
BOATS AND STREAMS



1. Downstream/Upstream:

In water, the direction along the stream is called downstream. And, the direction against the stream is called upstream.

2. If the speed of a boat in still water is u km/hr and the speed of the stream is v km/hr, then:

Speed downstream = $(u + v)$ km/hr.

Speed upstream = $(u - v)$ km/hr.

3. If the speed downstream is a km/hr and the speed upstream is b km/hr, then:

Speed in still water = $\frac{1}{2}(a + b)$ km/hr.

Rate of stream = $\frac{1}{2}(a - b)$ km/hr.

1. The speed of a boat when travelling down streams is 32 km/hr, whereas, when travelling upstream it is 28 km/hr, what is the speed of the boat in still water and the speed of the stream?

$$\text{Speed of boat in still water} = \frac{1}{2}(32 + 28) \text{ Km / hr} = 30 \text{ km / hr}$$

$$\text{Speed of stream} = \frac{1}{2}(32 - 28) \text{ Km / hr} = 2 \text{ km / hr}$$

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 rate of stream.

time upstream : time downstream = 2 : 1

Speed is inversely proportional to time for a given distance and therefore,
speed upstream : speed downstream = 1 : 2

Let speed upstream = x

speed downstream = $2x$

$$\text{Speed in still water} = \frac{1}{2}(x + 2x) = \frac{3x}{2}$$

$$\frac{3x}{2} = 6$$

$$x = 4$$

$$\text{speed upstream} = x = 4$$

$$\text{speed downstream} = 2x = 8$$

$$\text{Rate of stream} = \frac{1}{2}(8 - 4) = 2$$

A man can row $7\frac{1}{2}$ kmph in still water. If in a river running at 1.5 km/ hr an hour, it takes him 50 minutes to row to a place and back, how far off is the place?

Speed downstream $= (7.5 + 1.5) \text{ km/hr} = 9 \text{ km/hr};$

Speed upstream $= (7.5 - 1.5) \text{ kmph} = 6 \text{ kmph}.$

Let the required distance be x km. then,

$$x/9 + x/6 = 50/60.$$

$$2x + 3x = (5/6 * 18)$$

$$5x = 15$$

$$x = 3.$$

Hence, the required distance is 3 km.

A boat goes 8 km upstream and then returns. Total time taken is 4 hours 16 minutes. Velocity of the current is 1 km / hour. Actual velocity of the boat is

Let the velocity of the boat be x

$$\text{time taken for upstream motion} = \frac{8}{x-1}$$

$$\text{time taken for downstream motion} = \frac{8}{x+1}$$

Total time =

$$\frac{8}{x-1} + \frac{8}{x+1} = \frac{16x}{x^2-1} = 4\frac{16}{60} = \frac{64}{15}$$

cross multiplying

$$240x = 64x^2 - 64 \implies 64x^2 - 240x - 64 = 0$$

$$x = 4 \text{ km/h}$$

A boatman goes 2 km against the current of the stream in 2 hour and goes 1 km along the current in 20 minutes. How long will it take to go 5 km in stationary water?

$$\text{Speed upstream} = \frac{2}{2} = 1 \text{ km/hr}$$

$$\text{Speed downstream} = \frac{1}{\left(\frac{20}{60}\right)} = 3 \text{ km/hr}$$

$$\text{Speed in still water} = \frac{1}{2}(3 + 1) = 2 \text{ km/hr}$$

$$\text{Time taken to travel 5 km in still water} = \frac{5}{2} = 2\frac{1}{2} \text{ hours} = 2 \text{ hour } 30 \text{ minutes}$$

A boatman can row 3 km against the stream in 20 minutes and return in 18 minutes. Find the rate of current.

$$\text{Speed upstream} = \frac{3}{\left(\frac{20}{60}\right)} = 9 \text{ km/hr}$$

$$\text{Speed downstream} = \frac{3}{\left(\frac{18}{60}\right)} = 10 \text{ km/hr}$$

$$\text{Rate of current} = \frac{10 - 9}{2} = \frac{1}{2} \text{ km/hr}$$

A man takes 3 hours 45 minutes to row a boat 15 km downstream of a river and 2 hours 30 minutes to cover a distance of 5 km upstream. Find the speed of the current

downstream :

distance = 15 km

time = 3 hrs 45 mins

mins to hr : $\div 60$

$$= 3 + \frac{45}{60} = 3 + \frac{3}{4} = 3\frac{3}{4} \text{ hr} = \frac{15}{4} \text{ hr}$$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{downstream speed} = \frac{15}{\frac{15}{4}} = 15 \times \frac{4}{15} = 4 \text{ km/hr}$$

upstream :

distance = 5 km

time = 2 hrs 30 mins

$$= 2 + \frac{30}{60} = 2 + \frac{1}{2} = 2\frac{1}{2} \text{ hr} = \frac{5}{2} \text{ hr}$$

$$\text{upstream speed} = \frac{5}{\frac{5}{2}} = 5 \times \frac{2}{5} = 2 \text{ km/hr}$$

$$\text{speed of current} = \frac{1}{2}(\text{downstream speed} - \text{upstream speed})$$

$$= \frac{1}{2}(4 - 2)$$

$$= \frac{1}{2} \times 2$$

$$= 1 \text{ km/hr}$$

A man row 6km/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?

Upstream speed = $(6 - 1.2)$ km/h

$\Rightarrow 4.8$ km/h

Downstream speed = $(6 + 1.2)$ km/h

$\Rightarrow 7.2$ km/h

Let the distance of the place be x km.

According to the question,

$$(x/7.2) + (x/4.8) = 1$$

$$\Rightarrow 4.8x + 7.2x = 7.2 \times 4.8$$

$$\Rightarrow 12x = 7.2 \times 4.8$$

$$\Rightarrow x = 2.88$$

\therefore The distance of the place will be 2.88 km.