

Physics 201 - Lecture 2

A1!

1. Units in Equations ✓
2. Measuring things ✓ (Uncertainty)
3. Scalars and Vectors ✓
4. The Algebra of Scalars
5. The Algebra of Vectors

There are 22 kg of apples in a basket. Each apple has a mass of 0.25 kg. How many apples are in the basket?

$$\text{Total Mass} = 22 \text{ kg}$$

$$m_{\text{Apple}} = 0.25 \text{ kg}$$

$$N_{\text{apples}} = \frac{\text{Total Mass}}{m_{\text{apple}}} = \frac{22 \text{ kg}}{0.25 \text{ kg}} = 88$$

Suppose we have an equation like.

$$y = (y_0) + (v_0 t) + \left(\frac{1}{2} a t^2\right)$$

$\text{m} \quad \text{m} \quad \text{m}$

What are the units of each variable?

$$[y] = \text{m}$$

$$[y_0] = \text{m}$$

$$[t] = \text{s}$$

$$[v_0 t] = \text{m}$$

$$[v_0] = m/s$$

{ why: \hookrightarrow

$$[v_0] \cdot s = m$$

$$[v_0] = m/s$$

$$[a] = m/s^2 \quad \left\{ \text{why?} \right.$$

$$\left[\frac{1}{2} a t^2 \right] = m$$

$$\cancel{\left[\frac{1}{2} \right]} [a] [t]^2 = m$$

$$[a] \cdot s^2 = m$$

$$[a] = m/s^2$$

$$\text{density} = \frac{\text{mass}}{\text{volume}} \quad \frac{\text{kg}}{\text{m}^3}$$

$$= \frac{\text{volume}}{\text{mass}} \quad \cancel{\frac{\text{m}^3}{\text{kg}}}$$

\hookrightarrow from one unit to

Converting from one unit
to another:

Measure : one unit

Calculation is SI units

Speed of a car: mph \times
 \rightarrow m/s

SI units:
 $\uparrow\uparrow$

Système Internationale - (Metric System)

length \rightarrow m
mass \rightarrow kg
time \rightarrow s } based on this.
 $v \rightarrow$ m/s

Temp \rightarrow K

mph \rightarrow m/s

$$1 \frac{\text{mile}}{\text{hour}} = \text{_____} \text{ m/s}$$

$$1 \text{ mile} = 1609.34 \text{ m}$$

$$1 \text{ hour} = 3600 \text{ s}$$

$$\cancel{\frac{\text{mile}}{\text{hour}}} \times \frac{1609.34 \text{ (m)}}{\cancel{\text{mile}}} \times \frac{\cancel{1 \text{ hour}}}{3600 \text{ (s)}}$$

$$1 \text{ mph} = 0.4470 \text{ m/s}$$

$$\text{70 mph} = 70 \times 0.4470 \text{ m/s}$$

10 m/s

$$= 31.3 \text{ m/s}$$

Measuring Things.

In general : physical quantities

distance, mass, density, force,
velocity, pressure, ...

Scalars

- ① size ← "magnitude"
- ② unit



Vectors

- ① size
- ② unit
- ③ direction.

