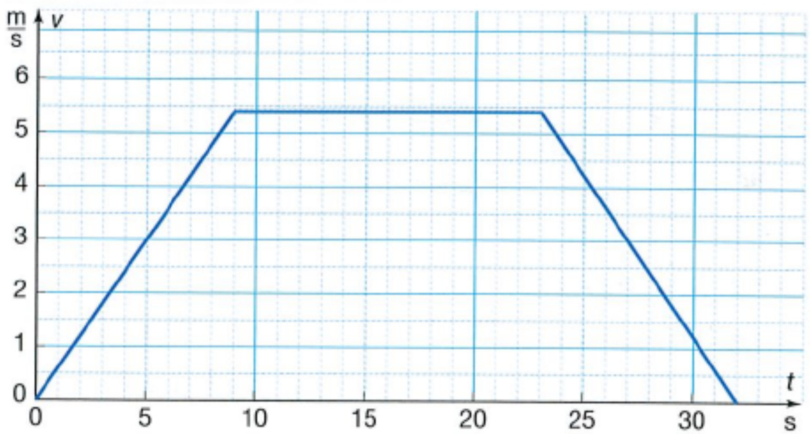
Esimerkki 1



Kuvaaja esittää yksinkertaistettuna Tampereen Särkänniemessä sijaitsevan Näsinneulan tornin hissin nopeutta ajan funktiona.

a) Tulkitse kuvaajaa, kun mittauksen aloitushetkellä hissi oli alimmassa kerroksessa.

b) Laske hissin keskikiihtyvyys aikaväleillä 0,0…9,0 s ja 23…32 s.

c) Laske hissin nousumatka.