

WEEK: 2 – 3
NAME OF SCHOOL:
SUBJECT: PHYSICS
TOPIC: SCALAR AND VECTOR
CLASS: SS II
DATE:
AVERAGE AGE: 14+
PERIOD:
SEX: MIXED
DURATION: 45 MINUTES
INSTRUCTIONAL MATERIAL: WHITE BOARD, MAKER PEN and CHART

PERFORMANCE OBJECTIVE: By The End Of This Lesson, The Students Should Be Able To:

- ❖ Concept of scalar and vector
- ❖ Vector representation
- ❖ Resultant vector
- ❖ Addition of vectors
- ❖ Resolution of vectors with many directions into two components

ENTRY BEHAVIOUR: The Students Have Learnt About Scalar And Vector In Their Previous Class.

INSTRUCTIONAL TECHNIQUES: Observation explanatory discussion, demonstration, question and answers

SET INDUCTION: Introduction Of The Topic To The Students Starting From The Know To Unknown.

2.0.0 SCALAR AND VECTOR UANTITIES

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2.1.0. Physical Quantities:

Physical quantities are properties of a phenomenon that can be determined by calculation or measurement from a reference point using an instrument.

2.2.0. Types of quantities:

Physical quantities are classified into two. Namely:

I. Scalar Quantities:

Scalar quantities are those quantities that have only magnitude / size. They do not have directions.

Examples of scalar quantities:

He following e examples of physical quantities:

- Distance
- Time
- Length
- Temperature
- Speed
- Volume
- Density
- Area
- Current

Addition of Scalar Quantities:

Scalar quantities are added by ordinary algebraic methods.

Examples of Addition of scalar Quantities:

- $V_1 + V_2 = 5 \text{ cm}^3 + 10 \text{ cm}^3 = 15 \text{ cm}^3$
- $L_1 + L_2 = 25 \text{ m} + 46 \text{ m} = 71 \text{ m}$
- $A_1 + A_2 = 213 \text{ m}^2 + 236 \text{ m}^2 = 449 \text{ m}^2$

II. Vector Quantities:

Vector quantities are those quantities that have both magnitudes / sizes and directions / parts.

Examples of Vector Quantities:

- Force
- Weight
- Acceleration due to gravity
- Magnetic field
- Electric field
- Gravitational field.
- Displacement
- Momentum
- Velocity
- Acceleration

2.2.3. Representation of Vector:

A vector quantity is represented by a line with an arrow head. The length of the line represent the size or magnitude of the vector quantity while the arrow head represent the director of travel of the as shown below:

2.2.4: Addition of Vectors:

Addition of vectors is also called equivalent vector or resultant vector or effective vector. Vectors that travel in the same directions are added together. Also, if two vectors travel in opposite, the vector that travels to the left is regarded to be a negative vector while the other vector that travel to the right is the positive vector.

To find the sum of the two vectors, the two vectors are added together putting into consideration the negative sign of the negative vector as shown below.

Examples On Addition of vectors:

I. Given that 35 N force F₁ travel from west to east and 25 N force F₂ travel in the opposite direction to that of 35 N force. Find the resultant of the two vectors.

Solution:

Resultant Vector $R = \text{vector } F_1 + (- \text{vector } F_2)$

Resultant vector $R = \text{vector } F_1 - \text{vector } F_2$

Resultant vector $R = 35 \text{ N} - 25 \text{ N} = 10 \text{ N}$

II. 76 N force travelled from east to west. If 54.35 N travelled in a direction that is opposite to that of 76 N, what is the force?

Solution:

Let 76 N be F_1 and 54.35 N be F_2

East to west is a negative direction of travel, therefore $F_1 = -76$ N

54.35 N travelled in opposite direction to 76 N,
therefore $F_2 = 54.35$ N

Resultant vector $R = -\text{vector } F_1 + \text{vector } F_2$

Resultant vector $R = -76$ N + 54.35 N = -21.65 N

Note: In some questions, an arrow is used to show the direction of travel of the vectors.

