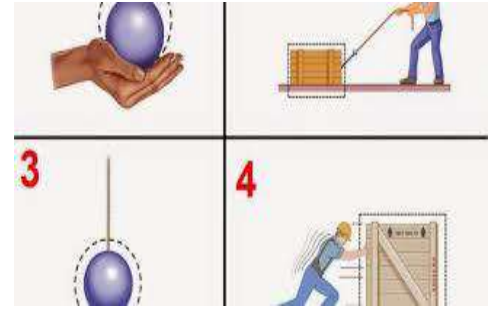


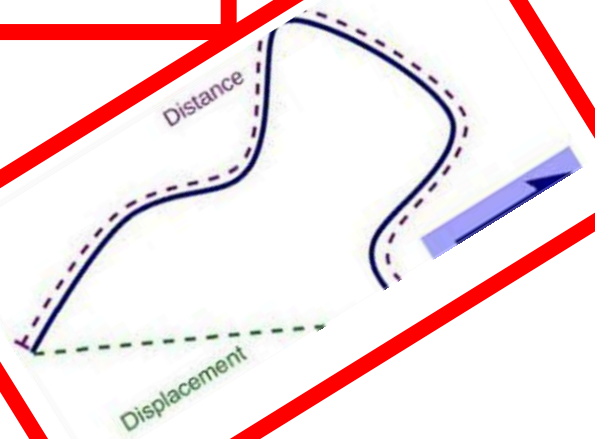
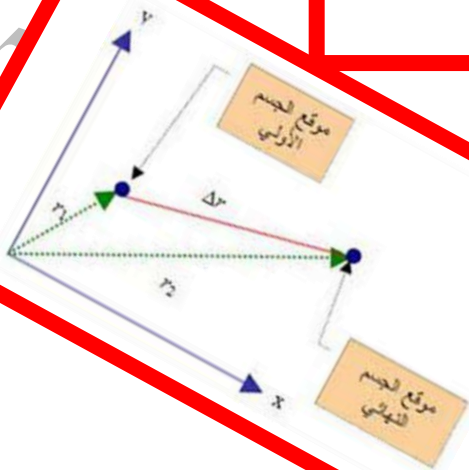
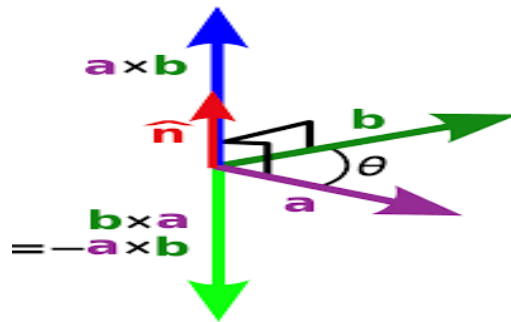
Physics G 9Advance



