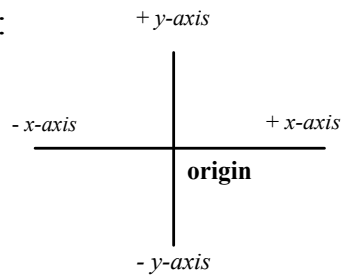


LEVEL 1

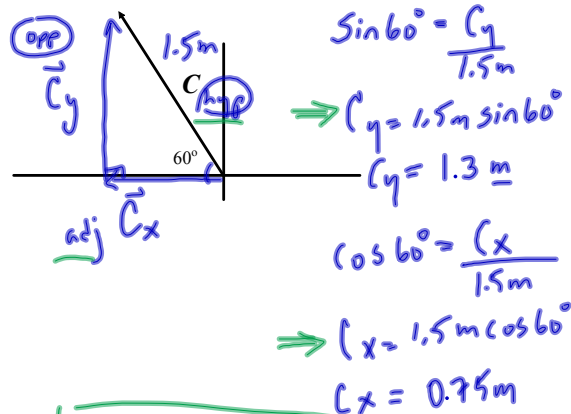
Perpendicular Components of a Vector

Reminder:



Example:

Vector C has a magnitude of 1.5 m. Its direction is 60° above the negative x -axis. What are the perpendicular components of C ?

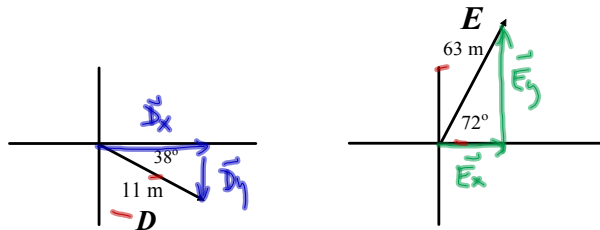


$$\vec{C}_x = 0.75 \text{ m, left}$$

$$\vec{C}_y = 1.3 \text{ m, up}$$

Practice Problems:

What are the perpendicular components of D and E ?



$$D_x = 11 \text{ m} \cos 38^\circ \quad D_y = 11 \text{ m} \sin 38^\circ \quad E_x = 63 \text{ m} \cos 72^\circ \quad E_y = 63 \text{ m} \sin 72^\circ$$

$$D_x = 8.7 \text{ m} \quad D_y = 6.8 \text{ m} \quad E_x = 19 \text{ m} \quad E_y = 60 \text{ m}$$

$$\vec{D}_x = +8.7 \text{ m} \quad \vec{D}_y = -6.8 \text{ m} \quad \vec{E}_x = +19 \text{ m}, \quad \vec{E}_y = +60 \text{ m}$$

What is the resultant of D and E ?

$$\vec{R} \rightarrow \begin{matrix} R_x \\ R_y \end{matrix}$$

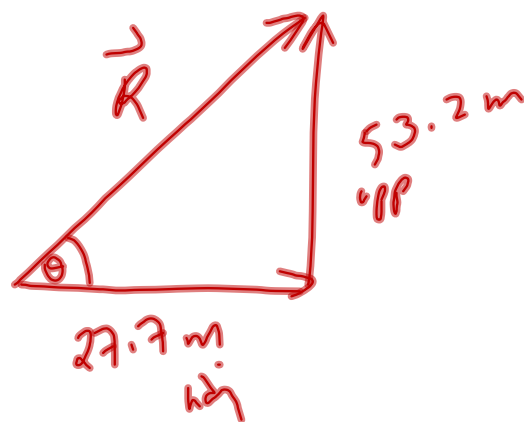
$$\vec{R}_x = \vec{D}_x + \vec{E}_x, \quad \vec{R}_y = \vec{D}_y + \vec{E}_y$$

$$R_x = +8.7 \text{ m} + 19 \text{ m} \quad R_y = -6.8 \text{ m} + 60 \text{ m}$$

