Class Note

Friday, September 22, 2017   10:16 AM

8/23 Uncertainty

Wednesday, August 23, 2017 9:29 AM

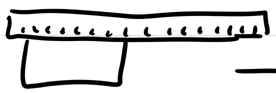
Uncertainty

Certain means 100% sure

uncertain means not 100% sure

Uncertainty (2 type)

Using a ruler to measure something



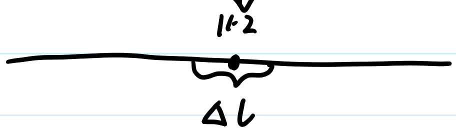
→ $l = 11.2$ cm

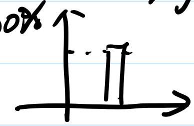
$l = 11.2 \pm 0.1$ cm

Δl (range) (relative) uncertainty

$\frac{\Delta l}{l}$ ((quality) percentage uncertainty

The true value lies between the relative uncertainty gap



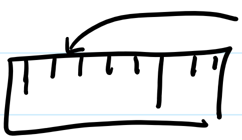


← quality of data

$\frac{\Delta l}{l}$ percentage uncertainty → the ratio of the uncertainty over total.

Δl relative uncertainty

measurement: (for 99% of measurement)

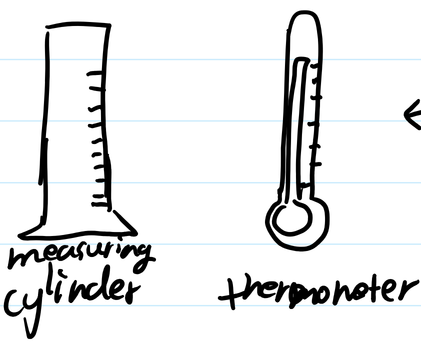


1mm gap → uncertainity is $\frac{1}{2}$ of smallest gap

Δ(start point + end point) = 1 smallest gap.

Δ uncertainty = smallest division

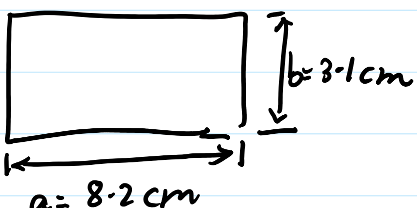
however there is some few exception



← the zero is already deal with by the design

Δuncertainity $= \frac{1}{2}$ smallest gap (division)

Calculation:



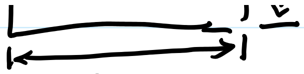
no multiplication

find $P = 2(a+b) = a+a+b+b$.

$P = 2(a+b) = 22.6$ cm $\Delta P = 0.1+0.1+0.1+0.1 = 0.4$

$P = 22.6 \pm 0.4$ cm

contain multiplication



a = 8.2 cm

$p = 22.6 \pm 0.4$ cm

contain multiplication

$A = ab$ 2-3 s.f (have, something)

$a = 8.2 \pm 0.1$ cm $b = 3.1 \pm 0.1$ cm

$A = ab = 8.2 \times 3.1 = 25.4\ cm^2$

+/− : add relative uncertainty
×/÷ : add percentage uncertainty

$A = 25.4 \pm \Delta A$

not need percentage for further calculation

$$\frac{\Delta A}{A} = \frac{\Delta a}{a} + \frac{\Delta b}{b} = \frac{0.1}{3.1} + \frac{0.1}{8.2} = 0.044$$

decimal point need to be identical → $\Delta A = A \cdot \frac{\Delta A}{A} = 25.4\ 0.044 = 1.1$

however, if ....

$$A = \frac{C^3 \cdot V^2}{\sqrt{t}}$$ ← find each individual and then combine together