How To Find Resultant Vector Of Perpendicular vectors:

The resultant vector of two vectors that travelled in a perpendicular direction one to another cannot be found by mere addition of vectors. Rather, a vector triangle is used to find the resultant of the vectors. The two perpendicular vectors are represented by the adjacent sides of a right angle triangle in such a way that the vectors follow one another behind. The resultant of the vectors is represented by the hypotenuse of the triangle in such a way that the direction of the resultant vector is opposite to the direction of the two vectors. The length of the hypotenuse represents the magnitude / size of the resultant vector.

Pythagoras formula is then used to calculate the resultant vector.

Thus, $R^2 = F_1^2 + F_2^2$
 $R = \sqrt{F_1^2 + F_2^2}$

Direction of Resultant Vector:

The direction of a resultant vector is the angle which resultant vector make with the horizontal.

Formula For Calculating Direction Of Resultant Vector:

The formula for calculating the direction of a resultant vector is given below.

$\tan \theta = \text{opposite} / \text{adjacent}$

$\theta = \tan^{-1} (\text{opposite} / \text{adjacent})$

Resultant Vector:

Resultant vector is that single vector which would have the same effect in magnitude and direction as many vectors that act together.

Explanation:

A resultant vector is a single vector that will do the same amount of work, in the same direction that many vectors acting together would have done.

Methods Of Finding Resultant Vector:

There are two methods of finding the resultant vector of two or more vectors acting from a common point:

I. The Parallelogram method

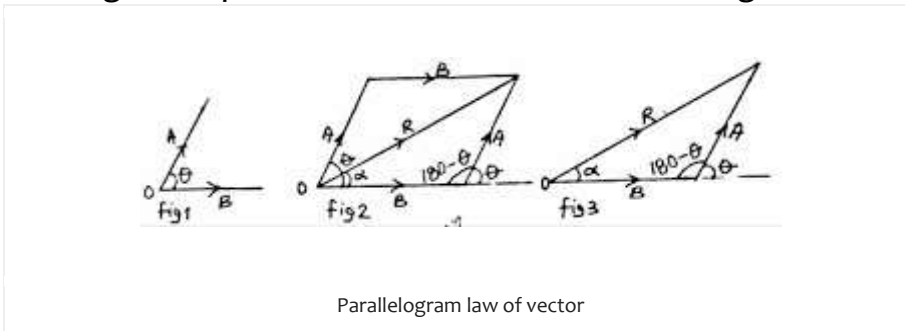
II. The triangle method

The Parallelogram Method of Finding Resultant Vector:

If two vectors act at an angle of @ to one another and act from a common point, parallelogram method is used to find the resultant of the two vectors. In a parallelogram method, the two vectors are represented by the adjacent sides of the parallelogram while the diagonal represent the resultant vector.

Parallelogram Law Of Vector:

The parallelogram law of vector states that if two vectors act from a common point at an angle @ to each other, the vectors can be represented in magnitude and direction by the adjacent sides of the parallelogram. The diagonal of the parallelogram represent the resultant vector in magnitude and direction.



From figure 3, let OA represent vector A and OB represent vector B while OR represent vector R we will use cosine thus:

$$R^2 = OA^2 + OB^2 - 2*(OA)*(OB)*\text{Cos}(180 - @)$$

$$R = \sqrt{OA^2 + OB^2 - 2*(OA)*(OB)*\text{Cos}(180 - @)}$$

@ is the angle between the two vectors.

Direction of a Resultant Vector:

The direction of a resultant vector is the angle which the resultant vector makes with the horizontal at the point of its origin.

Formula For Calculating Direction Of Resultant Vector:

The direction of resultant vector can be calculated using the formula as stated below.

From the figure above, we will use the sine formula to calculate the angle which the resultant vector makes with the horizontal force.

Therefore,

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$
$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Side } a / \sin A = \text{side } b / \sin B$$

or

$$\text{side } a / \sin A = \text{side } c / \sin C$$

or.

$$\text{Side } b / \sin B = \text{side } c / \sin C$$

Which of the formula to use depends on the angles whose sides and angles are given.

Worked Example:

1. Calculate the resultant of two vectors of 4 units and 7 units acting at a point at an angle of 60° to each other. Calculate the direction of the vector.

Solution:

The question is as shown in the figure by your right.