$$R_x = +27.7 \text{ m} \quad R_y = 53.2 \text{ m}$$

LEVEL 1

$$\vec{R}_x = +27.7 \text{ m} \quad \vec{R}_y = +53.2 \text{ m}$$



$$R = \sqrt{(27.7)^2 + (53.2)^2}$$

$$R = \underline{60 \text{ m}}$$

$$\tan \theta = \frac{53.2}{27.7}$$

$$\theta = \underline{62^\circ}$$

$$\vec{R} = \underline{60 \text{ m}}, \underline{62^\circ} \text{ N of E}$$

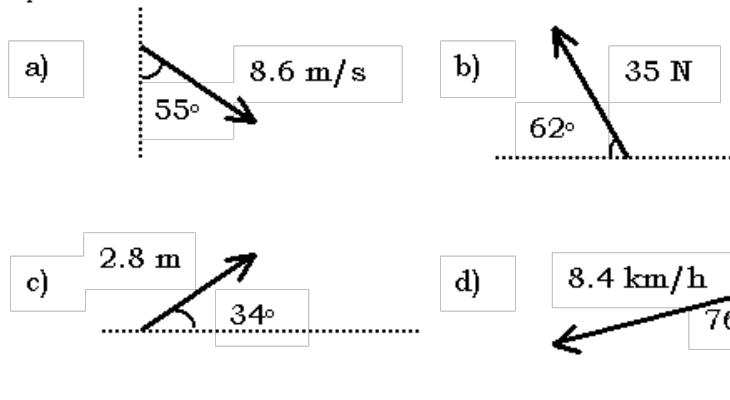
LEVEL 1

Handout - Perpendicular Components

LEVEL 1

Physics 111
Vectors – Components

1. For each vector below, draw a sketch showing its components and calculate the magnitudes of the components.

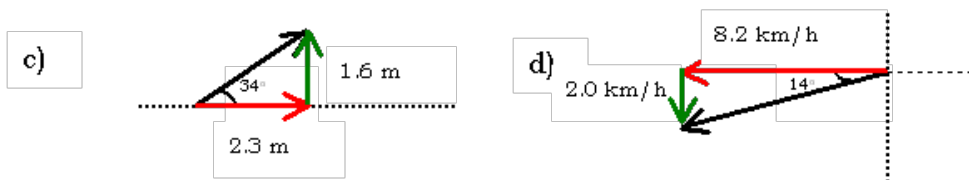
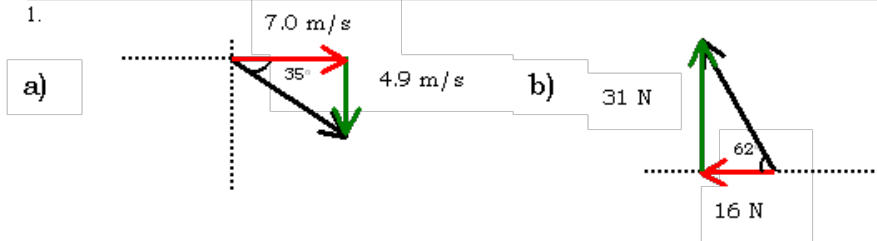


- The velocity of an ambulance is 28 m/s, 35° N of E. What are the components of the ambulance's velocity?
- The displacement of a plane is 289 km, 31.0° S of W. What are the components of the plane's displacement?
- Sally pulls on the handle of a wagon with a force of 65 N. If the handle makes an angle of 35° with the horizontal, what is the magnitude of the vertical component of the force?
- A cannon ball is shot from a cannon with a velocity of 350 m/s at angle of 55° to the ground. Fizzicks calculates the magnitude of the horizontal component of the cannon ball's velocity to be 287 m/s. Is Fizzicks correct?
- The magnitude of a force is 72 N. If the magnitude of one of its perpendicular components is 48 N, what is the magnitude of the other component?
- Three forces act simultaneously on point P: the first force is 12 N north, the second force is 13 N west and the third force is 15 N, 20° north of east. Calculate the components of each vector, the components of the resultant and the resultant force.
- You kick a soccer ball 6.22 m north. An opponent kicks it 5.10 m in a direction 28.2° south of west and then one of your teammates kicks it 2.08 m in a direction 56.0° north of west. What is the resultant displacement of the ball?
- You are giving your younger brother driving lessons in an empty parking lot on a Sunday afternoon. He drives at 24 m/s in a direction 75° N of E, then 35 m/s S and 58 m/s 64° S of W before you tell him to stop. What is the resultant velocity?