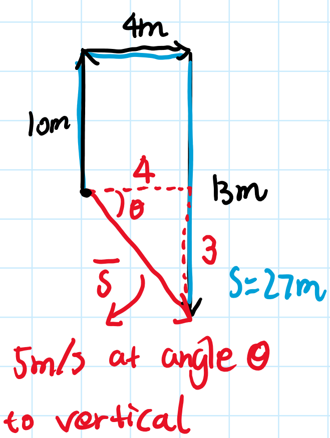
$$\frac{\Delta A}{A} = 3\frac{\Delta C}{C} + 2\frac{\Delta V}{V} + \frac{1}{2}$$

Do the example at home on the ppt in a seprate sheet
Run the uncertainty ppt
Assignment book p16-18
Bring AS Lab book
⭐ If we are having multiple Δ for calculation, the Δ is the smallest possible number of decimal point in all of the number

Vectors

Quantities:
- vector : quantity has both direction and magnitude (size / number, numeraical value)
- Scalor : has magnitude only

frequently asked question: Is this a vector / scalor



Vectors	Scalar
• velocity ($\vec{v}$)	• speed (v)
• displacement ($\bar{s}$)	• distance (s)
(weight/tension/friction) • Force ($\bar{F}$)	• mass (m)
• acceleration ($\bar{a}$)	• temperature (t)
• momentum ($m\vec{v}$)	• moment
	(actually strange) • electric field strength (in AS level)

The total 5 Vector you need to know in AS

The other are just scalar if it's not vector.

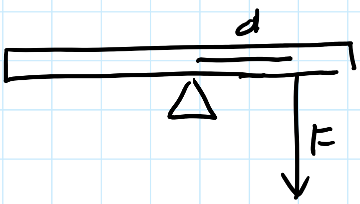
velocity is written as $\vec{v}$ / $\vec{v}$

distinguish between speed and velocity

⚠ $\vec{v}$ means vector, not average !

Strange Vector in consideration:

Vector · scalar usually is Vector (99%) Ve



F·d is a scalar (strictly a vector, but....)

① exception : moment

$E = \frac{F}{Q} \rightarrow \frac{\text{Vector}}{\text{Scalar}}$ should be Vector, but we make it Scala.

② exception: electric field strength

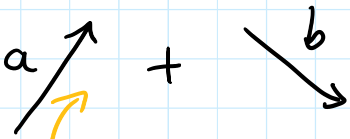
$W = \vec{F} \cdot \vec{S} \rightarrow$ Vector · Vector results in a scalar

Operation with Vector

① Adding

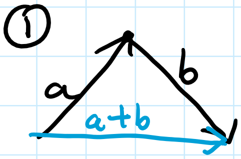
2 rules

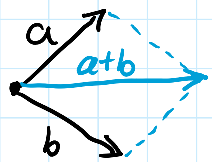
① Adding



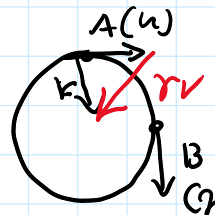
$\bar{a} + \bar{b}$

2 rules

① 

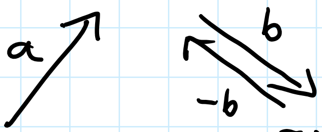
② 

These are called coplanar vector (on the same plane)
collinear Vector (belong to the same line)

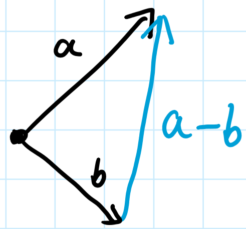


v is the same
$\bar{r}$ is not the same
$\Delta r = r - u = 0 \quad \Delta\bar{r} = \bar{r} - \bar{u} \neq 0$

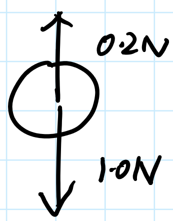
② subtracting
$\bar{a} - \bar{b}$ (from b to a) rules:



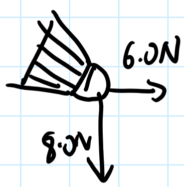
$\bar{a} - \bar{b} = \bar{a} + (-\bar{b})$
not allow to do in physics



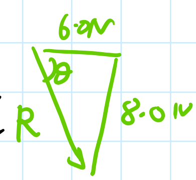
from end of $\bar{b}$ to end of $\bar{a}$



