

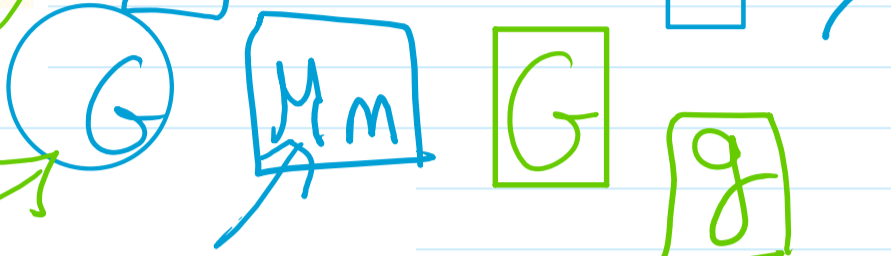
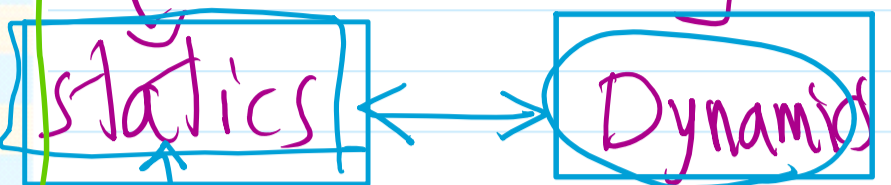
2- The multiples of units:

Unit	symbol	measure
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	K	10^3

Fractions of units:

units	symbol	measure
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	u	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Mechanics



9.8

[h]