Data given in the question:

$F_1 = OA = 4$ units, $F_2 = OB = 7$ units, $\theta = 60^\circ$, $R = ?$

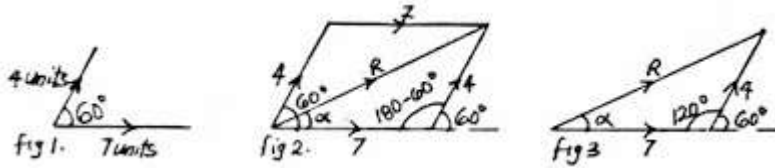


Diagram is as shown by your right:

Formula:

$$R^2 = OA^2 + OB^2 - 2(OA)(OB)\cos(180 - \theta)^\circ$$

Substitution: $R^2 = 4^2 + 7^2 - 2 \cdot 4 \cdot 7 \cdot \cos(180 - 60)^\circ$

$$R^2 = 16 + 49 - 56 \cdot \cos 120^\circ$$

$$R^2 = 65 - 56 \cdot (-0.5)$$

$$R^2 = 65 + 56 \cdot 0.5$$

$$R^2 = 65 + 28 = 93$$

$$R = \sqrt{93} = 9.64 \text{ units.}$$

Direction of the vector:

Angle $\theta = ?$,

2. If the resultant of two vectors 5 N and 7 N is 12 N, calculate the angle between the two vectors.

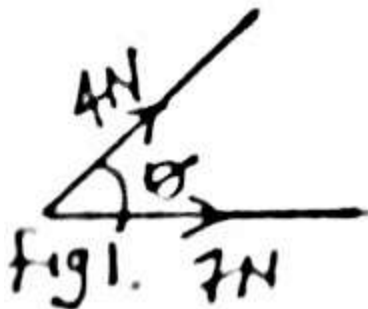
Solution:

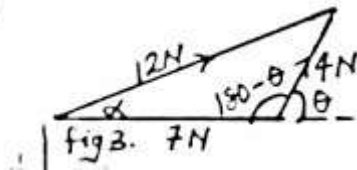
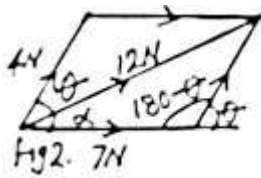
Data given in the question:

$F_1 = OA = 4$ N, $F_2 = OB = 7$ N. $R = 12$ N, let angle $\theta = P$

Note that angle

Diagram here:





From figure 3,

Formula: $R^2 = OA^2 + OB^2 - 2(OA)(OB)\cos(180 - P)^\circ$

Substitution: $12 = 4^2 + 7^2 - 2 * 4 * 7 * \cos(180 - P)^\circ$

. $12 = 16 + 49 - 56 * \cos(180 - P)^\circ$

$12 = 65 - 56 * \cos(180 - P)^\circ$

Collect like terms: $56 * \cos(180 - P) = 65 - 12$

$\cos(180 - P)^\circ = 65 - 12 / 56$

. $\cos(180 - P)^\circ = 53 / 56$

$\cos(180 - P)^\circ = 0.9464$

Transfer cos to the other side of the equation / make $(180 - P)$ the subject

$180 - P = \cos^{-1}(0.9464)$

$180 - P = 18.84$

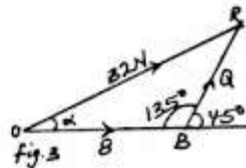
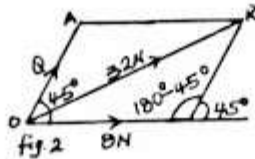
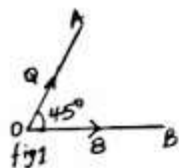
Make P the subject: $p = 180 - 18.84 = 161.16^\circ$

3. The resultant vector of two vectors are 32 N. If the angle between the vectors is 45° , calculate Q if the other vector is 8N.