Displacement and Force in two dimensions

إعداد

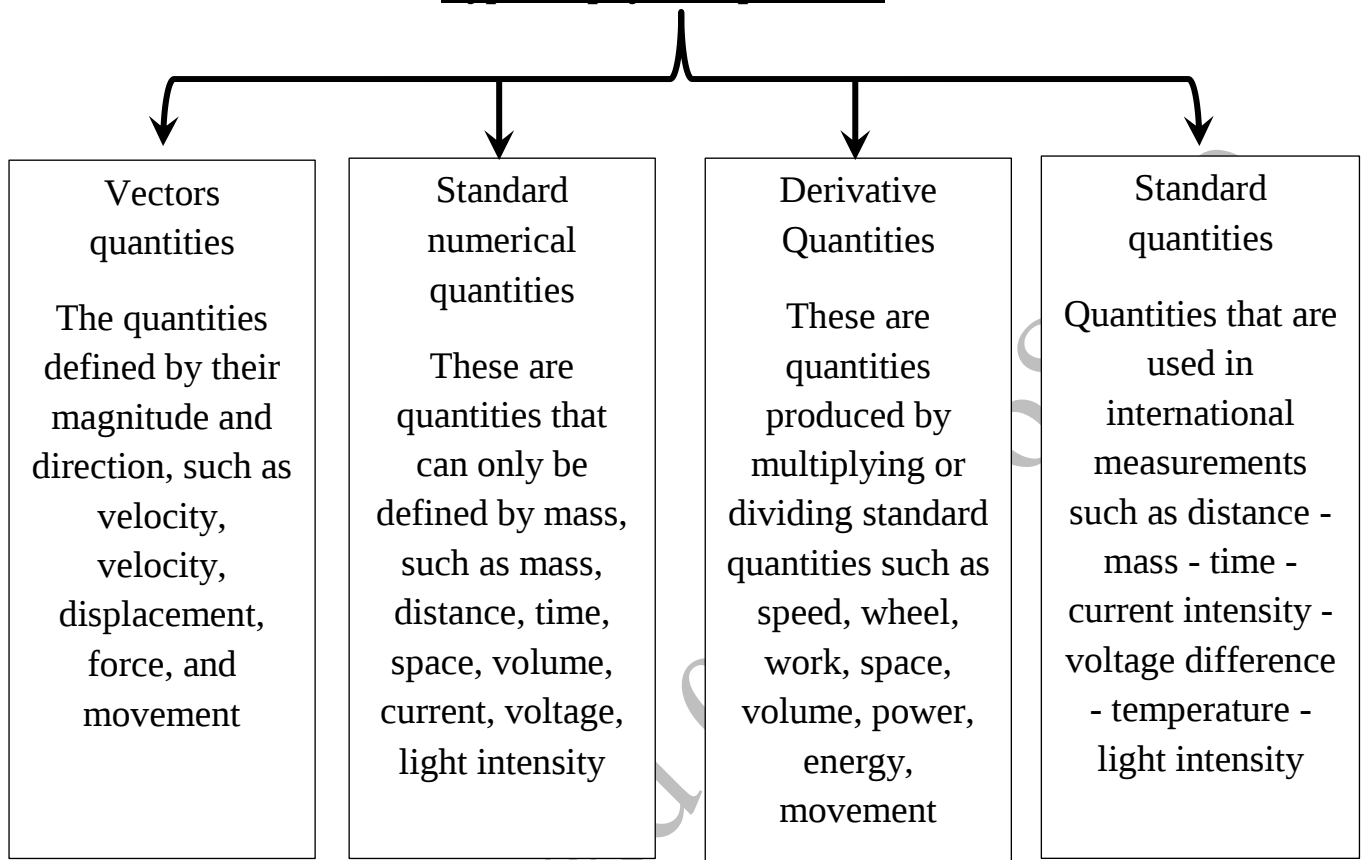
الأستاذ / مجدي عوض



Vector

First: Physical quantities:

Types of physical quantities



Q: When can speed be considered a numerical quantity and when can be considered a vector quantity

Graphical representation of the vector:

In order to represent the vector, the following conditions must be met:

- ① Know the starting point
- ② Know the amount
- ③ Know the direction
- ④ Choose an appropriate drawing scale
- ⑤ Know the endpoint

The starting point is called the "vector tail" and the end point is called the "vector head"

Example: Ahmad walked 20 m eastward as graphically

- ① Select the scale (the vector length will be 10 cm every 1 cm representing 2 m)
- ② The starting point is specified and the steps above are completed

The start point .
the tail



The endpoint
head

Vector Transport :

The vector can be moved from one location to another with two basic conditions available

- ① Maintain vector quantity
- ② Maintain vector direction

Adding vector (calculation resultant):

The collection of vector quantities is required to consist of the same type and have the same measurement units. The result of the collection process is called the sum and symbolized by the symbol (R)

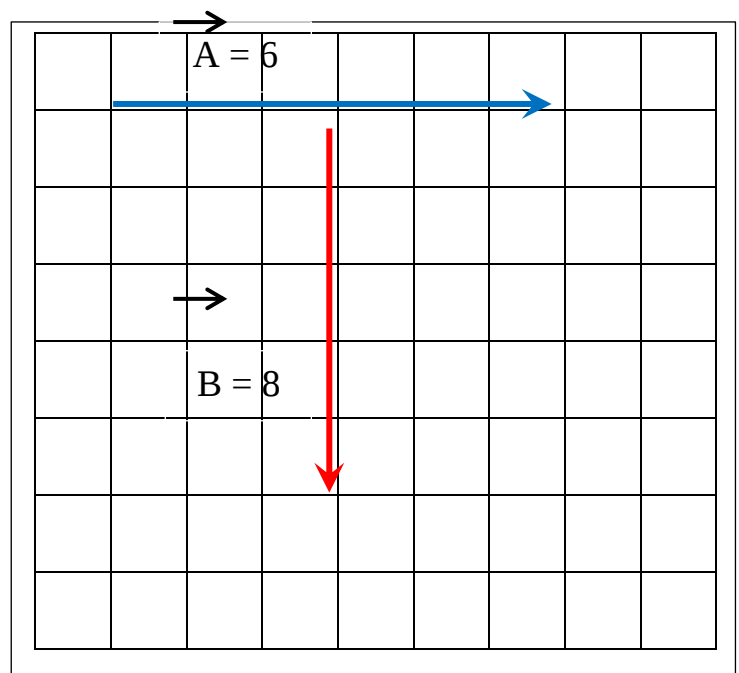
Adding Vectors methods:

First: Graph Method

Adding vectors can not be completed according to the adjacent drawing

For adding vectors process you can follow the following steps

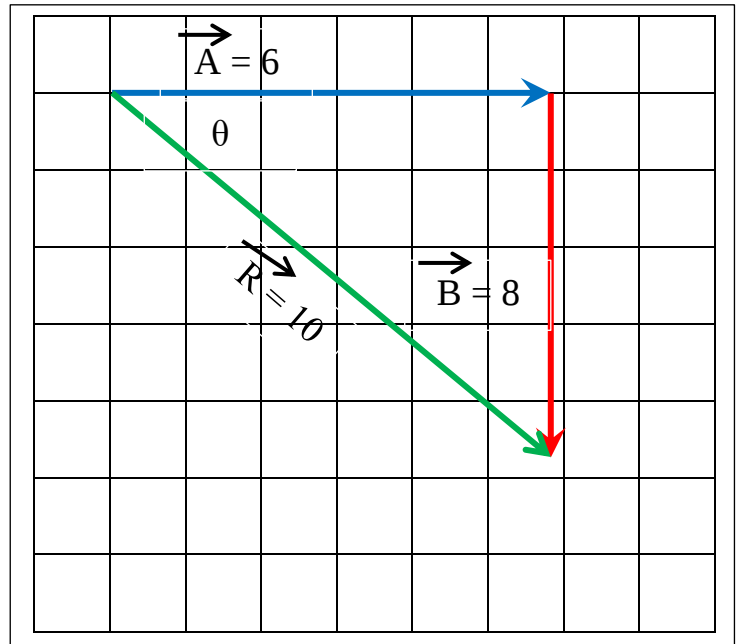
- 1 - For adding vectors process, the vector (B) must be moved while maintaining the vector value and direction as mentioned before
- 2 - The head of the vector (A) must meet with the vector tail (B)