$\bar{R} = 0.8N$ downwards

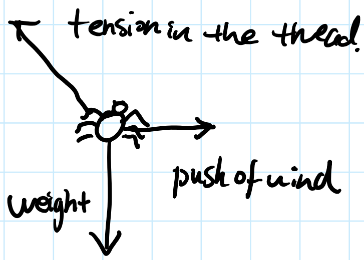


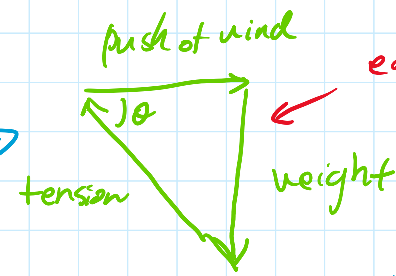
$\bar{R} = 10.0N$, 53° downward from vertical



③ Vector triangle

if the net force is 0, then it's equillibrium, and force will create the vector triangle





each arrow start from the end.

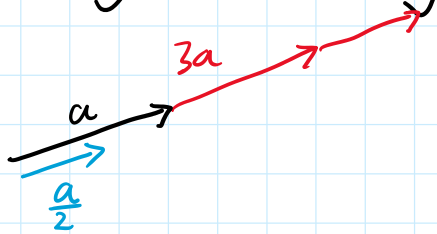
• $\boxed{\text{You need to label them}}$

I must be able to arrive to where I started

the drawing of vector triangle might be different, but they are all vector triangle.

④ Timing and dividing

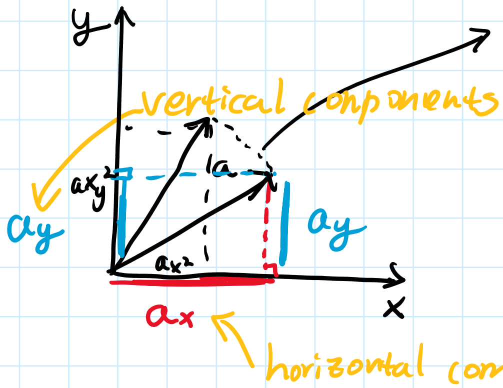
④ Timing and dividing



all of these primitive operation is used to describe complex things.

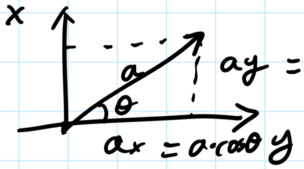
Resolving vectors → change it to scalars

totally describe the direction



$$a = \sqrt{a_x^2 + a_y^2}$$

only operate with number



$a_y = a \cdot \sin\theta$

$a_x = a \cdot \cos\theta$

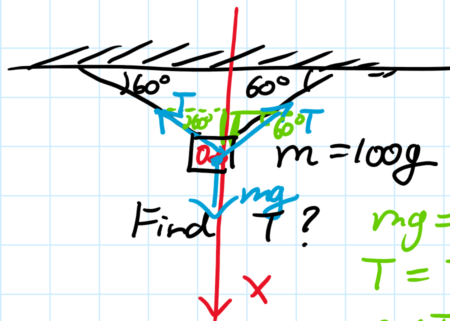
use sine rule and cosine rule

⑤ Projecting Vectors

↳ do on any axis (not the x-y axis on resolving)

worked example

1) draw free body diagram
2) chose axes
3) put perpendicular line

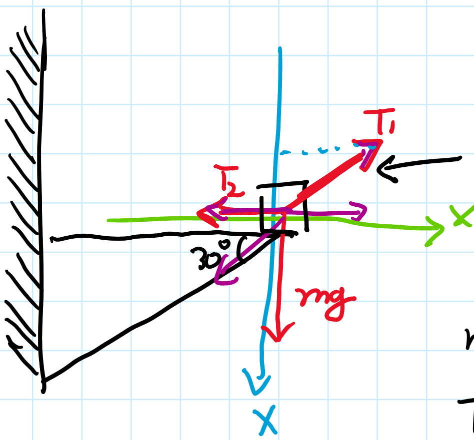


Find T?