Solution:

Data given in the question:

$R = 32\text{N}, F_1 = OA = q \text{ N}, F_2 = OB = 8 \text{ N}, \text{angle } @ = 45^\circ$



Formula:

From figure 3,

$R^2 = OA^2 + OB^2 - 2(OA)(OB)\cos(180 - @)^\circ$

Substitution: $32^2 = q^2 + 8^2 - 2*q*8*\cos(180 - 45)^\circ$

$$32^2 = q^2 + 64 - 16q \cdot \cos 135^\circ$$

$$32^2 = q^2 + 64 - 16q \cdot (-0.7071)$$

$$32^2 = q^2 + 64 + 16q \cdot 0.7071$$

$$1024 = q^2 + 64 + 11.31q$$

$$0 = q^2 + 11.31q + 64 - 1024$$

$$0 = q^2 + 11.31q - 960$$

Since we derived a quadratic expression, we will use the general formula to calculate q as follows:

Formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$c = 960, a = 1, b = 11.31$

Substitution: $x = \frac{-11.31 \pm \sqrt{(11.31)^2 - 4 \cdot 1 \cdot 960}}{2 \cdot 1}$

$$X = \frac{11.31 \pm \sqrt{(127.92 - 3840)}}{2}$$

$$X = \frac{11.31 \pm \sqrt{-3712.08}}{2}$$

$$X = \frac{11.31 \pm (-0.93)}{2}$$

$$X_1 = \frac{11.31 + (-60.93)}{2}$$

$$X_1 = \frac{11.31 - 60.93}{2} = -49.62 / 2$$

$$X_1 = -24.81 \text{ N}$$

$$X_2 = \frac{11.31 - (-60.93)}{2}$$

$$X_2 = \frac{11.31 + 60.93}{2} = 72.24 / 2$$

$$X_2 = 36.12 \text{ N}$$

We ignore the negative value and take the positive value of the force. Therefore, the force $q = 36.12$ Newtons.

Analytical Method Of Finding Resultant Vector:

In the analytical method of finding the resultant vector of two vectors, the data given in the question are used to draw or construct a parallelogram to scale. Then the diagonal of the parallelogram is measured to determine its magnitude.

If the parallelogram is drawn accurately to scale, the measured resultant will be approximately the same as the calculated value.

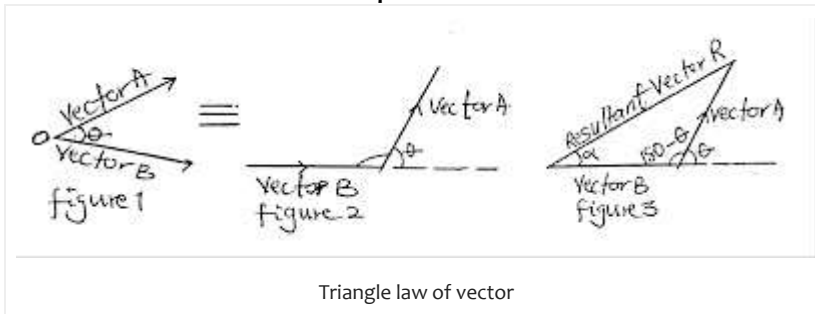
Triangle Law of Vector:

The triangle law of vector states that if two vectors act from a common point, the two vectors can be represented in magnitude and direction by the two sides of a triangle while the third side represents in magnitude and direction.

Triangle Method of Finding Resultant vector of two vectors:

If two vectors act at an angle of θ to one another and act from a common point as shown in figure 1 below, triangle method can also be used to find the resultant of the two vectors. The triangle is drawn as follows:

- I. Start from the common point O, draw an horizontal line OB to represent the vector that act in the horizontal direction as shown in figure 1. I.e vector OB
- II. Draw vector OA at the tip of vector OB such that it is



parallel in direction to the original direction of vector OA as shown in figure 2.

III. Draw a line to join the start of vector B and the end of vector A to complete the triangle as shown in figure 3.

From figure 3 above, you can now use any of the sine formulae to calculate either the resultant vector or any quantity that the question wants you to calculate.

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$
$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{b}{\sin B} = \frac{c}{\sin C}$$

Also, you can use any of the sine rule to solve problem.

The sine formulae are:

$$\text{Side } a / \sin A = \text{side } b / \sin B$$

or

$$\text{side } a / \sin A = \text{side } c / \sin C$$

or.

$$\text{Side } b / \sin B = \text{side } c / \sin C$$

Note:

The sine formula that you will use depends on the data that are given in the questions.

Exercises:

1. Two forces 5 N and 4 N are inclined to each other at 30° . Find then the resultant force by the triangle method and parallelogram method.

Components of Vectors:

Any vector that act in a particular direction has two components. A vector that act in the vertical direction has only vertical component of the vector / force. The vector does have horizontal component / direction because the horizontal component is zero. Also, if a vector act in a horizontal direction, the vector only has horizontal component / direction. The vector does not have vertical component / direction because the vertical component of the vector is zero. Component of a vector simply means direction of the vector.

