

### Exercise 8.8

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**1. The speed of a boat in still water is 8km/hr. It can go 15 km upstream and 22 km downstream in 5 hours. Find the speed of the stream.**

**Solution:**

Let the speed of stream be  $x$  km/hr

Given, speed of boat in still water is 8km/hr.

So, speed of downstream =  $(8 + x)$  km/hr

And, speed of upstream =  $(8 - x)$  km/hr

Using, speed = distance/ time

Time taken by the boat to go 15 km upstream =  $15/(8 - x)$ hr

And, time taken by the boat to return 22 km downstream =  $22/(8 + x)$ hr

From the question, the boat returns to the same point in 5 hr.

$$\text{so, } \frac{15}{(8 - x)} + \frac{22}{(8 + x)} = 5$$

$$\frac{15(8 + x) + 22(8 - x)}{(8 - x)(8 + x)} = 5$$

$$\frac{120 + 15x + 176 - 22x}{64 - x^2} = 5$$

$$\frac{296 - 7x}{64 - x^2} = 5$$

$$5x^2 - 7x + 296 - 320 = 0$$

$$5x^2 - 7x - 24 = 0$$

$$5x^2 - 15x + 8x - 24 = 0 \quad \text{[by factorisation method]}$$

$$5x(x - 3) + 8(x - 3) = 0$$

$$(x - 3)(5x + 8) = 0$$

$$\therefore x = 3, x = -8/5$$

As the speed of the stream can never be negative, only the positive solution is considered.

Therefore, the speed of the stream is 3 km/hr.

**2. A train, traveling at a uniform speed for 360 km, would have taken 48 minutes less to travel the same distance if its speed were 5 km/hr more. Find the original speed of the train.**

**Solution:**

Let the original speed of train be  $x$  km/hr

When increased by 5, speed of the train =  $(x + 5)$  km/hr

Using, speed = distance/ time

Time taken by the train for original uniform speed to cover 360 km =  $360/x$  hr.

And, time taken by the train for increased speed to cover 360 km =  $360/(x + 5)$  hr.

Given, that the difference in the times is 48 mins.  $\Rightarrow 48/60$  hour

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This can be expressed as below:

$$\frac{360}{x} - \frac{360}{(x+5)} = \frac{48}{60}$$

$$\frac{360(x+5) - 360x}{x(x+5)} = \frac{4}{5}$$

$$\frac{360x + 1800 - 360x}{x^2 + 5x} = \frac{4}{5}$$

$$1800(5) = 4(x^2 + 5x)$$

$$9000 = 4x^2 + 20x$$

$$4x^2 + 20x - 9000 = 0$$

$$x^2 + 5x - 2250 = 0$$

$$x^2 + 50x - 45x - 2250 = 0 \quad [\text{by factorisation method}]$$

$$x(x+50) - 45(x+50) = 0$$

$$(x+50)(x-45) = 0$$

$$\therefore x = -50 \text{ or } x = 45$$

Since, the speed of the train can never be negative  $x = -50$  is not considered.

Therefore, the original speed of train is 45 km/hr.

**3. A fast train takes one hour less than a slow train for a journey of 200 km. If the speed of the slow train is 10 km/hr less than that of the fast train, find the speed of the two trains.**

**Solution:**

Let's consider the speed of the fast train as  $x$  km/hr

Then, the speed of the slow train will be  $= (x - 10)$  km/hr

Using, speed = distance/ time

Time taken by the fast train to cover 200 km  $= 200/x$  hr

And, time taken by the slow train to cover 200 km  $= 200/(x - 10)$  hr

Given, that the difference in the times is 1 hour.

This can be expressed as below:

$$\frac{200}{x} - \frac{200}{(x-10)} = 1$$

$$\frac{(200(x-10) - 200x)}{x(x-10)} = 1$$

$$\frac{200x - 2000 - 200x}{x^2 - 10x} = 1$$

$$x^2 - 10x = -2000$$

$$x^2 - 10x + 2000 = 0$$

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$$x^2 - 50x + 40x + 2000 = 0 \quad [\text{by factorisation method}]$$

$$x(x - 50) + 40(x - 50) = 0$$

$$(x - 50)(x + 40) = 0$$

$$x = 50 \text{ or } x = -40$$

As, the speed of train can never be negative we neglect  $x = -40$

Thus, speed of the fast train is 50 km/hr

And the speed of slow train  $(50 - 10) = 40$  km/hr

**4. A passenger train takes one hour less for a journey of 150 km if its speed is increased 5 km/hr from its usual speed. Find the usual speed of the train.**

**Solution:**

Let's assume the usual speed of train as  $x$  km/hr

Then, the increased speed of the train =  $(x + 5)$  km/hr

Using, speed = distance/ time

Time taken by the train under usual speed to cover 150 km =  $150/x$  hr

Time taken by the train under increased speed to cover 150 km =  $150/(x + 5)$  hr

Given, that the difference in the times is 1 hour.