1
mass \rightarrow 1.35 kg
size unit

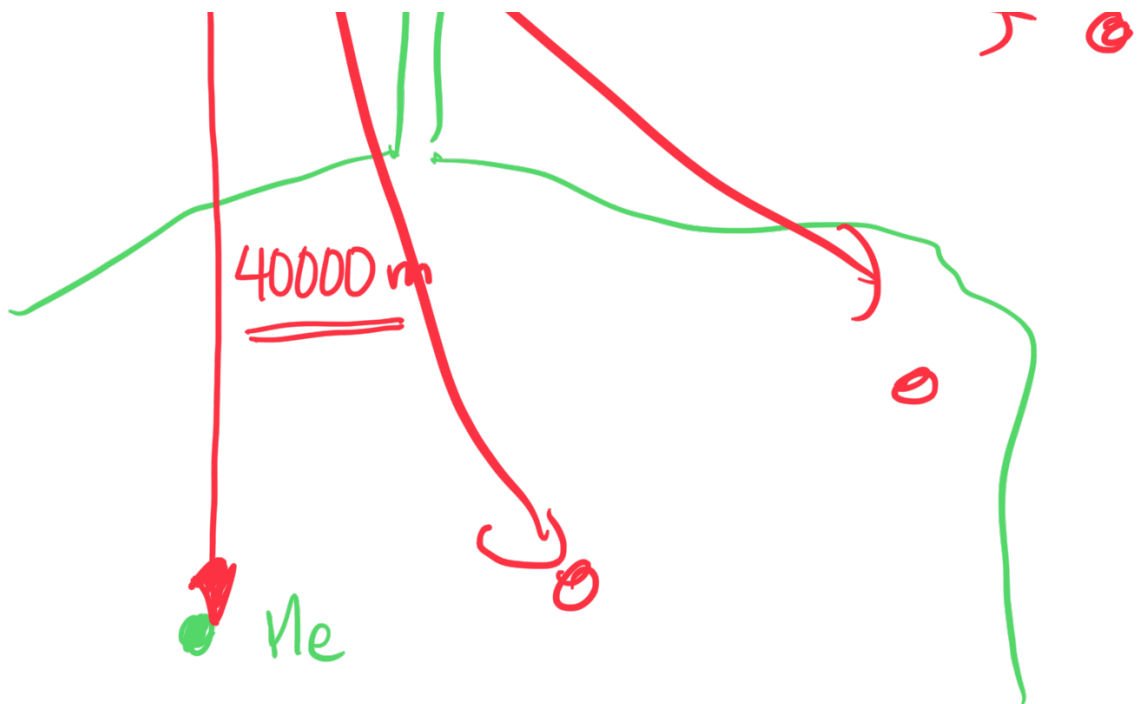
temperature \rightarrow 355 K
size unit

Where are you?

~~\rightarrow Norfolk~~

~~\rightarrow Ghent~~ Define coordinate system } choose!



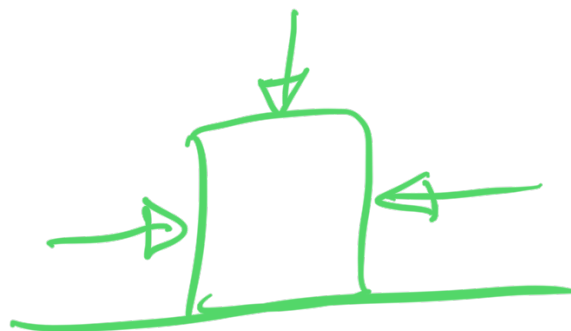


40000 m South

position
velocity

acceleration

force



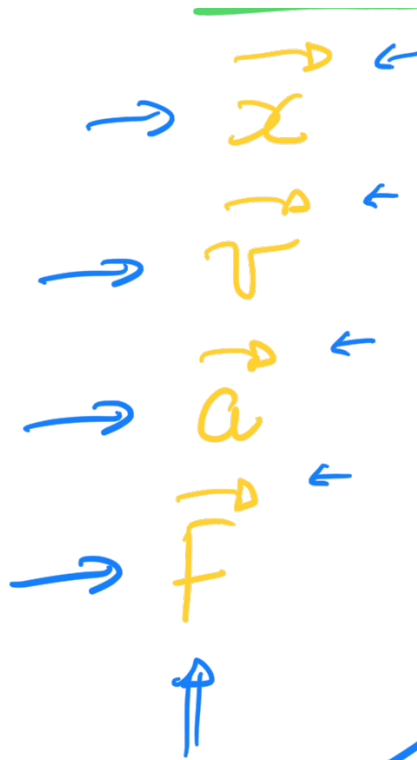
Scalars

||

Vectors.