If a vector act at an angle θ to the horizontal, the vector has both vertical and horizontal components. Also, if a vector act at an angle θ to the vertical, the vector also have both vertical and horizontal components.

Definition Of Components Of A Vector:

Component of a vector in a given direction is the effective value of that vector in that direction.

The horizontal component of a vector is the effective value of that vector in the horizontal direction while the vertical component of the vector is the effective value of the vector in the vertical direction.

How To Calculate Components Of A Vector That Act in A Given Direction:

From the figure above, F is a vector that act at angle θ to the horizontal. The vector F has two components or directions. The Vector has the vertical component / direction and the horizontal component / direction.

To be able to calculate the horizontal and vertical components of the vector F, you redraw a right angle triangle such that you use the vertical F_y to close the

triangle as shown above. You use SOHCAHTOA concept to calculate the vertical and the horizontal components of the vector F as I will show and explain below.

From figure 2, F_y is the vertical component of vector F while F_x is the horizontal component of the vector.

Vertical component of the vector:

I will use SOH CAH TOA concepts.

To calculate the vertical component F_y , I will use SOH:

SOH stands for Sine $\theta = \text{Opposite} / \text{Hypotenuse}$

Figure 2 above, opposite is F_y , Hypotenuse is F, Adjacent = F_x while θ is θ .
Substitute for F_y , F and θ in the formula above.

Therefore,

$$\sin \theta = F_y / F$$

Make F_y the subject:

$$F_y = F * \sin \theta \quad (\text{for vertical component})$$

Horizontal component of the vector:

Also, I will use CAH concept to find / calculate F_x .

CAH means Cos $\theta = \text{Adjacent} / \text{Hypotenuse}$

Substitute for F_x , F and angle θ in the formula above.

Therefore,

$$\cos \theta = F_x / F$$

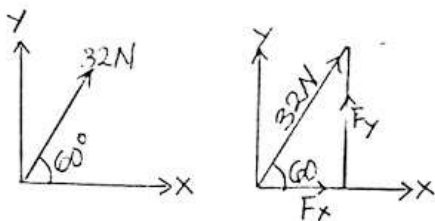
Make F_x the subject:

$$F_x = F * \cos \theta \quad (\text{for horizontal component})$$

Worked Examples:

1. A force of 23 N act at an angle of 60° to the horizontal. Calculate the components of the vector.

Solution:



Data given in the question:

Force $F = 32 \text{ N}$, angle $\theta = 60^\circ$

I. Vertical component F_y :

Formula: $F_y = F * \sin \theta$

Substitution: $F_y = 32 * \sin 60^\circ$

. $F_y = 32 * 0.8660$

$F_y = 27.712 \text{ N}$

II. Horizontal Component F_x :

Formula: $F_x = F * \cos \theta$

Substitution: $F_x = 32 * \cos 60^\circ$

. $F_x = 32 * 0.5$

$F_x = 16 \text{ N}$

2. The vertical component of a force F is 12 N . If the angle which the force make with the vertical is 30° , calculate the value of F and the horizontal component of the force.

Solution:

Force F :

Data given in the question:

$F = ?$, angle $\theta = 30^\circ$, vertical component $F_y = 12 \text{ N}$.

Formula: $F_y = F * \sin \theta$

Substitution: $12 = F * \sin 30^\circ$

$12 = F * 0.5$

Make F the subject:

$F = 12 / 0.5 \Rightarrow F = 24 \text{ Newton}$

Horizontal component F_x :

Formula: $F_x = F * \cos \theta$

Substitution: $F_x = 24 * \cos 30^\circ$

. $F_x = 24 * 0.8660. \Rightarrow F_x = 20.78 \text{ Newtons.}$

3. A rope is tied to a nail on vertical wall such that the rope makes an angle of 60° to the vertical. If 12 N force is applied at the end of the rope, calculate : (i) the force that will bend the nail (ii) the force that will pull out the nail from the

wall.

