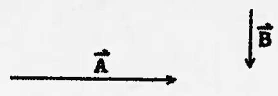
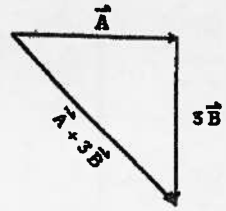
Example 1: Given :



Find : $\vec{A} + 3\vec{B}$

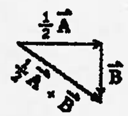
Solution :



Example 2: Given :

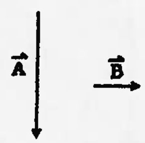
Find : $\frac{1}{2}\vec{A} + \vec{B}$

Solution :



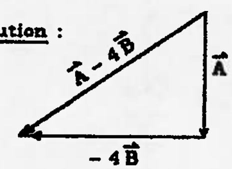
Example 3:

Given :

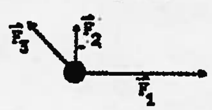


Find : $\vec{A} - 4\vec{B}$

Solution :

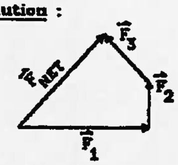


Example 4: Given : Three forces acting on an object



Find : The net force acting on the object

Solution :



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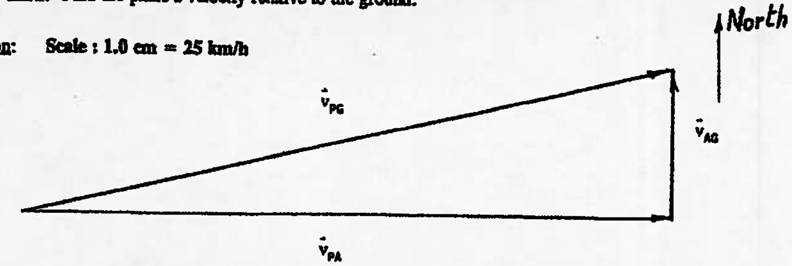
Example 5:

An aircraft heading east at 350. km/h relative to the air encounters a steady wind from the south whose speed is 80.0 km/h. Find the plane's velocity relative to the ground.

Solution: Scale : 1.0 cm = 25 km/h



$\vec{v}_{PA}$ = velocity of plane relative to the air

$\vec{v}_{AG}$ = velocity of air relative to the ground

$\vec{v}_{PG}$ = velocity of plane relative to the ground

$= 3.59 \times 10^2$ km/h [N77°E]

Example 6:

A student can swim at the rate of 0.80 m/s in still water. He swims north across a river that is 40. m wide and has a current of 0.60 m/s east.

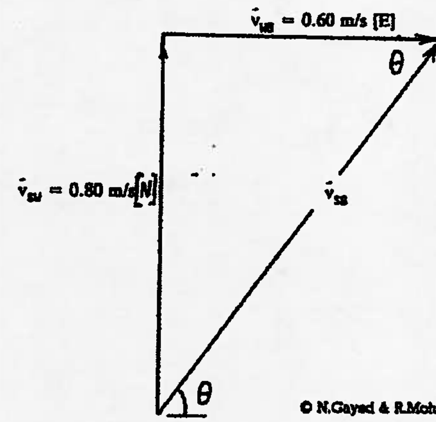
(a) Find the student's resultant velocity relative to the river bank.

(b) Calculate the time it takes him to reach the opposite bank.

(c) When he reaches the other side, how far downstream is he from his starting point ?

Solution:

(a) Scale : 1.0 cm = 0.10 m/s



$\vec{v}_{SW}$ = velocity of swimmer relative to water

$\vec{v}_{WB}$ = velocity of water relative to bank

$\vec{v}_{SB}$ = velocity of swimmer relative to bank

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From the scaled diagram, $\vec{v}_R$ = 1.0 m/s 53° to the shore

$\vec{v}_R$ could also be found mathematically as follows:

$$v_{SS} = \sqrt{(0.80\ m/s)^2 + (0.60\ m/s)^2}$$

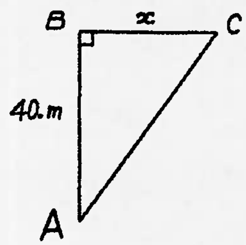
$$\theta = \tan^{-1} \frac{0.80\ m/s}{0.60\ m/s}$$

$$\vec{v}_{SS} = 1.0\ m/s\ 53° \text{ to the shore}$$

(b) Important Note: $t_{AB} = t_{BC} = t_{AC}$

i.e.: the time it would take the swimmer to swim from point A to point B with no current is the same as the time it would take the current to carry the swimmer from B to C and is the same as the time it actually takes the swimmer to travel from A to C.

$$t_{AB} = \frac{d_{AB}}{v_{AB}} = \frac{40.\ m}{0.80\ m/s} = 5.0 \times 10^1\ s$$



(c)

$$d_{BC} = v_{BC} \times t_{AB} = 0.60\ m/s \times 50.\ s = 30.\ m$$

$$x = 3.0 \times 10^1\ m$$

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PROBLEMS ON VECTORS

1. Two men can row a boat at a constant speed of 8.00 km/h. They row across a river that is 1.00 km wide and has a current with a velocity of 6.00 km/h east.
   (a) Calculate the men's resultant velocity relative to the shore.
   (b) How far below the starting point will they land ?
   (c) How far will they have travelled ?
   (d) How much time did it take them to reach the other side ?

2. A stream is running at 3.00 km/h and its width is 1.00 x 10^2 m. If a man can row a boat at a speed of 5.00 km/h, find the direction in which he must row in order to go straight across the stream, and the time it takes him to cross.

3. A canoeist can paddle at a speed of 2.0 m/s in still water. She heads north across a river that is 5.0 x 10^2 m wide and has a current of 1.0 m/s east.
   (a) Find the time it took her to reach the other side.
   (b) How much further downstream will she be than when she started ?

4. A speed boat travelled 6.0 km east, 3.0 km north east and finally 6.0 km north in 0.50 hours. Calculate:
   (a) the total distance travelled.
   (b) the speed boat's displacement.
   (c) the speed boat's average speed.
   (d) the speed boat's average velocity.

5. A woman jogs 8.0 km north, 6.0 km west, 5.0 km north 37° west and finally 7.0 km west in 10.0 hours. Calculate:
   (a) the total jogging distance.
   (b) the woman's displacement.
   (c) the woman's average speed.
   (d) the woman's average velocity.

6. An athlete runs around a circular race track of radius 42.0 m. If the athlete starts jogging clockwise from the north side of the track, calculate the distance travelled by the athlete and his displacement when he completes:
   (a) 1/4 lap (b) 1/2 lap (c) 3/4 lap (d) full lap

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