Section 1.4

Relative Motion :

Everything that we experience in our lives is based on our own frame of reference. Two individuals can experience the same event, yet describe the outcome or memory of the event in two very different ways.

In physics, we believe that both of the accounts could be truthful if one of the descriptions can be linked to the other through a simple change of reference.

Example for clarity.

It is raining outside. A student standing on the side of the road describes the rain as falling straight down. A student driving eastwards in a car reports that the rain is being blown towards the west (looks like it is coming right into the front window). Can both stories be correct if frame of reference is taken into account.

Discuss:

Example for clarity.

A person starts rowing across a river that is flowing from west to east. They row so that the nose of the boat is always facing due north.

a) What direction is the person in the boat rowing?

b) What direction is the current in the river flowing?

c) What direction does a person standing on the shore see the boat moving?

Sol'n a) The person rows North

b) The river flows East

c) The boat moves at an angle that lies between North and East, the amount depending upon the speed at which the person can row, and the speed of the current in the river.

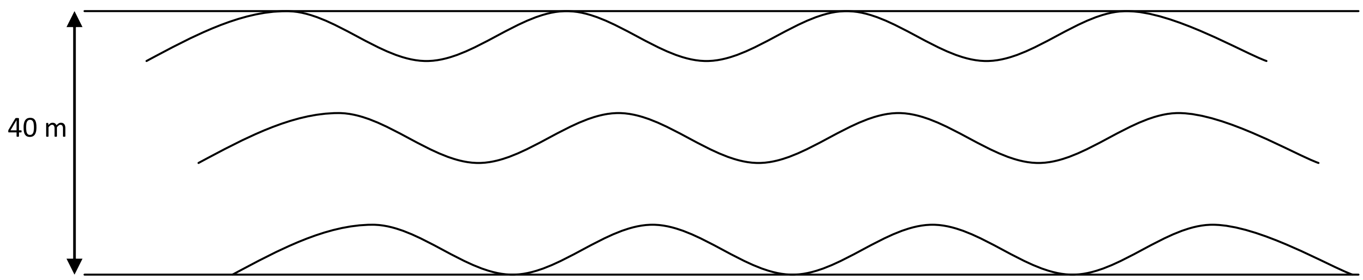
Typical Relative Motion Problem.

A boat is being rowed across a river with a velocity of 1 m/s [N]. The river is flowing towards the east with a velocity of 2 m/s [E].

a) If the river is 40 m wide, how long will it take for the boat to reach the other side?

b) What velocity does a person on the shore see the boat moving in the river?

c) How far down the river does the boat end up relative to where it would have landed had there been no current?



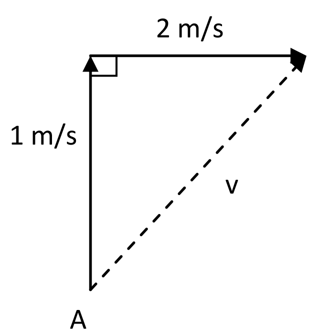

Sol'n

a) Despite the fact that the boat is being pushed down the river by the current, it is still moving towards the other shore at 1 m/s. So, t = d/s

$t = \frac{40\ m}{1\ m/s}$ = 40 seconds

takes 40 seconds to cross the river.

b) A person on the shore gets the addition of the two effects.




$v = \sqrt{1^2 + 2^2}$

$v = \sqrt{5}$

$v = 2.23\ m/s$

$\vec{v} = 2.23 \frac{m}{s}\ [63.4° \ E\ of\ N]$

$A = \tan^{-1}\left(\frac{2}{1}\right)$

$A = 63.4° \ E\ of\ N$

c) As in part a) the velocity of the boat crossing the river does nothing in moving it down stream. Only the river velocity plays a factor here. So d = st

d=(2 m/s)(40 s) = 80 m [E]

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