Solution:

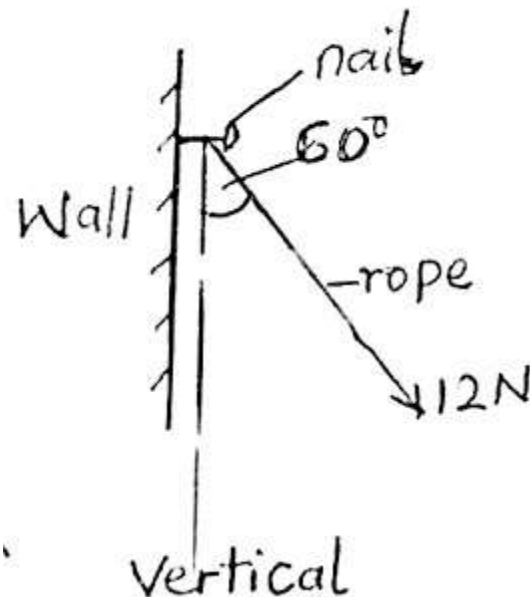


Diagram.

Data given in the question:

Force F on the rope = 12 N, angle of rope to the vertical = 60°

The force that will bend the nail is the vertical component of the Force F .

So we are to calculate F_y .

Formula: $F_y = F * \sin @$

Substitution: $F_y = 12 * \sin 60^\circ$

$$F_y = 12 * 0.8660. \rightarrow y = 10.39\text{N}$$

The force that will bend the nail is 10.39 Newtons.

The force that will remove the nail is the horizontal component of the force F .

So we have to calculate F_x :

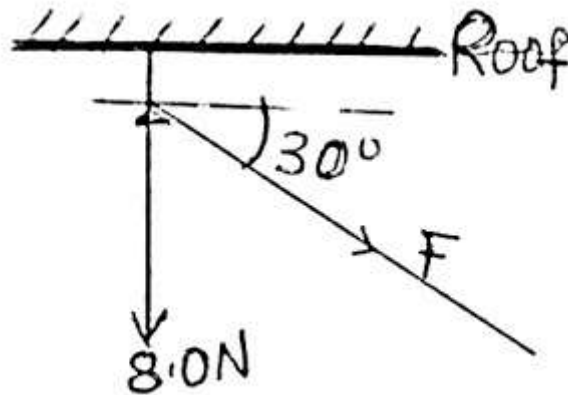
Formula: $F_x = F * \cos @$

Substitution: $F_x = 12 * \cos 60^\circ$

$$F_x = 12 * 0.5 \rightarrow F_x = 6.0 \text{ Newtons}$$

The force that will remove the nail is 6.0 Newtons

4. A cord is tied to a nail on the ceiling of at an angle of 30° to the horizontal. If F Newton force applied on the cord produced a vertical force of 8.0 N, calculate the force the was applied on the cord and the force that will bend the nail.



Solution:

Diagram:

Data given in the question:

Angle @ = 30° , force F = ?, vertical component

$F_y = 8.0 \text{ N}$,

horizontal component $F_x = ?$

Force F that was applied:

Formula. $F_y = F * \sin 30^\circ$

Substitution: $8.0 = F * \sin 30^\circ$

$$8.0 = F * 0.5$$

Make F the subject of formula:

$$F = 8.0 / 0.5. \Rightarrow F = 16.0 \text{ Newtons.}$$

The force that was applied is 16.0 Newtons.

The force that will bend the nail:

The force that will bend the nail is F_x which act in the horizontal direction.

Formula: $F_x = F * \cos @$

Substitution: $F_x = 16 * \cos 30^\circ$

$$F_x = 16 * 0.8660. \Rightarrow F_x = 13.86 \text{ newtons.}$$

The force that will bend the nail is 13.86 Newtons.

Resolution Of Vectors:

In resolution of vectors, many vectors which act in different directions are resolved into a single one single vertical and horizontal components. The concept that I explained above is the method that is used in resolution of more vectors. In resolution of vectors, you have to find the vertical component and the horizontal component of each of the vectors. After you might have calculated the vertical component and the horizontal component of each vectors, you add all the vertical components to get a single vertical component. You also add all the horizontal components to get a single horizontal component. Mind you, you must ignore the direction of the vectors. If the calculated vertical component is in the negative side of y-axis, you calculated vertical component must be negative (-ve / minus). Also, if your calculated horizontal component is in the negative side of x-axis, then your calculated horizontal component must be negative (- ve / minus). In the process of addition, negative vertical components and horizontal components are subtracted accordingly.

