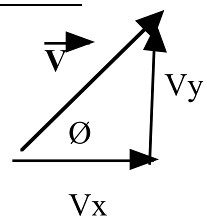
NAME_____________ DATE_________



Pythogarean: $\mathbf{V}^2 = Vx^2 + Vy^2$

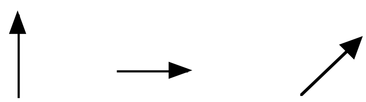
$Vx = \mathbf{V} \cos(Ø)$

$Vy = \mathbf{V} \sin(Ø)$

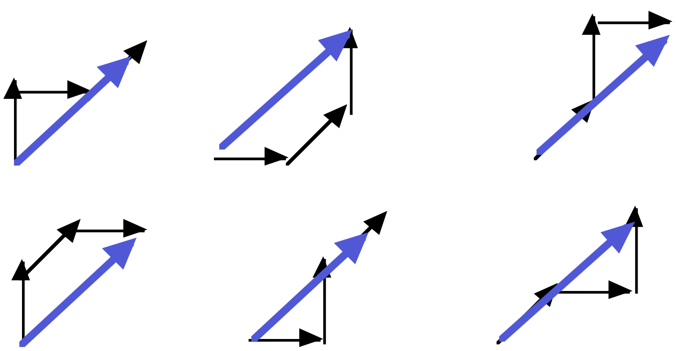
$Ø = \tan^{-1}(Vy/Vx)$

VECTOR 3 PROBLEMS **ANSWERS!!!**

Draw three different ways to add the three vectors to get a resultant:

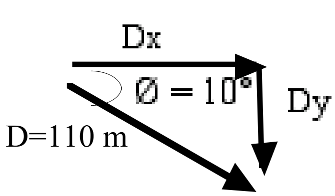


There are Six different ways to add these!



(From book Chapter 3 pgs 113-117)

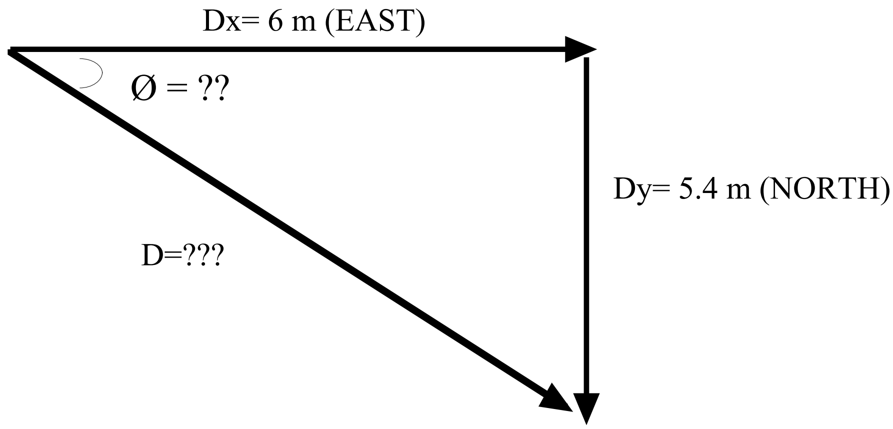
23. A submarine dives 110 meters at an angle of 10 degrees below the horizontal. What are the horizontal and vertical components of the sub's displacement? See Sample Problem 3B.



*Dx=**D**cos Ø so Dx = 110 cos (10°) = 110* .9848 = 108.32 meters=Dx*

*Dy=**D**sin Ø so Dx = 110 sin (10°) = 110* .1736 = 19.1 meters=Dy*

25. 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 m east, and the second putt displaces it 5.4 m south. What displacement would put the ball in the hole on one putt? See Sample Problem 3A