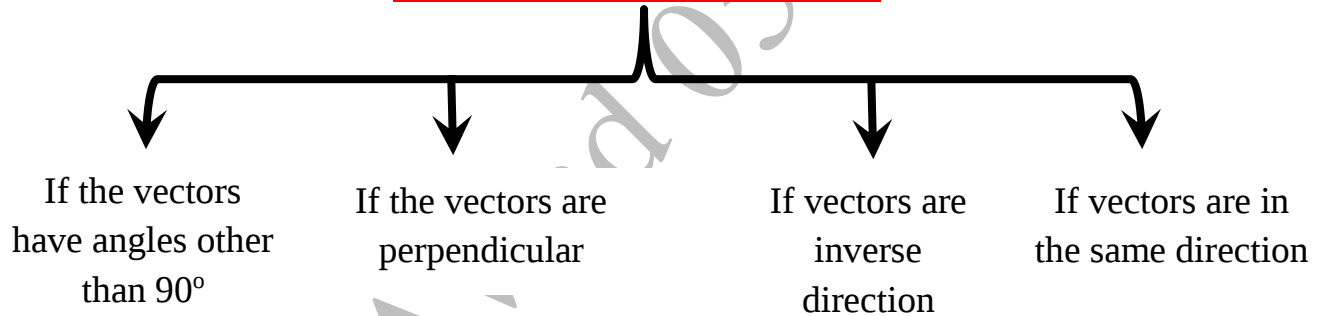
3. The distance from the tail of the vector (A) to the vector head (B) is measured and this is the value of the required sum

4. The direction of the resultant from the tail of the first vector (A) to the second vector head (B)

5. The angle of the sum from the first starting point is measured from the starting point of the vector (A) and denotes the vector angle (θ)

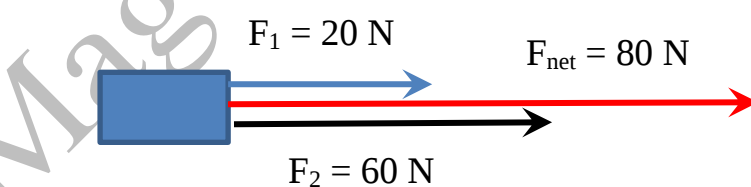


Second: Mathematics methods



First If vectors are in the same direction :

Example: Two forces affected an object to the east and the first force of 20 N and the second 60 N find resultant and the direction

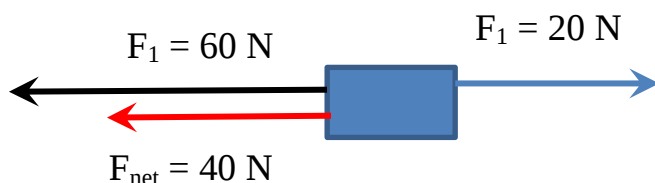


الحل :

$$F_{\text{net}} = F_1 + F_2 = 20 + 60 = 80 \text{ N}$$

Second: If vectors are inverse direction

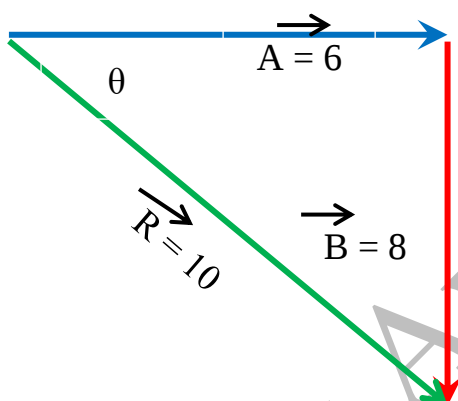
Example : two forces affected one object, one in the east and the other in the west direction. The first force of 20 N and the second 60 N find resultant and direction



$$F_{\text{net}} = F_1 + F_2 = 20 + (-60) = 40 \text{ N} \quad \text{on west}$$

Third : If the vectors are perpendicular

Example: Ahmad traveled 6m to the east and then to 8m in the south direction, respectively. Find the resultant of the two forces and their direction



$$R = \sqrt{A^2 + B^2}$$

$$R = \sqrt{6^2 + 8^2} = 10 \text{ m}$$

$$\theta = \tan^{-1} \frac{\text{opposite}}{\text{adjacent}}$$

$$\theta = \tan^{-1} \frac{8}{6} = 53.1$$

Fourthly: If the vectors have angles other than 90°

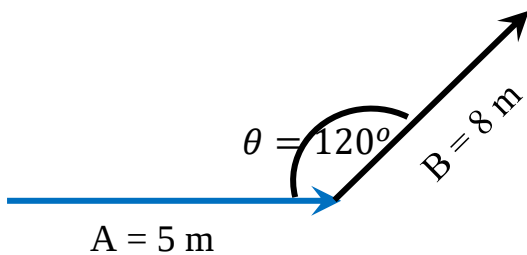
There are two different ways to resolve this type of vector

Method 1: cosine rule

It is necessary to use this method to know the amount of vectors and the angle value between them

$$R = A^2 + B^2 - 2AB \cos\theta$$

Example: find the resultant of the vector shown in the following figure



الحل

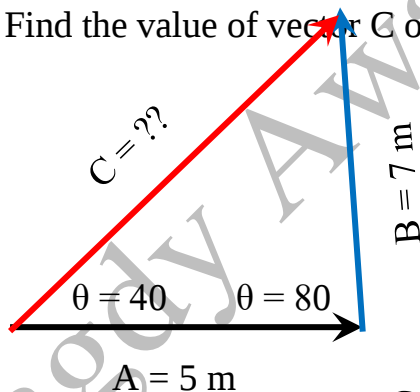
$$R = \sqrt{5^2 + 8^2 - 2 \times 8 \times 5 \cos 120} = 12.9 \text{ m}$$