LEVEL 1

Answers

1.



2. The horizontal component is 23 m/s east and the vertical component is 16 m/s north.
3. The horizontal and vertical components of the plane's displacement are 248 km west and 149 km south respectively.
4. The magnitude of the vertical component is 37 N.
5. No. The magnitude of the horizontal component is 201 m/s. Fizzicks actually calculated the vertical component of the cannon ball's velocity. Perhaps Fizzicks should have taken the time to draw a sketch of the situation.
6. The other component has a magnitude of 54 N.
7. The resultant force is 18 N, 77° N of W.
8. The resultant displacement of the ball is 7.91 m, 44.4° N of W.
9. The resultant velocity is 67 m/s, 73° S of W.

Terms to Know

Distance

- the separation between two points (how far an object has traveled)
- scalar quantity
- symbol: d
- units: nm, μm , cm, m, km, Mm, etc.

Position

- separation between an object and a reference point
- vector quantity
- symbol: \vec{x}
- units: cm, m, km, etc.

Note: Instantaneous position is the location of an object at an instant (at a single time, t)

Displacement

- change in position (the difference between two positions)
- vector quantity
- symbol: $\Delta\vec{x}$

change in - delta

$$\Delta\vec{x} = \vec{x}_2 - \vec{x}_1$$

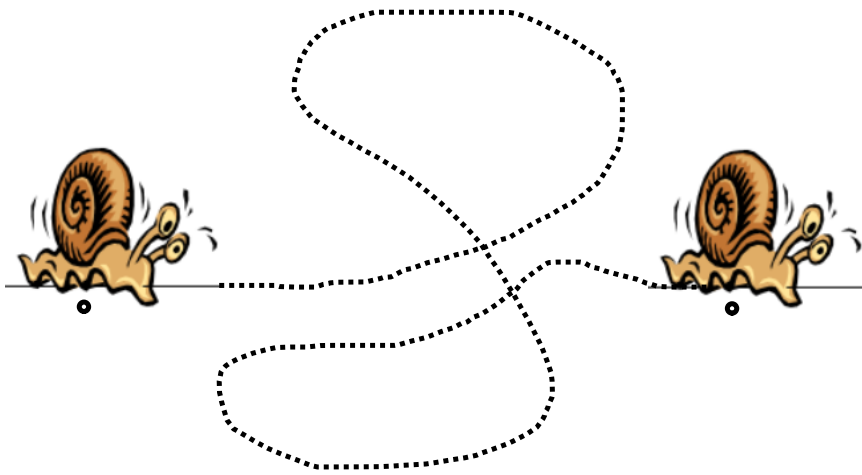
2 - final f
1 - initial i

- units: cm, m, km, etc.

$$\Delta\vec{x} = \vec{x}_f - \vec{x}_i$$

$$\Delta\vec{d} = d_2 - d_1 = d_f - d_i$$

Snail - on his morning walk...



$$\Delta \vec{x} = \vec{x}_2 - \vec{x}_1$$

initial position
(x_1)





final position
(x_2)

A3

Position + Displacement

Demo - Corridor
Gecko

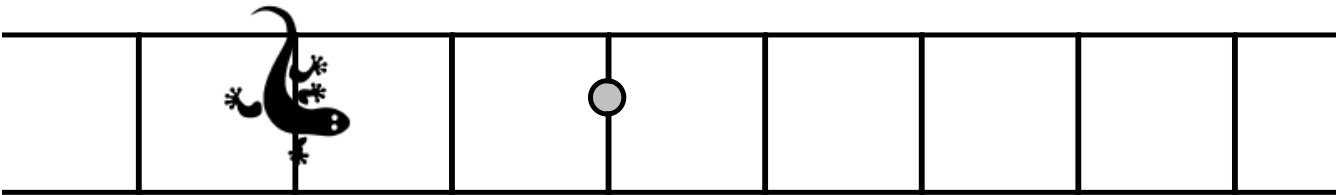
Positive Direction: 