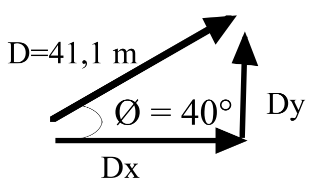


D$=?,\ D^2=Dx^2+Dy^2=6^2+5.4^2=36+29.16=65.16$, *so* $D=8.072\ m$

$Ø = \tan^{-1}(opp/adj) = \tan^{-1}(5.4/6)=\tan^{-1}(.9) = 41.99° = Ø$

So, ***D*** *= 8.072 m at 42 degrees South of East*

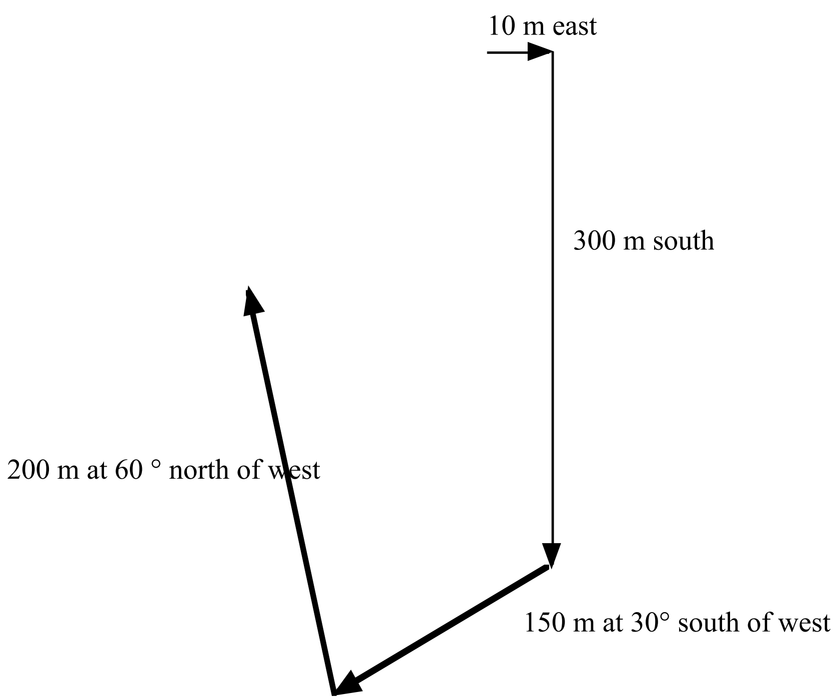
27. A roller coaster travels 41.1 meters at an angle of 40 degrees above the horizontal. How far does it move horizontally and vertically? See Sample Problem 3B



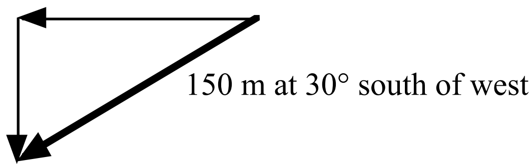
$Dx=\mathbf{D}\cos Ø$ *so* $Dx = 41.1 \cos(40°) = 41.1 * .766 = 31.48$ *meters*$=Dx$

$Dy=\mathbf{D}\sin Ø$ *so* $Dx = 41.1 \sin(40°) = 41.1 * .6428 = 26.42$ *meters*$=Dy$

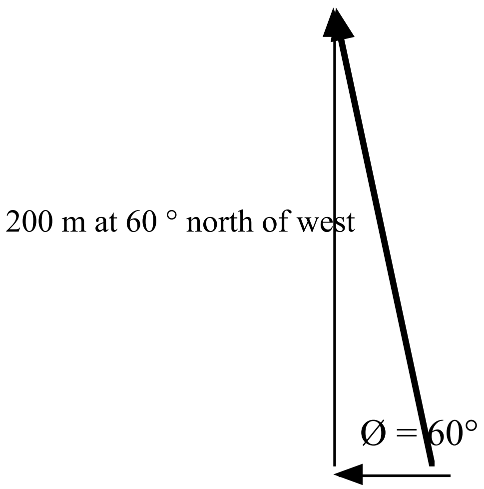
29. A person walks 10 m east, 300 m south, 150 m at 30 degrees south of west, then 200 m at 60 degrees north of west. What is the person's resultant displacement from the starting point? See Sample Problem 3C.



But we can change this to all north/south and east/west by finding the components of the two angled trips….