Method 2: The sin rule :

It is necessary to use this method to know the amount of vector and two angles, one facing the known vector and the other facing the resultant or the side to be found

$$\frac{A}{\sin \theta_A} = \frac{B}{\sin \theta_B} = \frac{C}{\sin \theta_C}$$

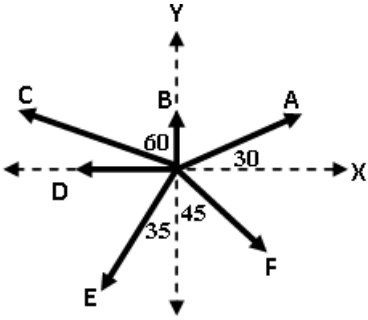
Example: Find the value of vector C of the following graphic



$$\frac{C}{\sin \theta_C} = \frac{B}{\sin \theta_B}$$

$$\frac{C}{\sin 80} = \frac{7}{\sin 40} \quad \therefore C = \frac{7 \sin 80}{\sin 40} = 10.27 \text{ m}$$

Summary and Notes on Vector



المتجه	الطريقة الأولى	الطريقة الثانية
A	يصنع زاوية 30 مع محور X الموجب	يميل بزاوية 30 شمال الشرق
B	يصنع زاوية 90 مع محور X الموجب	الشمال
C	يصنع زاوية 150 مع محور X الموجب	يميل بزاوية 60 غرب الشمال
D	يصنع زاوية 180 مع محور X الموجب	الغرب
E	يصنع زاوية 235 مع محور X الموجب	يميل بزاوية 35 غرب الجنوب
F	يصنع زاوية 315 مع محور X الموجب	الجنوب الشرقي

Draw	The direction of the resultant	Amount of resultant	Case	م
	In the direction of the vectors	$R = A + B$	Two Vector in the same direction	1
	In the direction of the larger vector	$R = A + (-B)$	vector in opposite direction	2
	$\theta = \tan^{-1} \frac{\text{opposite}}{\text{adjacent}}$	$R = \sqrt{A^2 + B^2}$	They are perpendicular (Between them angle 90°)	3
	$\frac{R}{\sin \theta} = \frac{A}{\sin a} = \frac{B}{\sin b}$	$R = \sqrt{A^2 + B^2 - 2AB \cos \theta}$ The law of cosine	Two vector have angel >90 or < 90	4

مسائل على إيجاد المحصلة

1 - If the sum of their force is equal to (520 N) when pulling in the same direction, and equal to (160 N) when they are pulling in opposite directions, calculate the force of each worker separately.

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2 - walk a cat on the pavement and cut a distance of (30 cm to the north then walk 60 cm) to the west:

Calculate the total displacement of the cat and determine its direction on the graph

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B) Calculate the angle created by the total displacement of the cat with the north direction.

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3. A person moved 140 m south and then moved 80 m towards the corner of 40° South west

A) Illustrate the movement of the person.

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B) Calculate the total displacement of the person and set their direction on the drawing

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C) Calculate the angle made by the offset with the south direction.

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4 - Can a vector be equal to zero? Explain this

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5- two forces ($F_1 = 18 \text{ N}$), $F_2 = 14 \text{ N}$) affect an object, calculate the amount and direction of the force obtained if the angle between the two forces:

A) Zero

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B) 180°

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C) 90°

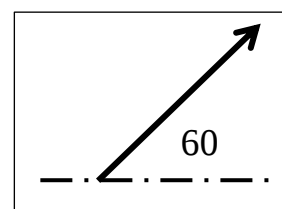
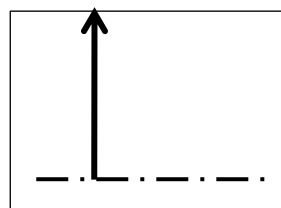
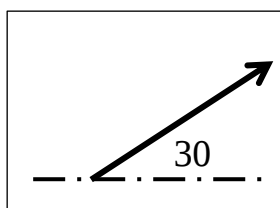
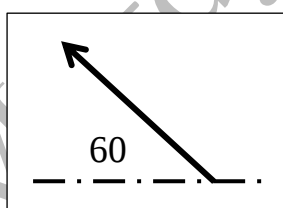
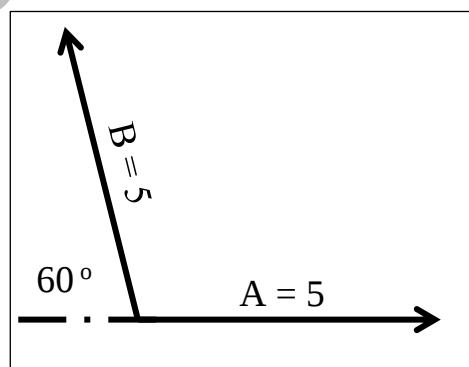
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D) 120°

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6. In the adjacent shape, the vectors ($\vec{A}$ and $\vec{B}$) are equal in magnitude

Which of the following forms represents their findings with the reason



7 - In the search for treasure The map indicates the leader of the scout camp team in one of the islands to walk 16 m (east and then 7 m south and then 4m west and finally 2m north to the treasure:

A) Draw the path of the scout camp team leader

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B) How far will the leader go to the treasure?

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C) If the commander follows the prescribed path, how much is his total clearance? What direction?

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8. A butterfly flies from a branch of a tree at a distance of 1.2m, with a straight, evaporated path that rises from the earth's surface (3.4m) and when you see a flower landing vertically (1.4m) until you reach it. What is the total butterfly displacement? What direction?

