[2] Boats and Streams

Basics of SDT:-

Formula:- Two speeds → Boat speed (x) + River speed (y) (stream)

DOWNSTREAM → $x+y$ (Boat + Stream)

UPSTREAM → ~~$x-y$~~ (~~Stream - boat~~) (Boat - stream)

1) What will be the boat's speed in still water and speed of river, if the boat takes 12 hours to row a certain upstream and 8 hours to row same dist downstream?

Soln: $S = D/T$:

Upstream: $U_S = \frac{48}{12} \Rightarrow 4$ km/hr

$x - y = 4$ — (1)

Downstream: $D_S = \frac{48}{8} = 6$ km/hr

$x + y = 6$ — (2)

$x - y = 4$

$x + y = 6$

$2x = 10$

$x = 5$ km/hr → Boat speed

$5 - y = 4$

$y = 1$ km/hr → Stream speed

2) Simran takes twice as long to swim upstream as to swim down the river and has a speed of 12 km/hr in still water. What is river's speed?

Solu: $T_{upstream} = 2 \times T_{downstream}$

$$\frac{D_U}{S_U} = 2 \times \frac{D_D}{S_D}$$

$$\frac{D}{x-y} = 2 \times \frac{D}{x+y}$$

$$x+y = 2x-2y$$

$$\boxed{x = 3y}$$

from question $\boxed{x = 12 \text{ km/hr}}$

$$\therefore y = 3 \times 4 \Rightarrow 3y = 12$$

$$y = 12 \div 3 \quad \boxed{y = 4 \text{ km/hr}}$$

3) It takes P 1 hour to row to a place and to come back. If the river is running at 2.4 km/hr and P has a speed of 12 km/hr in still water, what distance is the place from P's starting point?

Solu: $x = 12 \text{ km/hr}, \; y = 2.4 \text{ km/h}$

$S_u \Rightarrow x+y = 14.4 \quad | \quad S_d \Rightarrow x-y = 9.6 \text{ km/hr}$

given one hour to up and down

$$\therefore T_U + T_D = 1$$

$(D_U = D_D)$ $\leftarrow$ $\frac{D_U}{S_U} + \frac{D_D}{S_D} = 1 \Rightarrow \frac{D}{14.4} + \frac{D}{9.6} = 1$

$$\frac{9.6D + 14.4D}{9.6 \times 14.4} = 1 \Rightarrow \frac{24D}{4} = \frac{9.6 \times 14.4}{1.6}$$

$$\Rightarrow 6D = \frac{9.6 \times 14.4}{0.4}$$

$$\Rightarrow D = 14.4 \times 0.4 \Rightarrow \boxed{D = 5.76 \text{ km}}$$

4) An ocean current flows at a rate of 1.5 km/hr. A shark can swim in still water at rate 4.5 km/hr what is average speed for the entire distance travelled, if the shark swims from India to Australia and comes back?

Soln :- Avg Speed = $\frac{T \cdot D}{T \cdot \square}$ $\Rightarrow$ $\frac{2(D)}{\text{Tot Time}}$ $\Rightarrow$ $\frac{2D}{\text{Tot Time}}$ → distance upstream same

Tot Time = $T_D + T_{\square}$

$= \frac{D_d}{S_d} + \frac{D_u}{S_u}$

$= \frac{D}{3} + \frac{D}{6}$

$= \frac{9D}{18} = D/2$

$x = 4.5$
$y = 1.5$
$S_d = x+y = 6$
$S_u = x-y = 3$

Av speed = $\frac{2D}{\text{Tot Time}}$ $\Rightarrow$ $\frac{2D}{D/2}$

$= 4D/D$

Avg speed = 4 km/hr

5) Ajay takes 4 hours more while swimming upstream than downstream. His speed in still water is 10 km/hr. The speed of stream is 2 km/hr. what is the distance?

Soln :- $x = 10, y = 2$

$S_d = x+y \Rightarrow 12$

$S_u = x-y \Rightarrow 8$

Given $T_u = 4 + T_D$

$\frac{D_u}{S_u} = 4 + \frac{D_d}{S_d} \Rightarrow \frac{D}{8} = 4 + \frac{D}{12}$

$$\frac{D}{8} = \frac{48+D}{12}$$

$$3D = 96 + D$$

$$\boxed{D = 96 \text{ km}} \rightarrow \text{Total distance}$$

6) Raj swims 26km downstream in same time as 14km upstream. what is his speed in still water if speed of stream is 3km/hr?