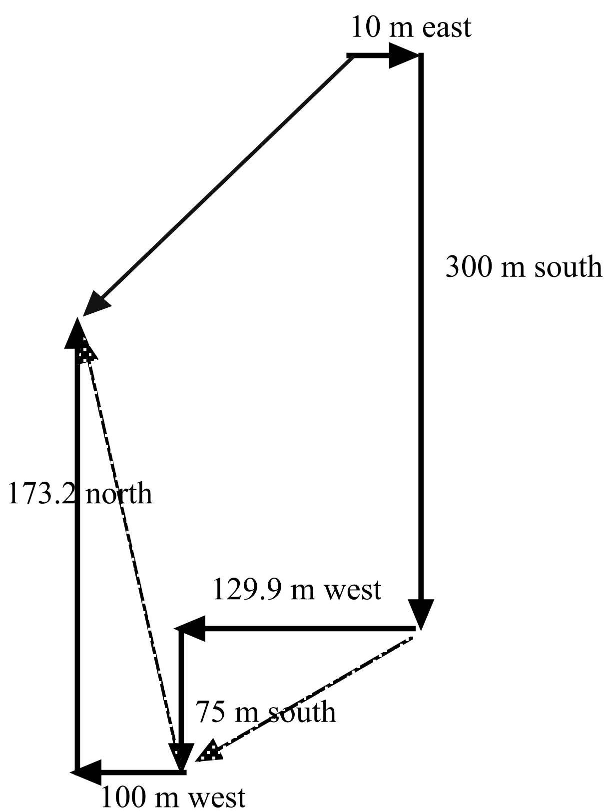


*Dx=**D**cos Ø so Dx = 150 cos (30°) = 129.9 meters west=Dx*
*Dy=**D**sin Ø so Dx = 150 sin (30°) = 75 meters south=Dy*

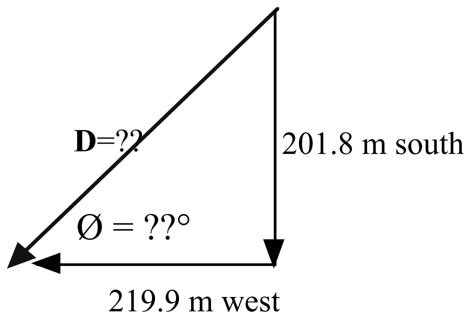


*Dx=**D**cos Ø so Dx = 200 cos (60°) = 100 meters west=Dx*
*Dy=**D**sin Ø so Dx = 200 sin (60°) = 173.2 meters north=Dy*

So the trip with just north/south and east west looks like:



Or we could just add all the north/south and east/west to make one big right triangle….
Y= -300 m S + -75 m S + 173.2 m N = -201.8 South
X= +10 m E + - 129.9 m W + -100 m W = -219.9 m West



D=?, $D^2=Dx^2+Dy^2= 219.9^2+127.55^2=48356+16269=64625$, *so D=254.2 m*

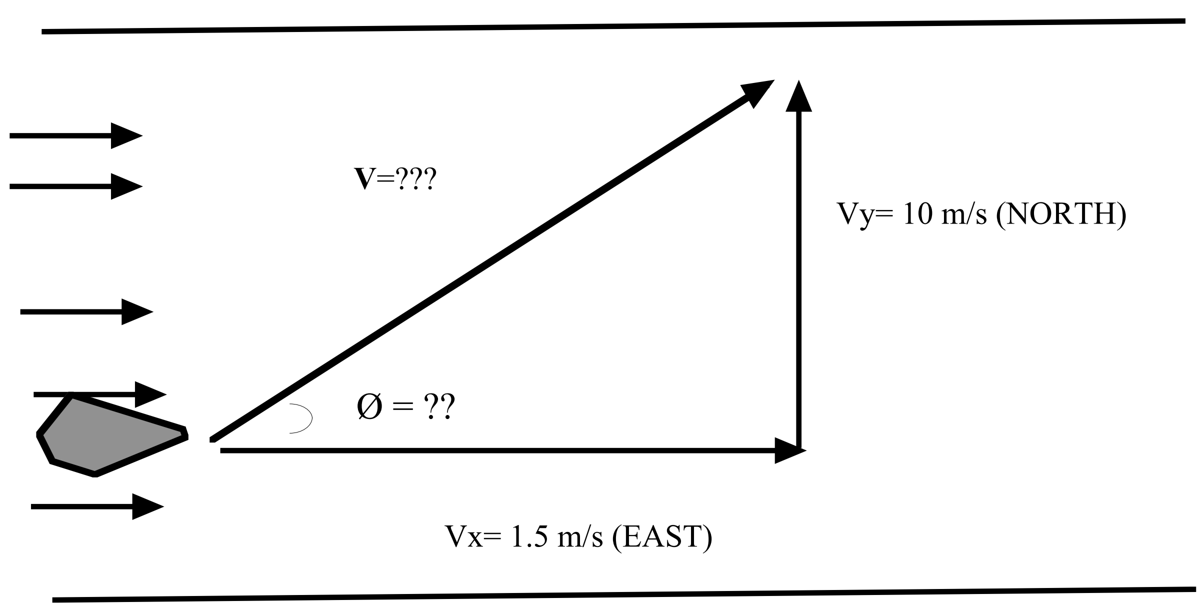
$Ø = \tan^{-1}(opp/adj) = \tan^{-1}(127.55/219.9)=\tan^{-1}(.58) = 30.11° = Ø$

