Q- A boat which can travel at 12.5 m/s in still water needs to travel West across a river with a current of 8.4 m/s flowing South.

(a) What heading must the boat take in order to travel West relative to the shore? Draw a diagram.

(b) What will be the boat's velocity relative to the shore?

Velocity of the stream is u = 8.4 m/s to the south.

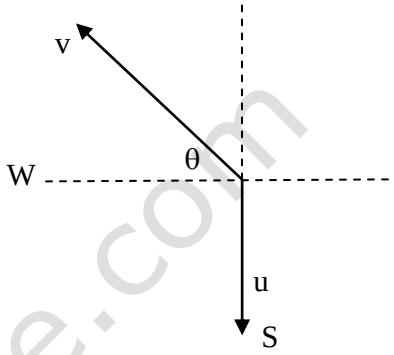
Velocity of the boat in still water v = 12.5 m/s.

Let the boat is heading at angle θ north of west.

Resolving the velocity of boat in north and west direction we get

Component of velocity v in west direction will be

v cos θ and that in north direction will be v sin θ



So we can say that the boat has three velocities

1. v cos θ to the west
2. v sin θ to the north and
3. u to the south.

Now if the boat has to travel west the resultant velocity must be in west direction and for that the component of the resultant velocity in north south direction should be zero and for that the component of v to the north must be equal in magnitude to stream velocity which is south. Hence we get

$v \sin\theta = u$

Or $\sin\theta = u/v$

Or $\sin\theta = 8.4/12.5 = 0.672$

Gives $\theta = 42.22^0$

Hence in order to travel west the boat must head 42.22^0 north of west.

b)

The resultant velocity of the boat in this case, which is the velocity relative to shore will be the west component only and hence it will be

$v \cos\theta = 12.5 * \cos 42.22^o = 12.5 * 0.740 = 9.26$ m/s.