m
min.
s

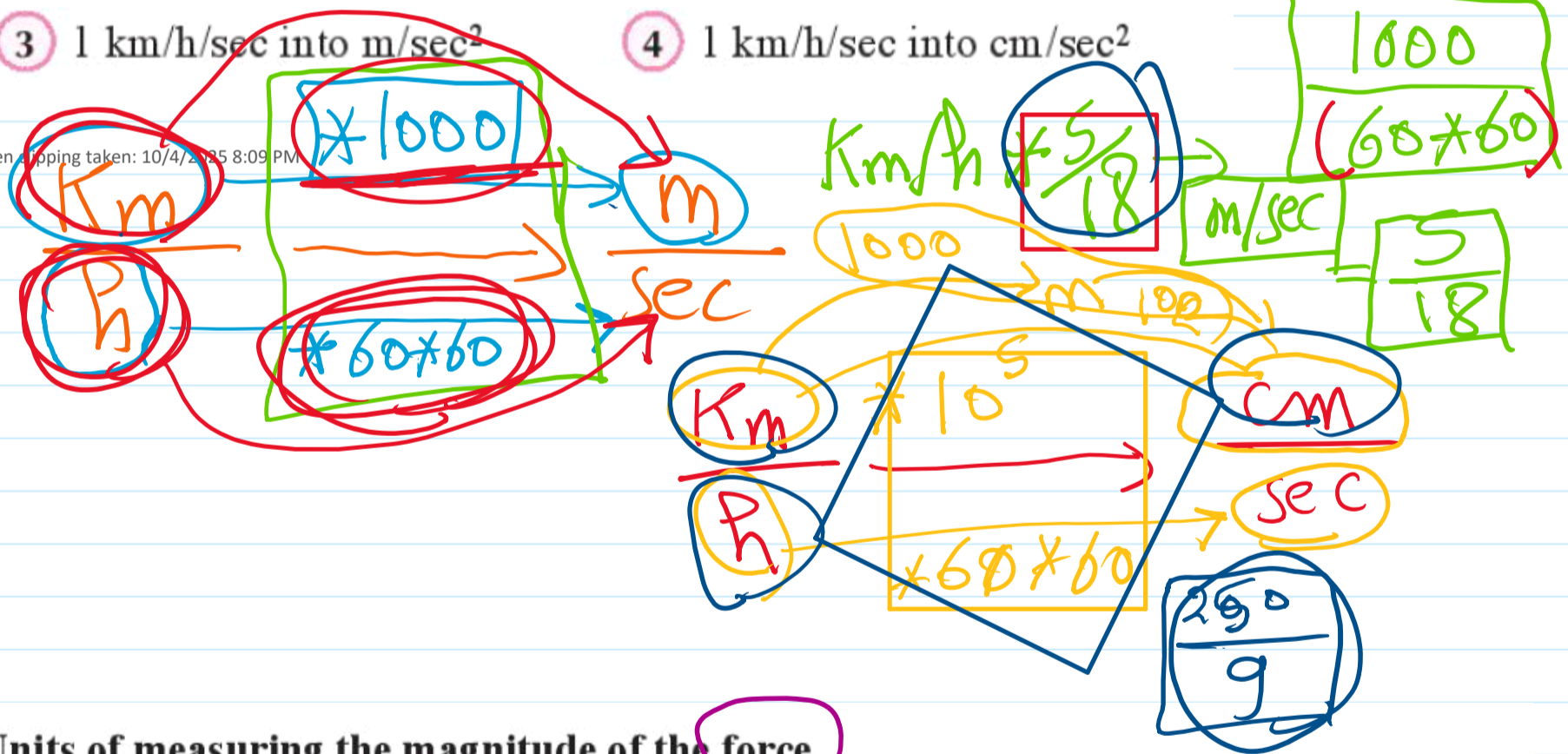
2 Acceleration

Acceleration is known as the rate of changing of velocity according to time. So that, acceleration is measured by the unit: m/sec. square (m/s^2)

$v \rightarrow m/sec$
 $a \rightarrow m/sec^2$

According to that we can transfer each of the following units to their corresponding units:

- 1 1 km/h into m/sec.
- 2 1 Km/h into cm/sec.
- 3 1 km/h/sec into m/sec^2
- 4 1 km/h/sec into cm/sec^2



Units of measuring the magnitude of the force

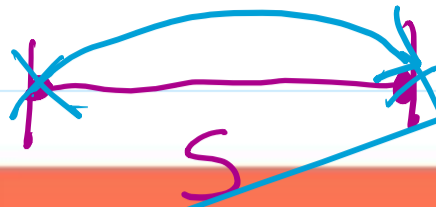
Absolute units:

As: Dyne and Newton, where: 1 Newton = 10^5 Dyne and they will define as follow:

* **Newton**: is the magnitude of the force that if it is acts on a mass equals 1 kilogram it gains an acceleration of magnitude 1 m /sec²

* **Dyne**: is the magnitude of the force that if it is acts on a mass equals 1 gram it gains an acceleration of magnitude 1 cm /sec²

start P. end point



Derived quantity	Relation with other quantities	measurement unit
Velocity (V)	Displacement ÷ time	m/s
Acceleration (a)	velocity ÷ time	m/s ²
Force (F)	mass × acceleration	N

Handwritten notes on the table:

- Velocity (V) is circled in blue.
- Displacement ÷ time is circled in purple.
- Acceleration (a) is circled in blue.
- velocity ÷ time is circled in blue.
- mass × acceleration is circled in blue.
- Measurement units: m/s, m/s², and N are circled in blue.
- Handwritten unit conversions: 60 (circled in red), 60 K/h (circled in yellow), 60 min, and 60 K.
- A speedometer diagram is drawn with 'Km/h' and a needle pointing to a value.
- A red box contains the number '120'.
- Red arrows and boxes connect the handwritten notes to the table.

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Handwritten note: 200 N/g

Handwritten note: 200 N [] → ✓✓

Properties of force

force

magnitude & direction

First: magnitude of a force.