So, ***D*** *= 254.2 m at 30.11 degrees South of West (or 59.88° West of South)*

But in the book, the first leg is 100 m, so Mr. T copied wrong, so
The big triangle should be 129.9 m west, 201.8 m south…, so the hypoteneuse is 239 m at 57.2° South of West

51. A river flows due east at 1.5 m/s. A boat crosses from the south shore to the north shore by maintaining a constant velocity of 10 m/s due north relative to the water.

a) What is the velocity of the boat as viewed by an observer on the shore?



V=?, $V^2=Vx^2+Vy^2= 1.5^2+10^2=2.25+100=102.25$, *so V=10.11 m/s*

$Ø = \tan^{-1}(opp/adj) = \tan^{-1}(10/1.5)=\tan^{-1}(6.67) = 81.46° = Ø$

*So, **V** = 10.11 m/s at 81.46 degrees North of East (or 8.53° East of North)*

b) If the river is 325 m wide, how far downstream has the boat moved by the time it reaches the north shore?

Time is the same in all directions!

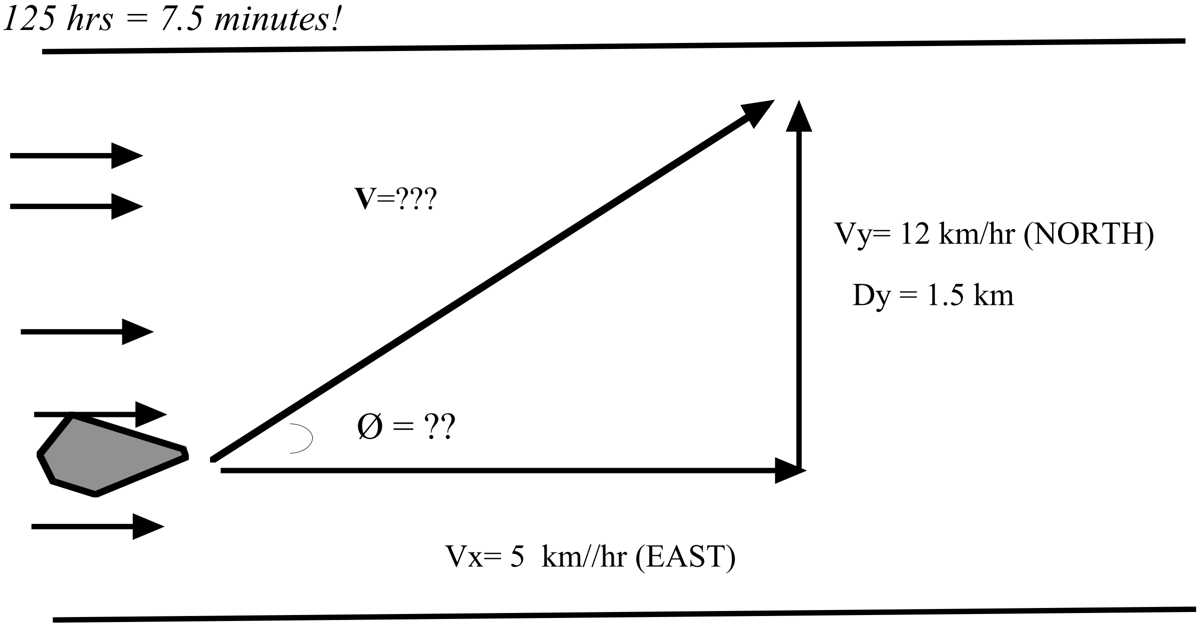
*Dy=VyT so 325m=10m/s * T so T = 32.5 seconds*

*Dx=VxT so Dy = 1.5 m/s * 32.5 sec = 48.75 meters*

See Sample Problem 3F

53. A hunter wishes to cross a river that is 1.5 km wide and that flows with a speed of 5 km/hr. The hunter uses a small powerboat that moves at a maximum speed of 12 km/hr with respect to the water. What is the minimum time needed for crossing?

