Academic Review - Physics

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January 2024

Topics

Nobel and Ig Nobel Prizes

2023 Nobel Prize of Physics - for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter

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2023 Ig Nobel Prize of Education - for methodically studying the boredom of teachers and students

Scalar and Vector

Scalar Quantity - a quantity which is expressed by magnitude only

Example

Mass
Time
Temperature
Area
Distance

Vector Quantity - a quantity which is expressed by magnitude and direction

Example

Force
Velocity
Weight
Acceleration
Displacement

Quiz

- 5 m
- 30 m/sec, East
- 5 km, North
- 20 degrees Celcius
- 1 GB
- 4000 calories

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– Scalar

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Resultant Vector

Definition

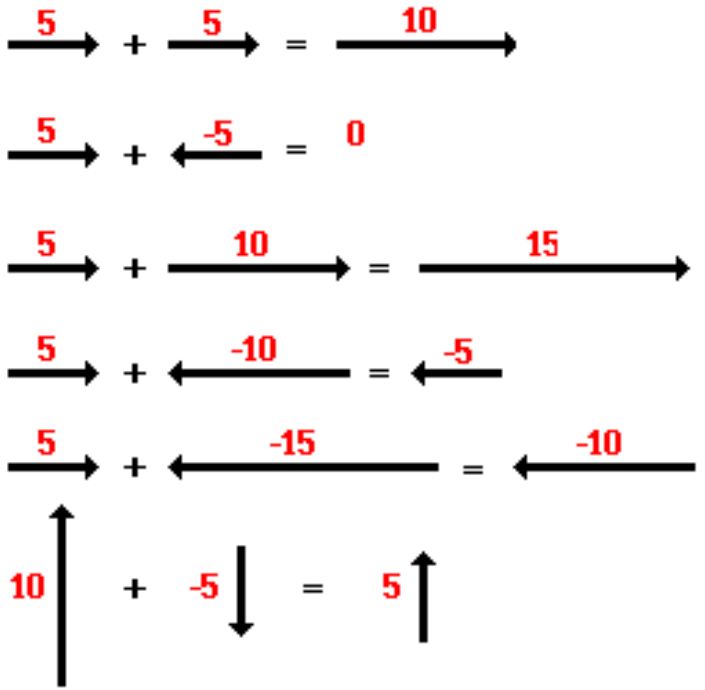
Sum of two or more vectors which will give the same effect as the original vectors

Process of finding the Resultant Vector

1. Addition/Subtraction
2. Pythagorean Theorem
3. Component Method

Addition/Subtraction

Can only be used on 1D vectors (same direction)