The magnitude of a force is determined by comparing it by a unit of force, the main units of measuring the magnitude of a force in mechanics are **Newton (N)** or kilogram weight

(kg.wt) where: weight

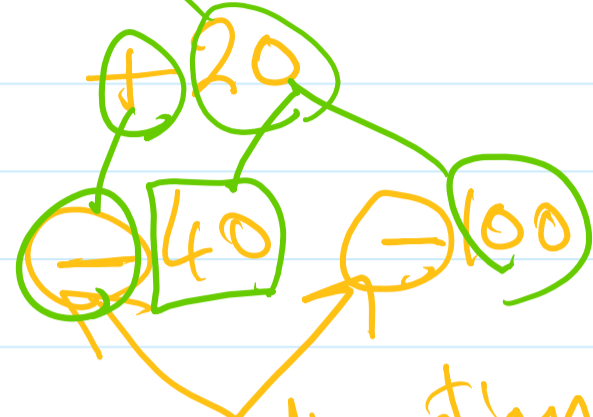
➤ 1 Kg.wt = 1000 gm.wt

1 Newton = 10^5 dyne

➤ 1 Kg.wt = 9.8 newton

1 gm.wt = 980 dyne

The rigid shape does under the force
The elastic shape can under the force as liquids, clay,



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Secondly: Direction of a force

Figure (1) represents the force vector \vec{F} which could be represented by a directed line segment \vec{AB} where A is its initial point, B is its terminal point. The magnitude of the force is determined by $\|\vec{AB}\|$ (its length with a suitable drawing scale). The direction of the arrow is corresponding to the direction of the force \vec{F} , where θ is called the polar angle in the plane of the force \vec{F} . Force is written in the polar form as (f, θ)

cos.

Add to your knowledge
Polar angle is the positive angle that the vector makes with the positive direction of x-axis.

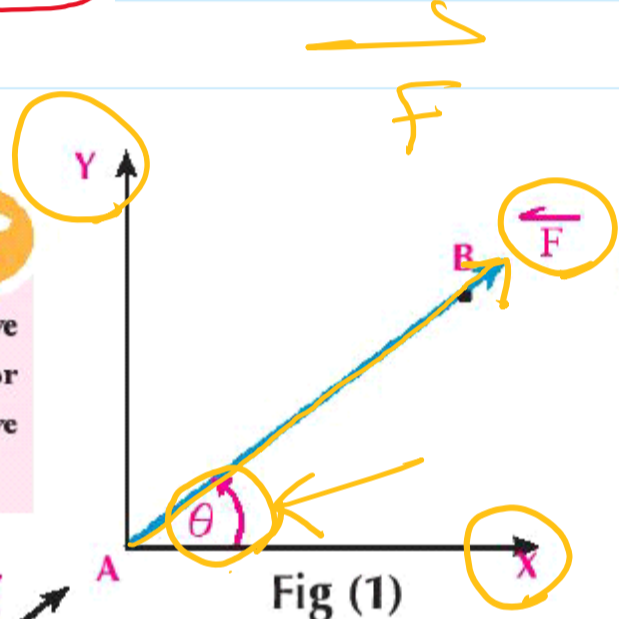


Figure (2)

The dir. of force when $\theta = 75^\circ$

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$\theta = -75^\circ$

Thirdly: Point of action of the force and its line of action

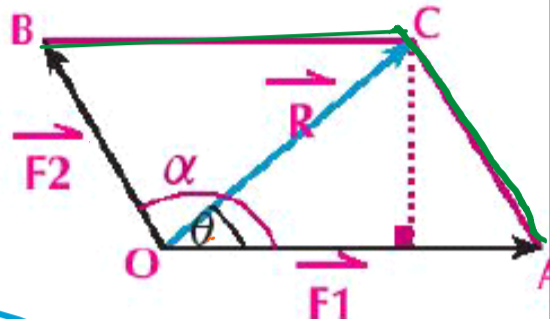
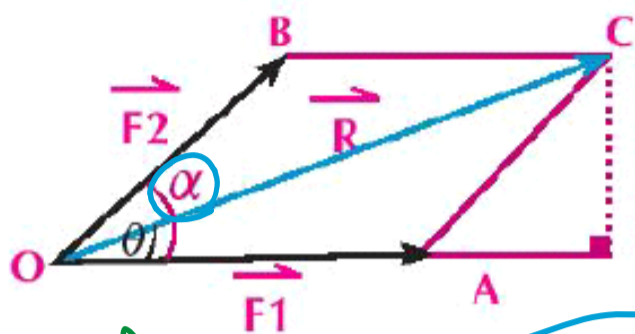
In figure (1) : Point A is always coincide on the point of action of the force \vec{F} , it is possible to transfer the point of action of the force to any other point lying on the line of action of the force without changing in its effect on the body as in **figure (2)**, The line of action of the force \vec{F} in **figure (1)** is denoted by \vec{AB} , i.e. the line of action of a force, is the straight line which passes through its point of action and is parallel to its direction.