It doesn't matter how fast the river flows!... If he aims straight across relative to the river he will travel the shortest distance across so T=D/V = 1.5 km/12 km/hr = .125 hrs = 7.5 minutes!



See Sample Problem 3F

**** Honors:

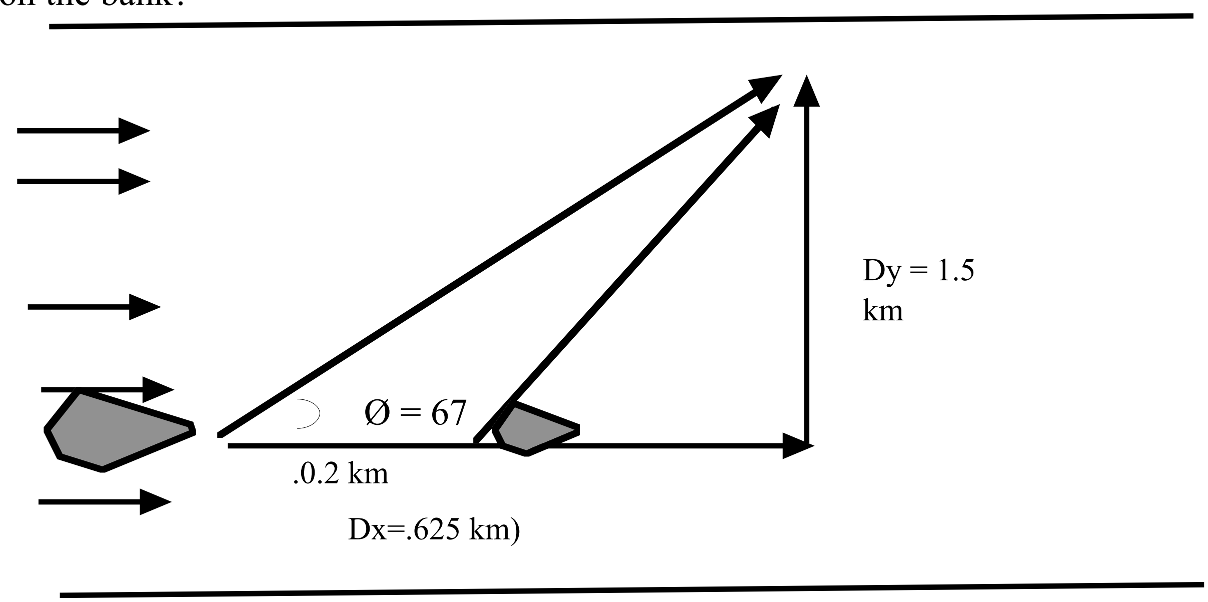
In problem 53, what is the hunter's displacement?

If t= .125 hrs, then Dx=VxT=5(.125)=.625km

*$\mathbf{V}^2=Vx^2+Vy^2$ so **V**= 13 km/hr, $\tan^{-1}(12/5)$= Ø = 67.38° to the bank of the river*

*So **D=VT**= 13(.125)=1.625 km at 67 degrees to the bank of the river (.625 km down stream)*

Suppose someone is .2 downstream from the hunter's original position and starts 3 minutes after him. What speed and bearing would they have to have to catch him on the bank?



.2 km down stream means they need to go (.625-.2)= .425 km in the x direction If they start 3 minutes after him that means they have (7.5-3)=4.5 minutes=.075 hrs. Their speed in the x direction (along the river) would be

$$Vx=Dx/T=.425/.075= 5.666 \text{ km/hr}.$$

They still need to go across the 1.5 km river in the y direction, same time of .075 hrs.... Vy=Dy/T=1.5/.075=20 km/hr.

So $\boldsymbol{V}^2=Vx^2+Vy^2$ *so* $\boldsymbol{V}$*= 20.7 km/hr,* $\tan^{-1}(20/5.666)= Ø = 74.18°$ *to the bank of the river.*