Definition of Resolution Of Vectors:

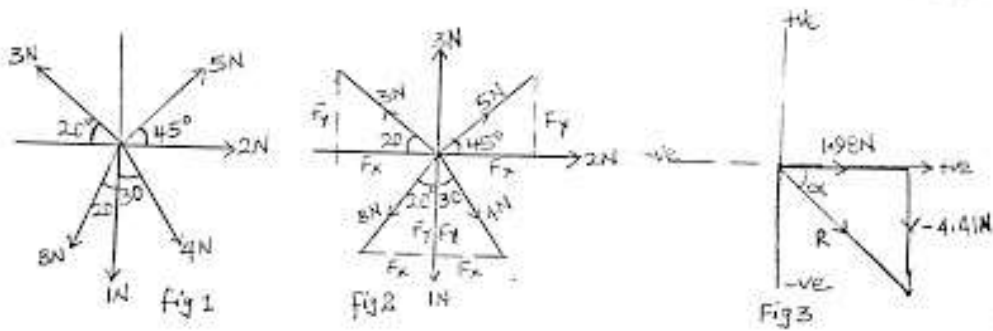
Resolution of vectors is process of resolving each vector into its vertical direction and horizontal direction and then add all the vertical components / direction and all the horizontal components / direction to obtain a single vertical direction and single horizontal direction after which the resultant is found.

How To Calculate Resultant Of More Than Two Vectors:

I will use the concept of calculating components of a vector that i explained above and worked example to show and explain how to calculate the resultant of more than two vectors.

For example, the figure below show seven vectors acting from a common in different directions.

Diagram here:



Note:

I am using the concept of **SOH CAH TOA** to calculate the components of each vector. To minimise time and space, I will substitute directly into each formula as I will be using them. So take note.

Therefore,

SOH CAH TOA

- I. SOH $\Rightarrow \sin @ = \text{opposite} / \text{hypotenuse}$
- II. CAH $\Rightarrow \cos @ = \text{adjacent} / \text{hypotenuse}$
- III. TOA $\Rightarrow \tan @ = \text{opposite} / \text{adjacent}$

Vertical components.

-1 N.
3 N

For 5N force: $\sin @ = \text{opp} / \text{hyp.}$

$$\begin{aligned} \sin 45^\circ &= F_y / 5. \\ F_y &= 5 * \sin 45^\circ. \\ F_y &= 5 * 0.7071. \\ F_y &= 3.54 \text{ N} \end{aligned}$$

For 3N force: $\sin @ = \text{opp} / \text{hyp.}$

$$\begin{aligned} \sin 20^\circ &= F_y / 3. \\ F_y &= 3 * \sin 20^\circ. \\ F_y &= 3 * 0.3420. \\ F_y &= 1.03 \text{ N.} \end{aligned}$$

For 8N force: $\cos @ = \text{adj} / \text{hyp.}$

$$\begin{aligned} \cos 20^\circ &= F_y / 8. \\ F_y &= 8 * \cos 20^\circ. \\ F_y &= 8 * 0.9396. \end{aligned}$$

Horizontal components

2 N

$\cos @ = \text{adj} / \text{hyp}$

$$\begin{aligned} \cos 45^\circ &= F_x / 5 \\ F_x &= 5 * \cos 45^\circ \\ F_x &= 5 * 0.7071 \\ F_x &= 3.54 \text{ N} \end{aligned}$$

$\cos @ = \text{adj} / \text{hyp}$

$$\begin{aligned} \cos 20^\circ &= F_x / 3 \\ F_x &= 3 * \cos 20^\circ \\ F_x &= 3 * 0.9396 \\ F_x &= -2.82 \text{ N} \end{aligned}$$

