BOAT AND STREAMS

Contents

2.9.3.4 Boat and Streams

2.9.3.4.1 Basic Concepts

Usually by the speed of the boat or swimmer we mean the speed of the boat (or swimmer) in still water. If the boat (or the swimmer) moves against the stream, it is called upstream and if it moves with the stream, it is called downstream.

If the speed of the boat (or the swimmer) is 'u' and if the speed of the stream is 'v' then, while upstream the effective speed of the boat = u - v and while downstream the effective speed of the boat = u + v.

If u km per hour be the boat's rate in still water and v km per hour the rate of the current. Then

u + v = boat's rate with current
u – v = boat's rate against current.

Solving for u and v we get:

u = $\frac{1}{2}$ (boat's rate with current + boat's rate against current)
v = $\frac{1}{2}$ (boat's rate with current – boat's rate against current)

Hence we have the following two facts:

(i) A boat's rate in still water is half the sum of his rates with and against the current.

(ii) The rate of the current is half the difference between the rates of the boat with and against the current.

The problems of boats and streams are also based on the basic relation of speed, distance and time i.e. Speed = $\frac{Distance}{Time}$

Example: A man can row upstream at 10 km/hr and downstream at 16 km/hr. Find the man's rate in still water and the rate of the current.

Solution: Man's rate in still water = $\frac{1}{2}$ (10 + 16) = 13 km/hr
Rate of current = $\frac{1}{2}$ (16 – 10) = 3 km/hr.

Example: A man rows downstream 24 km and upstream 18 km, taking 3 hours each time. What is the velocity of the current?

Solution: Downstream speed = $\frac{24}{3}$ = 8 km/hr.
Upstream speed = $\frac{18}{3}$ = 6 km/hr.
∴ Speed of stream = ($\frac{u-v}{2}$) = $\frac{8-6}{2}$ = 1 km/hr

Example: A man can row 6 km/hr in still water. It takes him twice as long to row up as to row down the river. Find the rate of the stream.

Solution: Let rate of stream = u km/h

Then, 6 + u = 2 (6 – u)

Or, 3u = 6

∴ u = $\frac{6}{3}$ = 2 km/h.

2.9.3.4.2 Specific Cases

- A man can row 'u' km/hr in still water. If in a stream, which is flowing at 'v' km/hr, it takes him 't' hrs to row to a place and back, the distance between the two places is $\frac{t\,(u^2-v^2)}{2u}$.

Example: A man can row 6 km/hr in still water. When the river is running at 1.2 km/hr, it takes him 1 hour to row to a place and back. How far is the place?

Solution: Distance = $\frac{1\times[6^2-(1.2)^2]}{2\times 6}$

$= \frac{36-1.44}{12}$ = 3 – 0.12 = 2.88 km.

- A man can row a certain distance downstream in t_1 hours and returns the same distance in t_2 hrs. then:

  (a) If the stream flows at the rate of u km/hr then the speed of the man in still water is given by $\frac{u\,(t_1+t_2)}{t_2-t_1}$ km/hr.

  (b) If speed of man in still water is v km/hr then the speed of stream is: $\frac{v\,(t_2-t_1)}{t_1+t_2}$ km/hr.

Example: Shyam can row a certain distance downstream in 9 hours and return the same distance in 12 hours. If the stream flows at the rate of 3 km per hour, find the speed of Shyam in still water.

Solution: Shyam's speed in still water = $\frac{3\,(12+9)}{12-9}$ = 21 km/hr.

Example: Shyam can row a certain distance downstream in 6 hours and return the same distance in 9 hours. If the speed of Shyam in still water be 12 km/hr, find the speed of the stream.

Solution: Speed of stream = $\frac{12\,(9-6)}{9+6}$ = 2.4 km/hr.