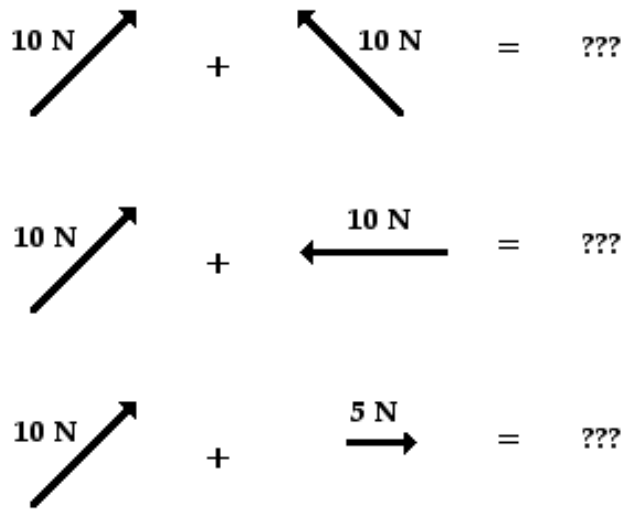


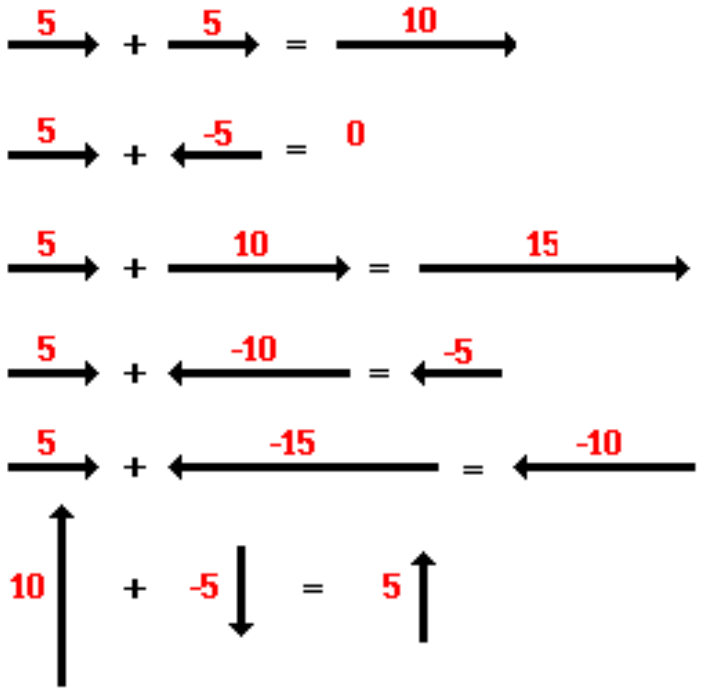
Images from www.physicsclassroom.com

Addition/Subtraction

Can only be used on 1D vectors (same direction)

What if we encounter more complicated vectors?





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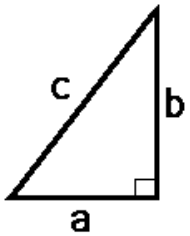
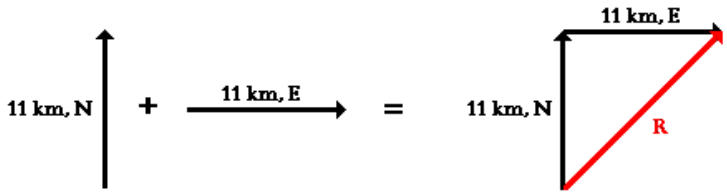
Pythagorean Theorem

$a^2 + b^2 = c^2$





$$11^2 + 11^2 = R^2$$
$$242 = R^2$$
$$15.6 = R$$

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Pythagorean Theorem

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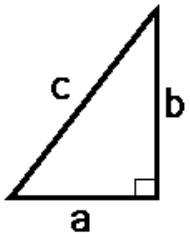
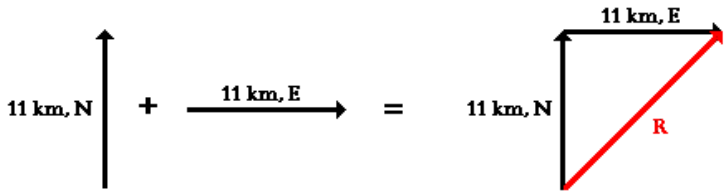


only use pythagorean theorem on perpendicular vectors!



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Component Method

Example

An airplane flies in a northeasterly direction at 100 km/h, at the same time there is a wind blowing at 20 km/h to the northwest. What is the resultant velocity of the plane?

X-components:

$$\begin{aligned} V_{xplane} &= V_{plane} \cos 45^\circ \\ &= 70.71 \text{ km/h} \\ V_{xwind} &= -V_{wind} \cos 45^\circ \\ &= -14.14 \text{ km/h} \end{aligned}$$

V_{xwind} can be equal to $V_{wind} \cos 135^\circ$ with the same answer

Component Method (cont.)

Y-compoments:

$$\begin{aligned} V_{yplane} &= V_{plane} \sin 45^\circ \\ &= 70.71 \text{ km/h} \\ V_{ywind} &= V_{wind} \sin 45^\circ \\ &= 14.14 \text{ km/h} \end{aligned}$$

Component Method (cont.)

Resultant Velocity

$$
\begin{aligned}
V_x &= V_{xplane} + V_{xwind} \\
&= 70.71 - 14.14 \\
&= 56.57 \text{ km/h} \\
V_y &= V_{yplane} + V_{ywind} \\
&= 70.71 + 14.14 \\
&= 84.85 \text{ km/h} \\
R &= \sqrt{56.57^2 + 84.85^2} \\
R &= 101.978857613 \text{ km/h} \\
\theta &= \arctan \frac{84.85}{56.57} \\
\theta &= 56.31^\circ
\end{aligned}
$$

Mechanics

Motion

Definition

Change in position of a object relative to other objects that are considered at rest

Newton's Law of Motion

Momentum and Impulse

Work, Energy, and Power