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9. The back picks up the ball from the midfield and runs back (10m) and set aside parallel to the midline (15m). The ball then throws a distance of 50m towards the length of the pitch. What is the total displacement of the ball?

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10. A cyclist passes 40m in the east and a distance of 30m to the north.

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11- climbs the world of the effects of the Great Pyramid in Giza, if the height of the pyramid (136m) and base (230m) what the amount of displacement of the world and what direction during the climb of the pyramid from bottom to top

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12. If the value of two orthogonal forces is 10 N and the value of one of the forces (6 N) is the value of the second force

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Vector Analysis

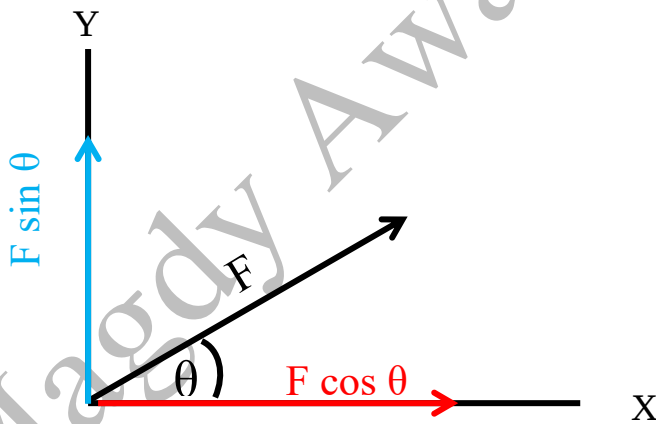
The resultant is to find a vector-from two vectors known. The analysis is a vector from which we get two vectors called the two orthogonal vehicles of the vector, one in the direction of the axis (X) and the other in the direction of the axis (Y)

Note very very important:

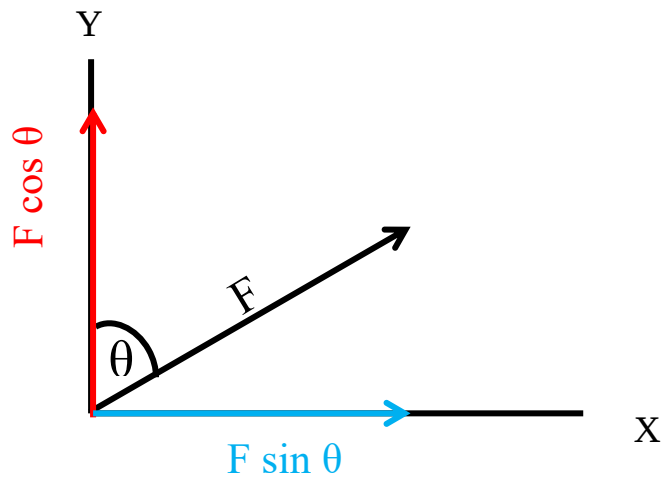
- ① The amount of the original vector is always greater than the amount of any of its two components
- ② Adopts a vector component signal on the quadrant where it is located. Which depends on the angle made by the vector with the X axis.
- ③ The rib from which the angle is measured, whatever its position takes cos, or the second side takes the value sin

Examples :

- ① The horizontal component in the direction vector (X) is $F \cos$.
- ② The vertical component in the direction (Y) is $F \sin$.



Note that the value Cos or the value Sin is determined by the position of the angle



Note very very important:

If a vector is applied or parallel to one axis, its component on the other axis = zero
because $\cos 90 = 0$

problems on vector analysis

1 - Displacement ($\vec{d}$) at (80 m) towards making (40°) southeast.

A) Draw the offset

B) Find the displacement vehicles

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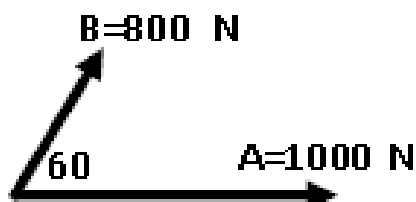
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2. If the vertical vehicle ($B_y = 16$) and ($B = 20$) is the value of (B_x)

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3. Calculate the amount and direction of the force collected as follows:

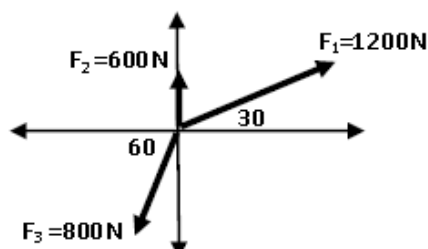


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4. Calculate the amount and direction of the force collected as follows:



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5 - Hamad walked 300 meters in the direction of the east and then walked 200 meters in the direction of (30 o) east - north and then walked (100 m) in the direction (60 o) degree north - west.

A) Draw a diagram of the path Hamad

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B) Calculate Hamad's displacement by a measure and direction.

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6 - Hamed moved from his house to the north and a distance of (6 km) and then turned east, and became displaced from the house (8 km)

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7 - Ahmed walks distance (0.4 km) at an angle (60 o) west of the north and then walks west. Draw the path of Ahmed's movement and then find Ahmed's displacement.