This can be expressed as below:

$$\text{So, } \frac{150}{x} - \frac{150}{(x + 5)} = 1$$

$$\frac{150(x + 5) - 150x}{x(x + 5)} = 1$$

$$\frac{150x + 750 - 150x}{x^2 + 5x} = 1$$

$$750 = x^2 + 5x$$

$$x^2 + 5x - 750 = 0$$

$$x^2 - 25x + 30x - 750 = 0 \quad [\text{by factorisation method}]$$

$$x(x - 25) + 30(x - 25) = 0$$

$$(x - 25)(x + 30) = 0$$

$$x = 25 \text{ or } x = -30 \text{ (neglected as the speed of the train can never be negative)}$$

Hence, the usual speed of the train is  $x = 25$  km/hr

**5. The time taken by a person to cover 150 km was 2.5 hrs more than the time taken in the return journey. If he returned at the speed of 10 km/hr more than the speed of going, what was the speed per hour in each direction?**

**Solution:**

Let the ongoing speed of person be  $x$  km/hr,

Then, the returning speed of the person is =  $(x + 10)$  km/hr (from the question)

Using, speed = distance/ time

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Time taken by the person in going direction to cover 150 km =  $150/x$  hr

And, time taken by the person in returning direction to cover 150 km =  $150/(x + 10)$ hr

Given, that the difference in the times is 2.5 hour  $\Rightarrow 5/2$  hours

This can be expressed as below:

$$\frac{150}{x} - \frac{150}{(x + 10)} = \frac{5}{2}$$

$$\frac{150(x + 10) - 150x}{x(x + 10)} = \frac{5}{2}$$

$$\frac{150x + 1500 - 150x}{x^2 + 10x} = \frac{5}{2}$$

$$\frac{1500}{x^2 + 10x} = \frac{5}{2}$$

$$3000 = 5x^2 + 50x$$

$$5x^2 + 50x - 3000 = 0$$

$$5(x^2 + 10x - 600) = 0$$

$$x^2 + 10x - 600 = 0$$

$$x^2 - 20x + 30x - 600 = 0 \quad \text{[by factorisation method]}$$

$$x(x - 20) + 30(x - 20) = 0$$

$$(x - 20)(x + 30) = 0$$

$x = 20$  or  $x = -30$ (neglected) As the speed of train can never be negative.

Thus,  $x = 20$  Then,  $(x + 10) (20 + 10) = 30$

Therefore, the ongoing speed of person is 20km/hr.

And the returning speed of the person is 30 km/hr.

**6. A plane left 40 minutes late due to bad weather and in order to reach the destination, 1600 km away in time, it had to increase its speed by 400 km/hr from its usual speed. Find the usual speed of the plane.**

**Solution:**

Let's assume the usual speed of the plane to be  $x$  km/hr,

Then the increased speed of the plane is  $= (x + 400)$  km/hr

Using, speed = distance/ time

Time taken by the plane under usual speed to cover 1600 km =  $1600/x$  hr

Time taken by the plane under increased speed to cover 1600 km =  $1600/(x + 400)$  hr

Given, that the difference in the times is 40mins  $\Rightarrow 40/60$  hours

This can be expressed as below:

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$$\frac{1600}{x} - \frac{1600}{(x+400)} = \frac{40}{60}$$

$$\frac{1600(x+400) - 1600x}{x(x+400)} = \frac{2}{3}$$

$$\frac{1600x + 640000 - 1600x}{x^2 + 400x} = \frac{2}{3}$$

$$1920000 = 2x^2 + 800x$$

$$2x^2 + 800x - 1920000 = 0$$

$$2(x^2 + 400x - 960000) = 0$$

$$x^2 + 400x - 960000 = 0$$

$$x^2 - 800x + 1200x - 960000 = 0 \quad \text{[by factorisation method]}$$

$$x(x - 800) + 1200(x - 800) = 0$$

$$(x - 800)(x + 1200) = 0$$

$$x = 800 \text{ or } x = -1200 \text{ (neglected)}$$

As the speed of the train can never be negative.

Thus, the usual speed of the train is 800 km/hr.

**7. An aero plane takes 1 hour less for a journey of 1200 km if its speed is increased by 100 km/hr from its usual speed of the plane. Find its usual speed.**

**Solution:**

Let's consider the usual speed of plane as  $x$  km/hr,

Then, the increased speed of the plane is  $(x + 100)$  km/hr

Using, speed = distance/ time

Time taken by the plane under usual speed to cover 1200 km =  $1200/x$  hr

Time taken by the plane under increased speed to cover 1200 km =  $1200/(x + 100)$ hr

Given, that the difference in the times is 1 hour.

So, this can be expressed as below:

$$\frac{1200}{x} - \frac{1200}{(x+100)} = 1$$

$$\frac{1200(x+100) - 1200x}{x(x+100)} = 1$$

$$\frac{1200x + 120000 - 1200x}{x^2 + 100x} = 1$$

$$120000 = x^2 + 100x$$

$$x^2 + 100x - 120000 = 0$$

$$x^2 - 300x + 400x - 120000 = 0 \quad \text{[by factorisation method]}$$

$$x(x - 300) + 400(x - 300) = 0$$

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$x = 300$  or  $x = -400$  neglected as the speed of the aero plane can never be negative.  
Therefore, the usual speed of train is 300 km/hr.

