Name: KEY

Date:

Section C D F

The Masters School
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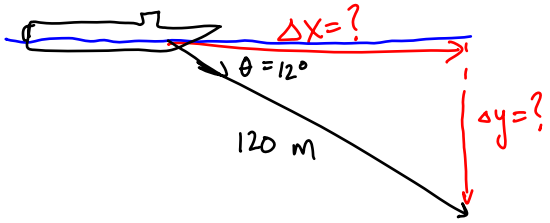
Physics

Vectors and Trig I

1. A submarine dives 120.0 m at an angle of 12.0° below the horizontal. What are the horizontal and vertical components of the submarine's displacement? Draw a diagram.



$\sin\theta = \frac{\Delta y}{120}$ $\quad 120\sin 12 = \Delta y$ $\quad 24.9\ m = \Delta y$

$\cos\theta = \frac{\Delta x}{120}$ $\quad 120\cos 12 = \Delta x$ $\quad 117.4\ m = \Delta x$

2. A golfer takes two putts to sink his ball in the hole once he is on the green. The first putt displaces the ball 6.10 m east, and the second putt displaces it 5.40 m south. What displacement would put the ball in the hole in one putt? *(reminder: displacement is a vector, so therefore you must find a magnitude and direction)*

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

$(6.1)^2 + (5.4)^2 = c^2$

$66.37 = c^2$

$8.15\ m = c$

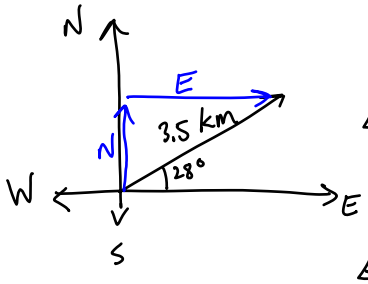
$\tan\theta = \frac{opp}{adj} = \frac{5.4}{6.1}$

$\tan\theta = .885$

$\theta = 41.5°$

Displacement = 8.15 m @ 41.5° South of East

3. A person walks 28.0° north of east for 3.50 km. How far would another person walk due north and due east to arrive at the same location?



$N = 3.5\sin 28$

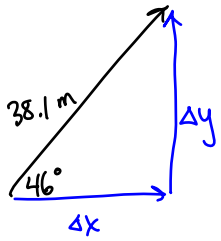
$N = 1.64\ km$

$E = 3.5\cos 28$

$E = 3.09\ km$

A person would walk 1.64 km North and 3.09 km East to arrive at the same location.

4. A roller coaster travels 38.1 m at an angle of 46.0° above the horizontal. How far does it move horizontally? How far does it move vertically?



Horizontal (Δx)

$\cos 46 = \frac{\Delta x}{38.1}$

$38.1\cos 46 = \Delta x$

$26.47\ m = \Delta x$

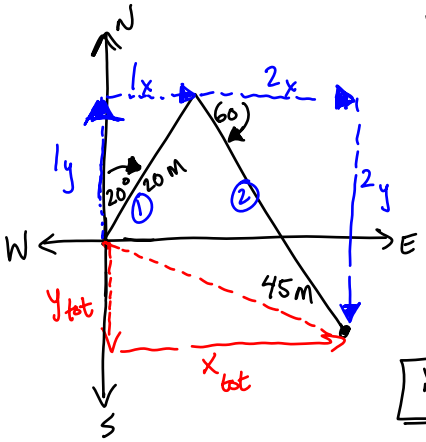
Vertical (Δy)

$\sin 46 = \frac{\Delta y}{38.1}$

$38.1\sin 46 = \Delta y$

$27.41\ m = \Delta y$

5. A person walks 20 m at an angle of 20° East of North. The person then turns right, and travels 45 meters at an angle of 60° South of East. What is their displacement from where they started? *(This is similar to the problem in your textbook on page 95)*



$x_{tot} = 1_x + 2_x$

$1_x = 20\sin(20)$

$1_x = 6.84$ m

$2_x = 45\cos 60$

$2_x = 22.5$ m

$x_{tot} = 29.34$ m

$y_{tot} = 1_y - 2_y$

$1_y = 20\cos 20$

$1_y = 18.79$ m

$2_y = 45\sin 60$

$2_y = 38.97$ m

$y_{tot} = -20.18$ m

To find Displacement distance, use pythag.

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

$(29.34)^2 + (-20.18)^2 = c^2$

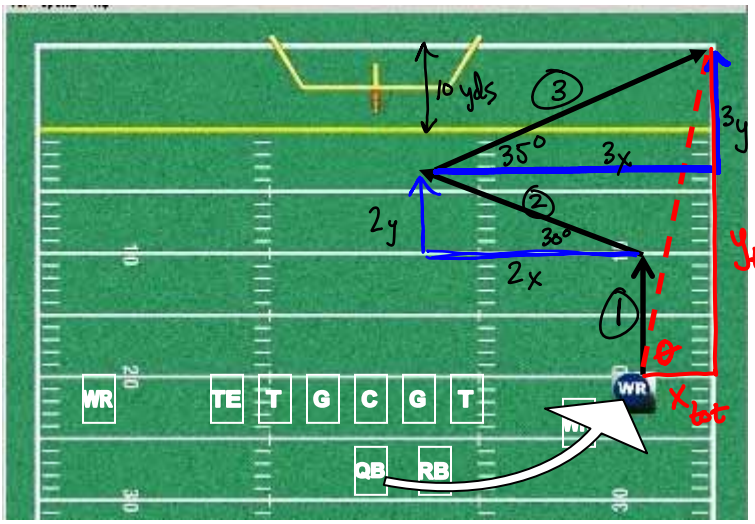
$35.61 = c$

To find angle, use trig

$\tan\theta = \frac{29.34}{20.18}$

$\theta = 55.48°$ South of East

6. Bill Belichick has 7 seconds on the clock at the half, and gathers the Patriots team for one last play. "Here's what we're going to do: Randy Moss, run straight to the 10, then run a slant to the 3 yard line at an of angle 30° above the horizontal, then fake back and run toward the corner at an angle of 35 degrees above the horizontal. Brady, once you snap the ball I want you to boot leg right, and connect with Moss in the corner of the endzone." If the endzone is 10 yards deep, and Brady threw from where Moss was originally standing, what is the exact angle and length that Brady has to throw the ball to make the touchdown? (*cameo question advisor: Charlie Siegler*)



$y_{tot} = 1 + 2y + 3y$ = 30 yds

$x_{tot} = 3x - 2x$ = 6.45 yds

3x

$\tan 35 = \frac{3y}{3x}$

$3x = \frac{3y}{\tan 35}$

$3x = \frac{13}{\tan 35}$

$3x = 18.57$ yds

2x

$\tan 30 = \frac{2y}{2x}$

$2x = \frac{2y}{\tan 30}$

$2x = \frac{7}{\tan 30}$

$2x = 12.12$ yds

$y_{tot} = 1 + 2y + 3y$

$y_{tot} = 10 + 7 + 13$

$y_{tot} = 30$ yds

Displacement

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

$6.45^2 + 30^2 = c^2$

30.69 yds $= c$

$\tan\theta = \frac{30}{6.45}$

$\theta = 77.87°$

He would have to throw the ball 30.69 yds at 77.87° above the horizontal