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8 - A person (4.5 km) walked in a direction and then turned at a angle (45 o) degrees to the right and walked a distance (6 km) How much clearance

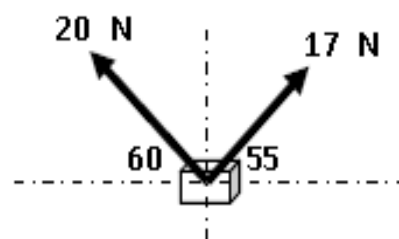
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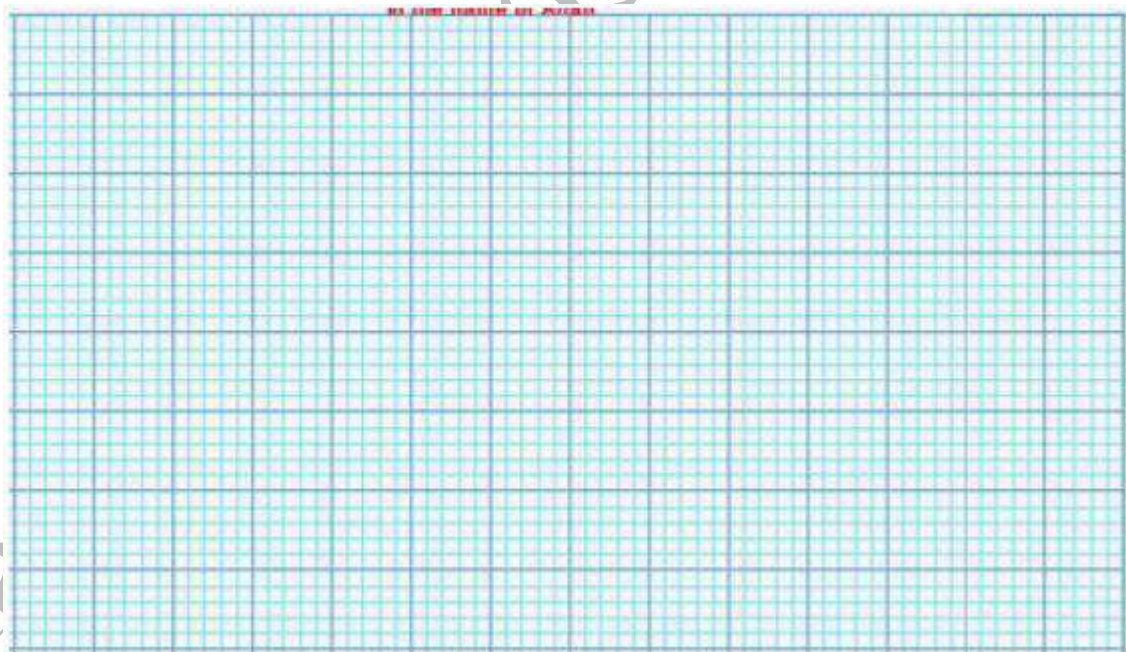
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9 - Brothers raise the fund of its mass (3.2 kg) by ropes. As shown in the figure

adjacent . Calculate the sum of the forces that influence the fund



10. An aircraft flying at a speed of 300 m / s at an angle of 35° north-east. (50 m / s) at an angle (15 o) west of the north. Between drawing the amount and direction of the velocity of the plane



11. The adjacent figure shows three forces (A, B and C) on a graph sheet using the vector analysis method to calculate.

A) the force-sum vehicle on the X-axis

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B) the force-force vehicle on the Y axis

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H) The total amount of the proceeds

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D) The direction of the outcome

12. Draw a three-strand balance as shown in the adjacent shape. How much power is the balance

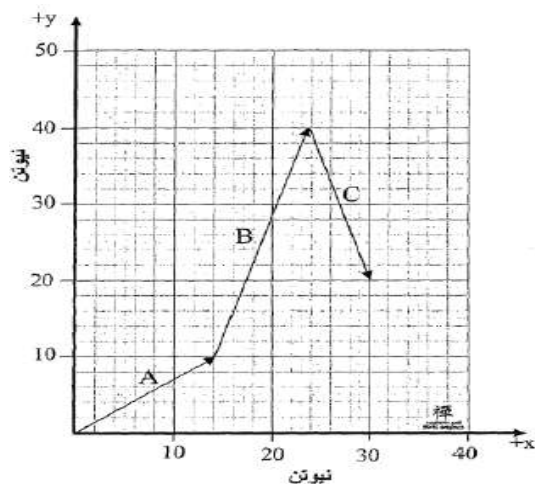


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13. Your school is located 15 km in the direction of making (30 °) northwest of your home, but the only way to reach the school is to walk 5 km to the north. What distance should you take to reach the school and in any direction?

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14. A truck runs on the horizontal runway of the airport in a straight line, always under an aircraft flying in the direction of making (32 °) above the horizontal. If the truck speed counter refers to (95Km / h), is the aircraft's vertical speed vehicle?

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15. A footballer runs 35m towards the length of the pitch before turning at a 25 ° angle to the right of his or her original course, running 15m before stopping another player. What is the total displacement of the player? What direction?

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Friction

Types of friction

Kinetic friction
(F_k)
It occurs when the object moves
Friction strength is less than force
Object in motion
A friction between the two surfaces results from the movement of one or both surfaces

Static friction
(F_s)
It occurs when the object is about to move
Force of friction = force
The object is relatively balanced
It results from friction between the two surfaces in the absence of movement between the two surfaces

Factors Affecting Friction Force :

- ① Surface materials ② The area of the touching surfaces ③ Normal force

Definition coefficient of static friction :

Is the ratio between the affect force and normal force when the object is about to move

Law of static friction calculation:

Static friction Force

Coefficient of static friction

$$F_s = \mu_s F_n$$

Normal Force

Definition coefficient of kinetic friction :

Is the ratio between the affect force and normal force when the object moves at a constant speed