Scalars

m
T
p
p



Text books



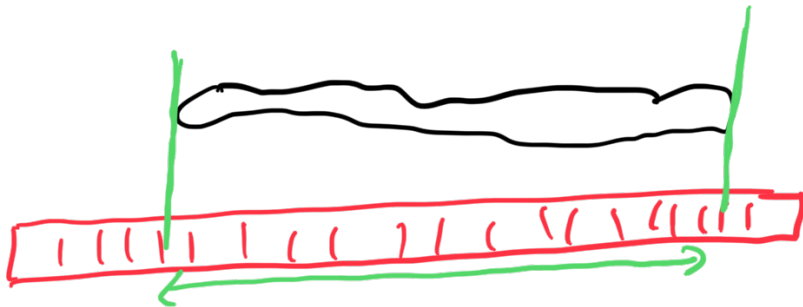
Size of a vector.

$$\vec{x} = \frac{40000}{\text{size}} \frac{\text{m}}{\text{unit}} \frac{\text{South}}{\text{direction}}$$

Size \rightarrow $|\vec{x}| = 40000$

~~\vec{x}~~

Uncertainty in Measurement.

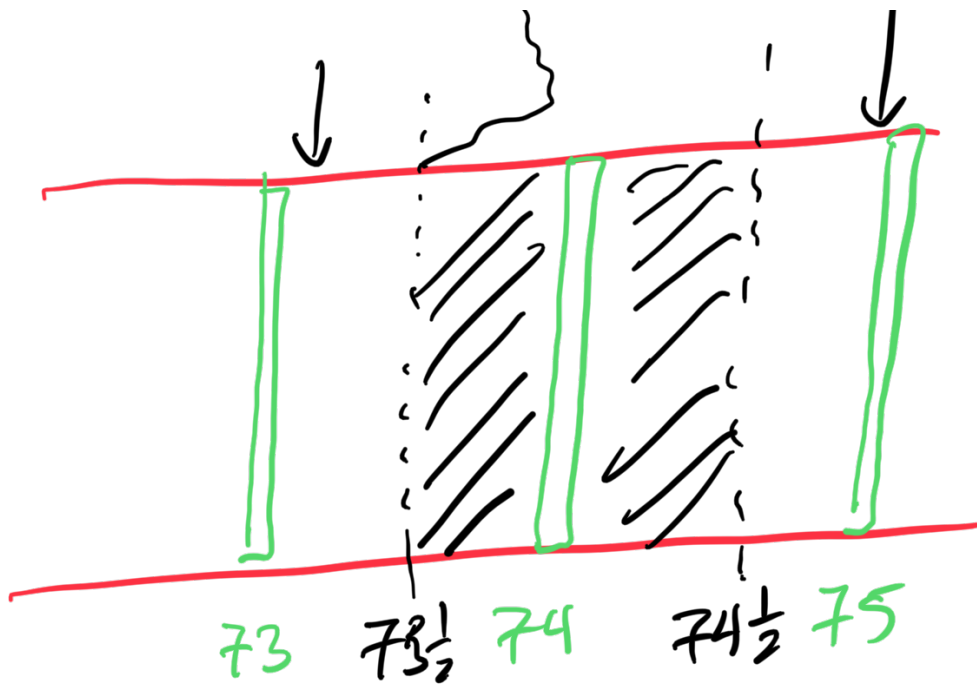


Smallest division = 1 mm

$$l = 74 \text{ mm}$$

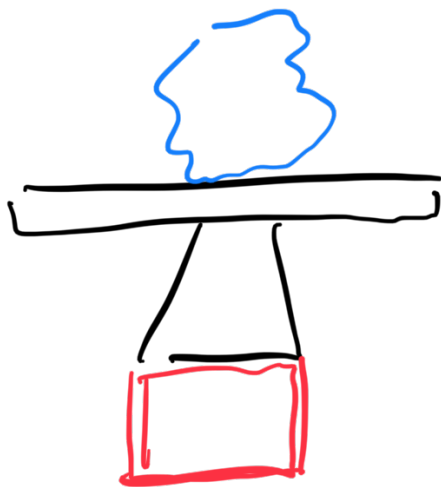
not 73 mm

not 75 mm



$$l = \left(74 \pm \frac{1}{2} \right) \text{ m}$$

≡



472 g

not 471 g

not 473 g

$$471.5g \leq m \leq 472.5g$$

$$m = \left(472 \pm \frac{1}{2} \right) g$$

Assignment : percentage error

$$\frac{\frac{1}{2} g}{472 g} \times 100\% \\ = 0.1059 \%$$