$\sin @ = \text{opp} / \text{hyp}$

$$\begin{aligned} \sin 20^\circ &= F_x / 8 \\ F_x &= 8 * \sin 20^\circ \\ F_x &= 8 * 0.3420 \end{aligned}$$

$$F_y = -7.52 \text{ N.}$$

For 4N force: $\cos @ = \text{adj} / \text{hyp.}$

$$\cos 30^\circ = F_y / 4.$$

$$F_y = 4 * \cos 30^\circ.$$

$$F_y = 4 * 0.8660.$$

$$F_y = -3.46 \text{ N.}$$

$$F_x = -2.74 \text{ N}$$

$\sin @ = \text{opp} / \text{hyp}$

$$\sin 30^\circ = F_x / 4$$

$$F_x = 4 * \sin 30^\circ$$

$$F_x = 4 * 0.5$$

$$F_x = 2.0 \text{ N}$$

Addition: vertical components = - 4.41N horizontal components = 1.98N

From figure 3, now that we have resolved all the vectors into a single vertical component / direction and horizontal component / direction, we will use Pythagoras formula and calculate the resultant of the resolved vertical and horizontal components of the vectors.

Therefore,

Let $A = 1.98\text{N}$, $B = - 4.41\text{N}$, $C = \text{Resultant R}$

Formula: $C^2 = A^2 + B^2$

Substitution: $C^2 = 1.98^2 + (- 4.41)^2$

$$C^2 = 3.9204 + 19.4481$$

$$C^2 = 23.3685$$

$$C = \sqrt{23.3685}. \Rightarrow C = 4.84 \text{ Newtons.}$$

Direction of the resultant vector:

We will now calculate the direction of the resultant vector as follow:

From figure 3 above, we will calculate the angle that the resultant vector make with the horizontal vector at the point of its origin. This angle gives the direction of the resultant vector.

Formula: $\tan @ = \text{opp} / \text{adj}$

Substitution: $\tan @ = 4.41 / 1.98$

$$\tan @ = 2.2273$$

$$. \quad @ = \tan^{-1} 2.2273. \Rightarrow @ = 0.04^\circ$$

You must know that the direction of the vector is stated using bearing format.

Therefore,

Direction of resultant vector = S 89.96° E

or

Direction of vector = $180 + 0.04 = 180.04^\circ$

That is all about the procedures that are involved in resolution of vectors

Exercises:

1. List four vector quantities that you were taught in the class.
2. Differentiate between vector quantities and scalar quantities. Give four examples for each of them.
3. Two, whose resultant is 85N, are perpendicular to one another. If one of them make an angle of 60° with the resultant, calculate its magnitude.
4. A boy pulled his toy on a horizontal ground with a rope inclined at 60 degrees to the horizontal. If the effective force pulling the toy along the horizontal ground is 7N, calculate the tension in the rope.
5. A girl pulls a load of 120 N with a rope inclined at an angle of 30° to the horizontal. If the tension in the rope is 100N, calculate the force that tends to lift the load off the ground and the force that pulls the load.
6. At what value of angle between two vectors will the resultant of the two vectors be maximum?
7. What is resultant of two vectors? An object is under the action of 8N and 10N. Find the resultant of the two vectors at if the forces are (i) parallel and act in the same direction, (ii) the two forces are parallel and act in opposite direction (iii) the two forces are inclined at angle of 60° to each (iv) the two forces are inclined at angle of 160° (v) the two forces are at 90° .
8. Find by drawing and calculation the resultant of two vectors of magnitudes 3N and 5N inclined at angle of 120°
9. What is meant by component of a vector? Illustrate with a diagram. Find the components of a force 150 N inclined at 60° to the horizontal.
10. Describe the force board experiment to show how to obtain the resultant of two non-parallel coplanar forces acting at a point.
11. 10N, 5N, 4N and 6N act on an object in the directions, North, West, East and South respectively. Calculate the magnitude and direction of their resultant.
12. State the principle of parallelogram of forces. Describe experiment to demonstrate it in the laboratory.
13. What is resolution of vector? A rope attached to a sledge makes an angle of with the ground. Calculate the force in the rope required to produce a horizontal component of 100N. What is the vertical component of the force?
14. A lawn mower is pushed with a force of 50N. If the angle between the handle and the ground is 30° , (i) calculate the magnitude of the force that is pressing the mower into the ground. (ii) calculate the force that move the mower forward. (iii) why does the mower moved forward and not downward into the ground.

15. A swimmer is able to swim at 1.4m/s in still water. (a) how far downstream will he land if he swims directly across a 180 m wide river? (b) how long will it take him to reach the other side?

16. From the figure below, calculate the magnitude and direction of the resultant forces.