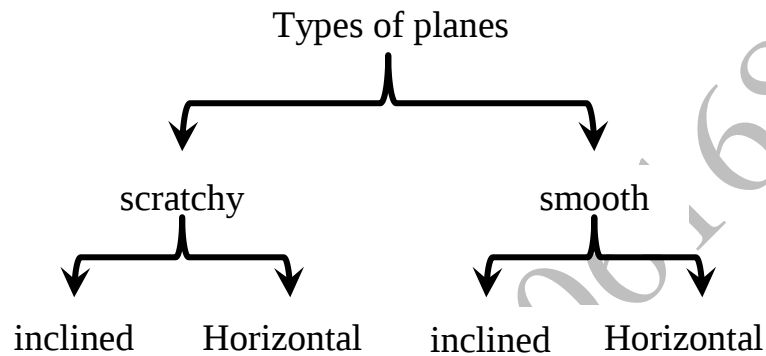
Law of kinetic friction calculation:

Diagram illustrating the Law of kinetic friction calculation:

Kinetic friction Force $F_K = \mu_K F_n$ Normal Force

Coefficient of kinetic friction

Movement of objects on planes and in two dimensions



Definition of smooth planes :

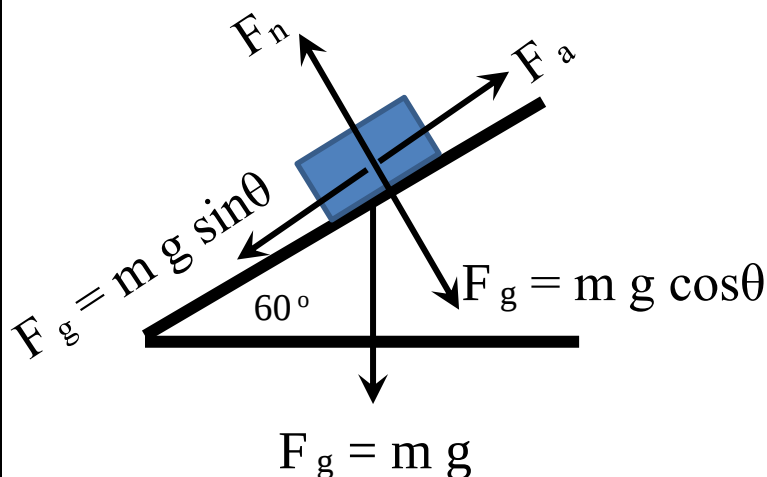
Is a frictionless plan (friction = zero)

Definition of scratch planes:

Is a scratch planes (the friction on the surface of the plan has a value and varies from surface to surface)

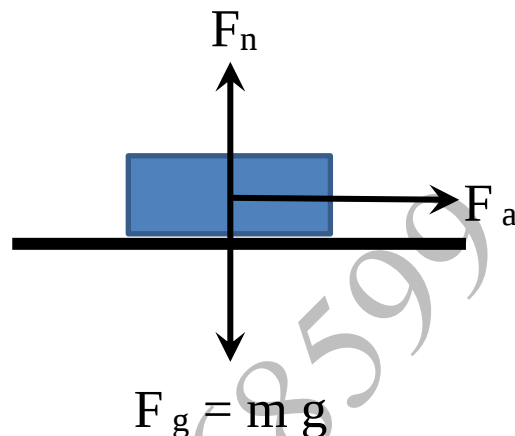
First: the movement on a horizontal plan and inclined smooth plan:

Movement equations:



$$\sum F_X = F a - m g \sin \theta = m a$$

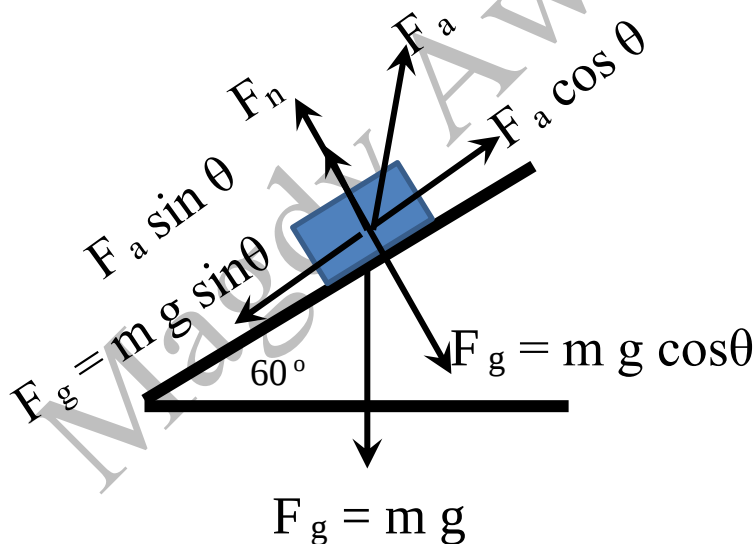
$$\sum F_Y = F_n - m g \cos \theta = 0$$



$$\sum F_X = F a = m a$$

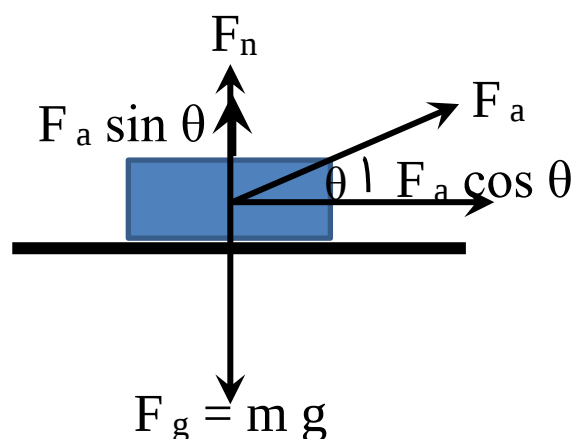
$$\sum F_Y = F_n - F_g = 0$$

If the force is at a tilt angle:



$$\sum F_X = F a \cos \theta - m g \sin \theta = m a$$

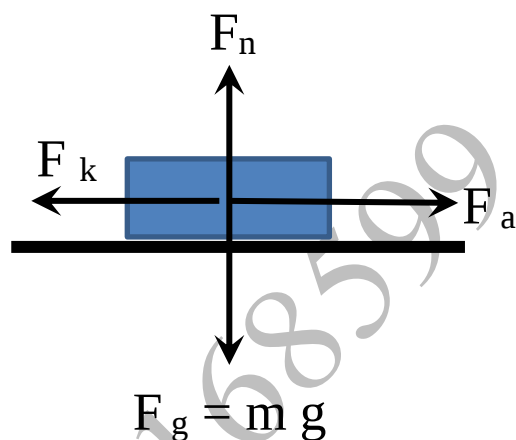
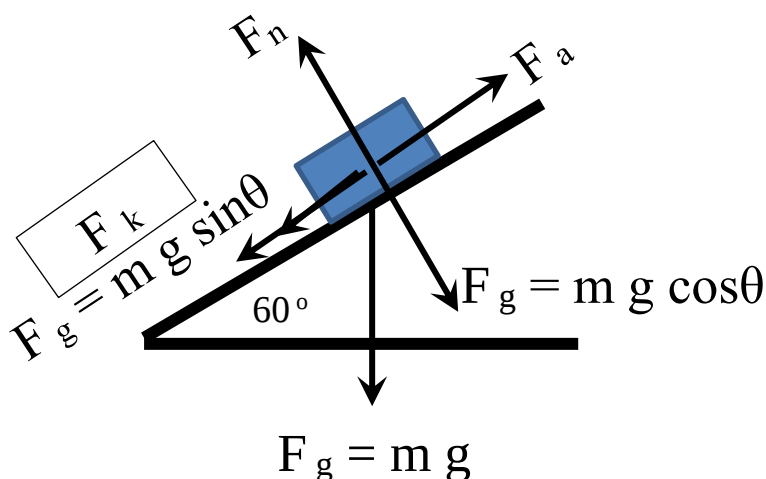
$$\sum F_Y = F_n + F_a \sin \theta - m g \cos \theta = 0$$



$$\sum F_X = F a \cos \theta = m a$$

$$\sum F_Y = F_n + F_a \sin \theta - F_g = 0$$

Second: Movement on the horizontal plan and inclined scratchy plan :

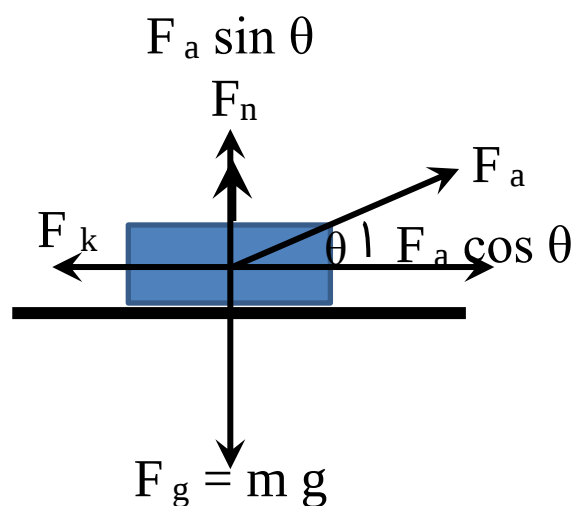
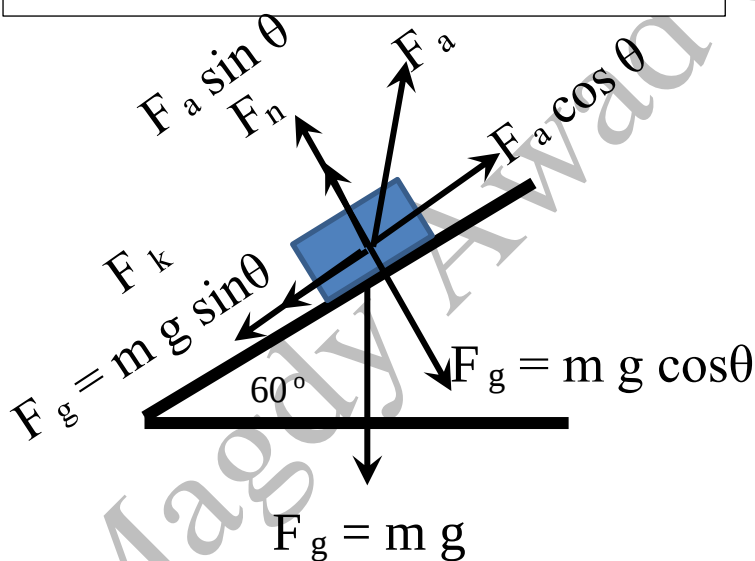


$$\sum F_X = F_a - mg \sin \theta - F_k = m a$$

$$\sum F_Y = F_n - mg \cos \theta = 0$$

$$\sum F_X = F_a - F_k = m a$$

$$\sum F_Y = F_n - F_g = 0$$



$$\sum F_X = F_a \cos \theta - mg \sin \theta - F_k = m a$$

$$\sum F_Y = F_n + F_a \sin \theta - mg \cos \theta = 0$$

$$\sum F_X = F_a \cos \theta - F_k = m a$$

$$\sum F_Y = F_n + F_a \sin \theta - F_g = 0$$