Soln: $D_d = 26$km $\quad D_u = 14$km

$S_{stream} \Rightarrow y = 3$ km/hr

$x = ?$

Gives same Time $\rightarrow T_u = T_D$

$$\frac{D_u}{S_u} = \frac{D_d}{S_d}$$

$$\frac{14}{x-y} = \frac{26}{x+y}$$

$$14x + 14y = 26x - 26y$$

$$40y = 12x$$

$$\frac{x}{y} = \frac{40}{12} = \frac{10}{3}$$

i.e $\boxed{y = 3}$

$$\frac{x}{3} = \frac{10}{3}$$

$$\boxed{x = 10}$$ //

$$\frac{26}{x-y} = \frac{14}{x+y}$$

$$\Rightarrow \frac{26}{x-3} = \frac{14}{x+3}$$

$$26x + 78 = 14x - 42$$

$$12x =$$

7) Ratio of Guddi's swimming speed in still water to the speed of river is 7:1. She swims 4.2km up the river in just 14min. How much time Guddi take to swim 15.4km down the river?

Soln: given $x : y \Rightarrow 7:1 \rightarrow \frac{x}{y} = \frac{7}{1} \Rightarrow \boxed{x = 7y}$

Up

D = 4.2km

T = 14 min

$V_s = \frac{D}{T}$

$= \frac{4.2}{1.4}$

$= 0.3 km/min$

$x - y = 0.3$

$7y - y = 0.3$

$6y = 0.3$

$y = \frac{0.3}{6}$

$y = 0.05 km/min$

$x = 7y = 0.35 km/min$

Down

D = 18.4km

$S = x + y \Rightarrow 0.35 + 0.05$

$S_d = 0.4 km/min$

$T_D = D/S \Rightarrow \frac{18.4}{0.4} \Rightarrow \frac{184}{4} \Rightarrow 46$

$T_D = 64 min$

8) Find ratio of swimming speed of Raj in still water to speed of river, if ratio of time taken to go 10km upstream to time taken to go 10km downstream is 11:5?

Sol:- $T_u : T_b \rightarrow 11:5$ To find x:y?

$\frac{T_u}{T_b} = \frac{11}{5}$ $\frac{D_u/S_u}{D_d/S_d} = \frac{11}{5}$

upstream and downstream dist = 10km given

$$\frac{16/x-y}{16/x+y} = \frac{11}{5}$$

$$\frac{x+y}{x-y} = \frac{11}{5} \Rightarrow 5x+5y = 11x-11y$$

$$\Rightarrow 6x = 16y \Rightarrow \frac{x}{y} = \frac{+6\,8}{6\,3}$$ $x:y \Rightarrow 8:3$

9) Raj swims for 6½ hours while going 24km downstream and 36 km upstream. But he takes 6 hours to swim 36km downstream and 24km upstream. At what rate is the river flowing?

Sol: Case 1

$T_D + T_u = 6\frac{1}{2} \Rightarrow \frac{13}{2}$

$$\frac{24}{S_d} + \frac{36}{S_u} = \frac{13}{2} \Rightarrow \boxed{\frac{48}{S_d} + \frac{72}{S_u} = 13} \quad -①$$

Case

$T_D + T_u = 6$

$$\boxed{\frac{36}{S_d} + \frac{24}{S_u} = 6} \quad -②$$

① ×1
② ×3

$$\frac{48}{S_d} + \frac{72}{S_u} = 13 \quad -③$$

$$\frac{108}{S_d} + \frac{72}{S_u} = 18 \quad -④$$

④ − ③ $\Rightarrow \frac{108}{S_d} - \frac{48}{S_d} + \frac{72}{S_u} - \frac{72}{S_u} = 18 - 13$

$$\frac{60}{S_d} = 5 \Rightarrow \boxed{S_d = 12 \text{ km/hr}} \Rightarrow x+y$$

from ① $\frac{48}{12} + \frac{72}{S_u} = 13 \Rightarrow 72 - 9 = S_u$

$\Rightarrow 4 + \frac{72}{S_u} = 13 \Rightarrow \frac{72}{S_u} = 9 \Rightarrow S_u = \frac{72}{9}$

$S_u = 63$

$\Rightarrow \boxed{S_u = 8 \text{ km/hr}} \Rightarrow x-y$

$x+y = 12$
$x-y = 8$
$2x = 20$
$x = 10$
$y = 2$