B C

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- ① origin point
- ② +ve direc. of x-ax.

The resultant of two forces meeting at a point analytically



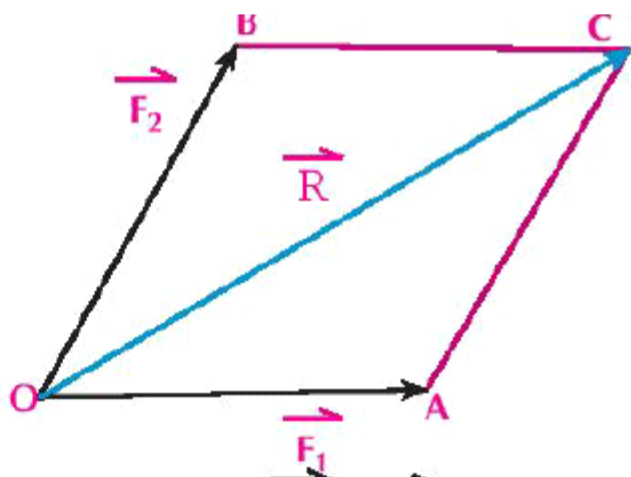
geometry
Trig.
algebra

angle bet two forces = α
angle bet. 1st force & resultant = θ

through its point of action and is parallel to its direction.

Resultant of two forces acting on one point:

for any two forces acting on a body at the same point there is a resultant force \vec{R} that acts at the same point and has the same effect of the two forces, it is represented geometrically by the diagonal of the parallelogram that represent the two forces by two adjacent sides.



In the opposite figure: \vec{R} is represented by the diagonal of the parallelogram (\vec{OC}), \vec{R} represents the resultant of the two forces \vec{F}_1 , \vec{F}_2 . **i.e.:** $\vec{R} = \vec{F}_1 + \vec{F}_2$

$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \alpha}$

$\tan \theta = \frac{F_2 \sin \alpha}{F_1 + F_2 \cos \alpha}$

dire^o

magnitude F_1 F_2

- ① Two forces of magnitudes 3 & $3\sqrt{2}$ newton act on a particle and the measure of angle between their lines of action is 45° . find the magnitude of their resultant and the measure of its inclination angle with the first force.

$\alpha = 45$

$R = \sqrt{3^2 + (3\sqrt{2})^2 + 2 \times 3 \times 3\sqrt{2} \times \cos 45}$

$R = 3\sqrt{5} \text{ (N)}$

$\tan \theta = 3\sqrt{2} \sin 45$ $\tan \theta = \frac{1}{2}$

$F_1 = 3 \text{ N}$

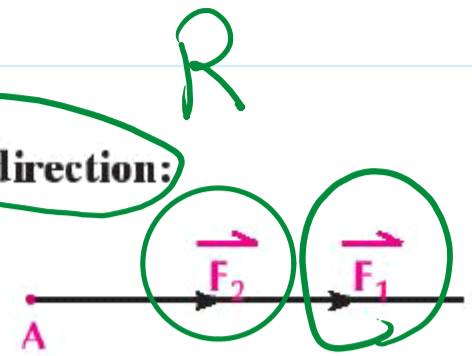
$$\tan \theta = \frac{5\sqrt{2} \sin 45}{3 + 3\sqrt{2} \cos 45}$$

$$\tan \theta = \frac{1}{2}$$
$$\theta = 26^{\circ} 33' 54''$$

Special cases:

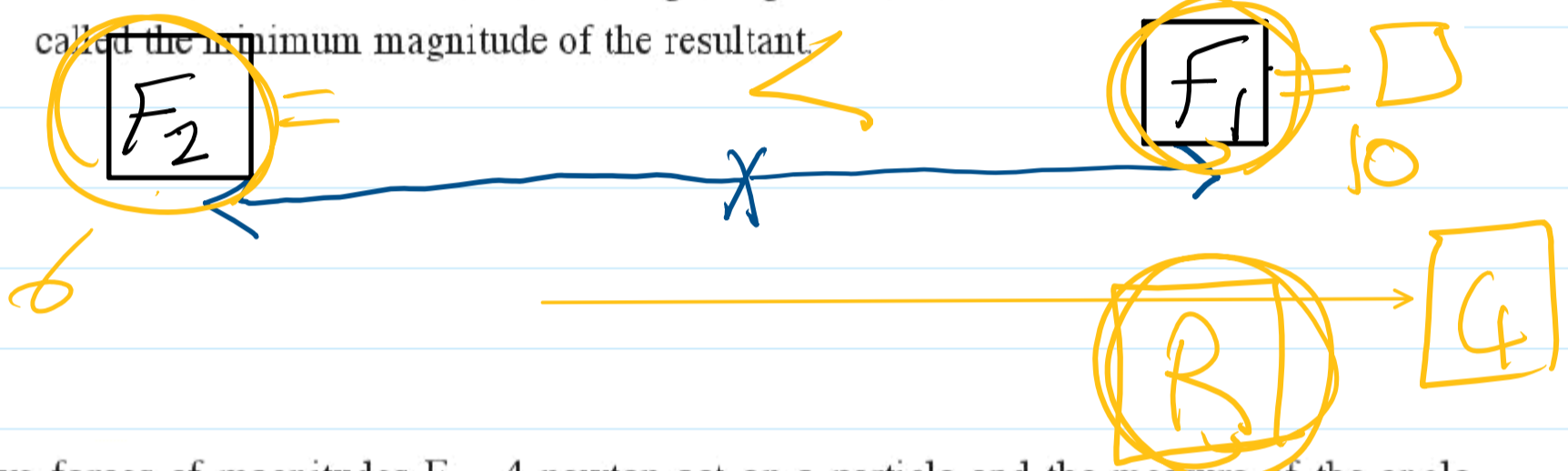
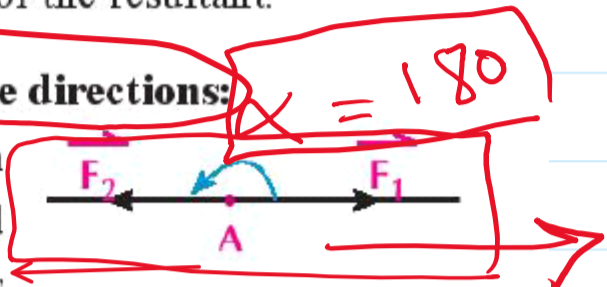
1- If the two forces have the same line of action and the same direction:

- In this case: $m(\angle \alpha) = 0$; $\cos \alpha = 1$ and by substitution in the resultant rule, we will find that $R = F_1 + F_2$, the direction of the resultant is the same direction as the two forces, In this case R is called the maximum magnitude of the resultant.



2- If the two forces have the same line of action and opposite directions:

- In this case: $m(\angle \alpha) = 180^\circ$; $\cos \alpha = -1$ and by substitution in the resultant rule, we will find that: $R = |F_1 - F_2|$ and \vec{R} acts in direction of the force or large magnitude, R is called the minimum magnitude of the resultant.



- ③ Two forces of magnitudes F , 4 newton act on a particle and the measure of the angle between their directions is 120° , the magnitude of their resultant equals $4\sqrt{3}$ newton. Find the magnitude of \vec{F} and the measure of the angle that \vec{R} form with \vec{F} .