$mg = mg$

$T = T\sin 60°$

$mg = 2 \times T\sin 60°$



must create vector triangle

$$\left.\begin{aligned} mg &= T_1 \cdot \sin 30° \\ T_2 &= T_1 \cdot \cos 30° \end{aligned}\right\}$$ combine and get the result.

9/1 Experiment Techniques

Friday, September 1, 2017 8:07 AM

when calculating gradient, do not use row data

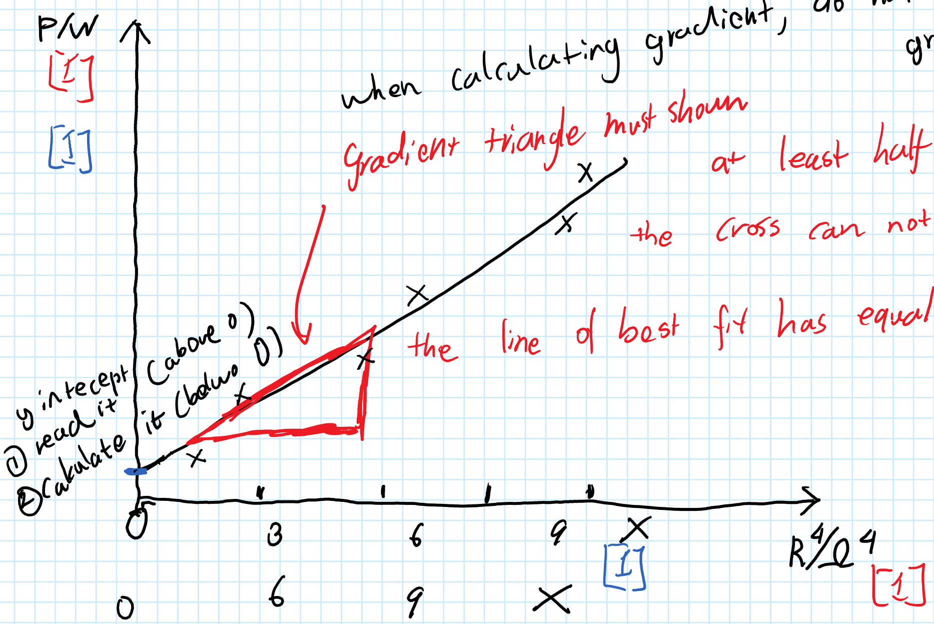
gradient $= \frac{D-D}{D-D} = xxy \ W\,\Omega^{-4}$

Gradient triangle must shown

at least half the scale each [1]

the cross can not be X (bulb), need to be small x

the line of best fit has equal number of point [1]



calculate intercept (below 0 / x don't start at 0)

$y = mx + b$ ← use another data to calculate it

0	3	6	9	X [1]
0	6	9	X	
2.1	3.1	4.1	X	
0	5	10	15	✓
0			10	X $\frac{10}{15} = \frac{2}{3}$
1	2	3	4	✓ don't need to start from 0

infintive decimal not allowed

9/6: Inertia

Wednesday, September 6, 2017 10:32 AM

Inertia

Inertia is reluctance of objects to change the speed

- It takes time for an object to change the speed
- Mass is the measure of inertia
    - The longer the mass, the longer the time require to change the speed

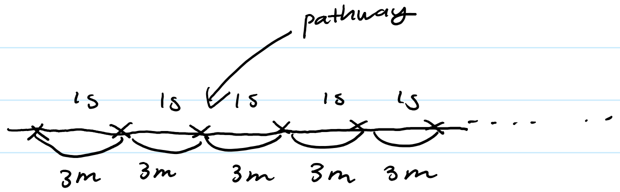
9/11: ULM and UAM

Monday, September 11, 2017 3:26 PM

Kinematics (motion)

ULM

uniform linear motion (steady speed motion)