Negative Direction: 

—

+

Reference Point



$\vec{x}_1 =$

$\vec{x}_2 =$

$$\Delta \vec{x} = \vec{x}_2 - \vec{x}_1$$

$$\begin{array}{cccc}
 -11b & +12b & 11b & -11b \\
 -11b & -11b & -11b & 11b \\
 -11b & -11b & -11b & -11b \\
 & 11b & -11b &
 \end{array}$$

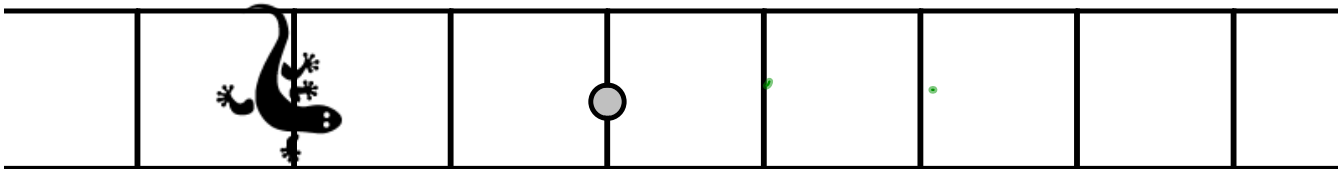
P6

Position + Displacement }
 Demo - Corridor
 Gecko

Positive Direction: $+$
 $-$

Negative Direction: $-$
 $+$

Reference Point



$\vec{x}_1 = -2$



$\vec{x}_2 =$

$\Delta \vec{x} = \vec{x}_2 - \vec{x}_1$ $3 - (-6)$
 17

$17t$ $-17t$ $-17t$ $-17t$
 $-17t$ $17t$ $-17t$ $-17t$
 $-17t$ $-17t$ $-29t$

Time Interval

- the amount of time that passes between two instants of time

- symbol: Δt

- units: s, h

- scalar quantity

$$\Delta t = t_2 - t_1 \Rightarrow t$$

Speed

Speed \rightarrow scalar

- the distance an object travels divided by the time interval during which the object was traveling (how fast an object is traveling)

$$\text{speed} = \frac{\text{distance}}{\Delta t}$$

$$v = \frac{d}{\Delta t} = \frac{d}{t} \text{ or } \frac{x}{t}$$

- scalar quantity
- symbol: v
- units: cm/s, m/h, km/h, m/s



Note: *Instantaneous speed* is the speed at which an object is traveling at time, t.



(Average) Velocity

Velocity \rightarrow Vector

- describes how fast an object moves from one position to another *and* indicates the direction in which the object is travelling
- the rate of change of position or the displacement of an object over a time interval
- vector quantity
- symbol: \vec{v}
- units: cm/s, m/s, km/h, etc.

$$\vec{v} = \frac{\Delta \vec{x}}{\Delta t} = \frac{\vec{x}_2 - \vec{x}_1}{\Delta t} = \frac{\vec{x}}{t} = \frac{d}{t}$$

p 3

(Average) Acceleration

- the rate of change of velocity of an object over a time interval
 - vector quantity
 - symbol: \vec{a}
 - units: m/s²
- f \rightarrow final
i \rightarrow initial

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{t}$$

p 6

Attachments

Physics 112- C2 Graphical Rep of Vectors.doc

Physics 112 - Analytical Man of Vectors.doc

Physics 112 - Analytical Man of Vectors (Answers).doc

Physics 111- C2 Graphical Rep of Vectors.doc

j0388427[1].wav

j0388430[1].wav

j0388453[1].wav