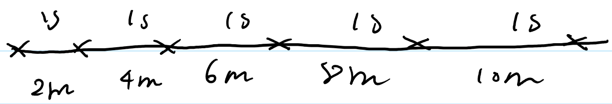
definition: means object covers = distances during equal time

formula: $V = \frac{s}{t}$ V is rate of change of s

m/s or km/h

plasticine
modeling clay
blue tel

uniform acceleration motion (constant acceleration) → constant change of velocity



UAM

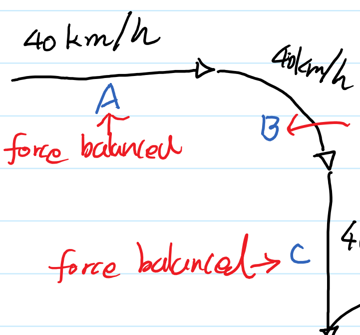
change in speed = 2m/s/s

$a = 2m/s^2$

Δ (delta → change) $\vec{a} = \frac{\Delta v}{t}$

acceleration is the rate of change of velocity

20 min = $\cancel{\frac{1}{3}}$ no fraction as the final answer! (allow in intermediate)



$\boxed{\text{no h/ min/ km for acceleration} \quad \text{only } m/s^2!}$

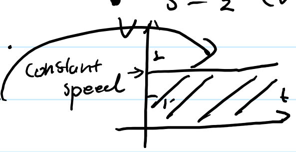
know the derivation of the formula.

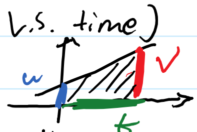
- $V = u + at$ (from definition $a = \frac{v-u}{t}$) $a = \frac{\Delta v}{t} = \frac{v-u}{t}$ $at = v-u$ $V = u + at$

$S = \int v\,dt$

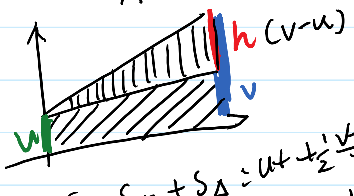
- $s = \frac{1}{2}(v+u)t$ (distance is the area of velocity v.s. time)

Area = distance · time





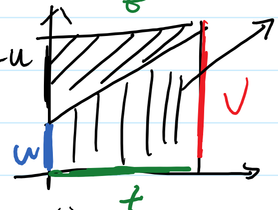
$S = \frac{1}{2}(v+u) \cdot t$



- $s = ut + \frac{1}{2}at^2$ v-u

$S = S_\square + S_\Delta = ut + \frac{1}{2}\frac{v-u}{t} \cdot t \cdot t$

$= ut + \frac{1}{2}at^2$



$Vt - \frac{1}{2}at^2$

- $v^2 - u^2 = 2as$ (by cancelling t from v and u)

$v = u + at$ $s = ut + \frac{1}{2}at^2$ $t = \frac{v-u}{a}$ $S = \frac{u(v-u)}{a} + \frac{1}{2}a\frac{(v-u)^2}{a^2}$ $= 2u(v-u) + (v-u)^2$

$$2as = 2u(v-u) + (v-u)^2 = \cancel{2uv} - 2u^2 + v^2 - \cancel{2uv} + u^2 = v^2 - u^2$$

the first five seconds of motion   inital speed $= 0$

$$V_{average} = \text{average speed} = \frac{\text{total distance travled}}{\text{total time taken}}$$

UAM

ULM

$$\text{average velocity} = \frac{\text{total displacement travelled}}{\text{total time taken}}$$

work example S

$40km/h$ t_1

$60km/h$ t_2

$t_1 \neq t_2$

$V_{average} = ?$ [3]

$$V_{average} = \frac{S_{total}}{t_{total}} = \frac{2S}{t_1 + t_2} = \frac{2S}{\frac{S}{V_1} + \frac{S}{V_2}} = \frac{2}{\frac{1}{V_1} + \frac{1}{V_2}} = \frac{2V_1V_2}{V_1 + V_2}$$

Falling Under Gravity: ($g = 9.81\ m/s^2$).