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Ch-4
Exercise 4.8

Let the speed of stream be x
speed of boat in still water = 8 km/h
Upstream distance = 15 km
Downstream distance = 22 km
Total time = 5 hrs .

ATQ,

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

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

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

$$296 - 7x = 5(64 - x^2)$$

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

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

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

$$5x^2 - 15x + 8x - 24 = 0$$

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

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

$$x-3=0$$

$$\boxed{x=3}$$

$$5x+8=0$$

$$\boxed{x=-\frac{8}{5}}$$

(Neglected)

$\therefore$ Speed of stream = $\boxed{3 \text{ km/h}}$

Q. 2 Let the original speed of the train be x .
 Increased new speed = $x+5$
 Distance = 360 km

ATQ,

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

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

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

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

$$450 \times 5 = x^2 + 5x$$

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

$$x^2 + 50x - 45x - 2250 = 0$$

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

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

$$x+50 = 0$$

$$x = -50$$

(Neglected)

$$x-45 = 0$$

$$x = 45$$

$\therefore$ Original speed of train = 45 km/h

Q. 4 Let the usual speed of the train be x .
 Total distance = 150 km.
 New speed = $x+5$

ATQ,

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

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

$$150x + 750 - 150x = x^2 + 5x$$

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

$$x^2 + 30x - 25x - 750 = 0$$

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

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

$$x+30 = 0$$

$$x = -30$$

(Neglected)

$$x - 25 = 0$$

$$x = 25$$

∴ Usual speed of train = 25 km/h

Q. 6 Let the usual speed of the train be x .

Distance = 1600 km

Increased speed = $x + 400$

Atq,

$$\frac{1600}{x} - \frac{1600}{x+400} = \frac{402}{603}$$

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

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

$$3(640000) = 2(x^2 + 400x)$$

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

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

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

$$x^2 + 1200x - 800x - 960000 = 0$$

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

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

$$\begin{array}{l|l} x+1200=0 & x-800=0 \\ \hline \boxed{x=-1200} & \boxed{x=800} \\ \text{(Neglected)} & \end{array}$$

$\therefore$ Usual speed of ~~train~~ plane = $\boxed{800 \text{ km/h}}$

Q.7. Let the usual speed of plane be x .
Distance = 1200 km
Increased speed = $x+100$

ATQ,

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

$$1200(x+100) - 1200x = x^2 + 100x$$

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

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

$$x^2 + 400x - 300x - 120000 = 0$$

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

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

$$\begin{array}{l|l} x+400=0 & x-300=0 \\ \hline \boxed{x=-400} & \boxed{x=300} \\ \text{(Neglected)} & \end{array}$$

$\therefore$ Usual speed of train = $\boxed{300 \text{ km/h}}$

Q.8 Let the average speed of train be x .
New speed = $x+6$.

ATQ,

$$\frac{63}{x} + \frac{72}{x+6} = 3$$

$$\frac{63(x+6) + 72x}{x^2 + 6x} = 3$$

$$63x + 378 + 72x = 3x^2 + 18x$$

$$378 + 135x = 3x^2 + 18x$$

$$3x^2 + 18x - 135x - 378 = 0$$

$$3x^2 - 117x - 378 = 0$$

$$x^2 - 39x - 126 = 0$$

$$x^2 - 42x + 3x - 126 = 0$$

$$x(x - 42) + 3(x - 42) = 0$$

$$(x - 42)(x + 3) = 0$$

$$x - 42 = 0$$

$$\boxed{x = 42}$$

$$x + 3 = 0$$

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

(Neglected)

$\therefore$ Average speed of train = $\boxed{42 \text{ km/h}}$

Let the original speed of train be x .

New speed = $x + 15$

ATQ,

$$\frac{90}{x} - \frac{90}{x+5} = \frac{261}{602}$$

$$\frac{90(x+5) - 90x}{x^2 + 5x} = \frac{1}{2}$$

$$2(90x + 450 - 90x) = x^2 + 5x$$

$$10 = x^2 + 5x$$

$$x^2 + 5x - 10 = 0$$

ATQ,

$$\frac{90}{x} - \frac{90}{x+15} = \frac{30}{60} \times 60$$

$$\frac{90(x+15) - 90x}{x^2 + 15x} = \frac{1}{2}$$

$$2(90x + 1350 - 90x) = x^2 + 15x$$

$$x^2 + 15x - 2700 = 0$$

$$x^2 + 60x - 45x - 2700 = 0$$

$$x(x+60) - 45(x+60) = 0$$

$$(x+60)(x-45) = 0$$

$$x+60=0$$

$$x = -60$$

(Neglected)

$$x-45=0$$

$$x = 45$$

∴ Original speed of train = 45 km/h

Q. 12 ~~Original~~ Let the original speed of plane be x .
New speed = $x + 250$

ATQ,

$$\frac{1250}{x} - \frac{1250}{x+250}$$

$$\frac{1250}{x} - \frac{1250}{x+250} = \frac{50}{60}$$

$$\frac{1250(x+250) - 1250x}{x^2 + 250x} = \frac{5}{6}$$

$$1250 \left[\frac{x+250-x}{x^2 + 250x} \right] = \frac{5}{6}$$

$$\frac{250}{x^2 + 250x} = \frac{5}{6} \times \frac{1}{1250}$$

$$250 \times 1500 = x^2 + 250x$$

$$x^2 + 250x - 375000 = 0$$

$$x^2 + 750x - 500x - 375000 = 0$$

$$x(x + 750) - 500(x + 750) = 0$$

$$(x + 750)(x - 500) = 0$$

$$x + 750 = 0$$

$$\boxed{x = -750}$$

(Neglected)

$$x - 500 = 0$$

$$\boxed{x = 500}$$

$\therefore$ Usual original speed of plane = $\boxed{500 \text{ km/h}}$

~~Let the original speed~~

Let the original speed of the plane be x .

New speed = $x + 100$

ATQ,

$$\frac{1500}{x} - \frac{1500}{x+100} = \frac{30}{60}$$

$$\frac{1500x + 150000 - 1500x}{x^2 + 100x} = \frac{1}{2}$$

$$2 \times 150000 = x^2 + 100x$$

$$x^2 + 100x - 300000 = 0$$

$$x^2 + 600x - 500x - 300000 = 0$$

$$x(x + 600) - 500(x + 600) = 0$$

$$(x + 600)(x - 500) = 0$$

$$x + 600 = 0$$

$$\boxed{x = -600}$$

(Neglected)

$$x - 500 = 0$$

$$\boxed{x = 500}$$

$\therefore$ Original speed of plane = $\boxed{500 \text{ km/h}}$

Q. 14

Let the speed of the stream be x .

$$\text{Upstream speed} = 18 - x$$

$$\text{Downstream speed} = 18 + x$$

$$\text{Distance} = 24 \text{ km}$$

ATQ,

$$\frac{24}{18-x} - \frac{24}{18+x} = 1$$

$$\frac{24(18+x) - 24(18-x)}{(18-x)(18+x)} = 1$$

$$\frac{24[18+x-(18-x)]}{18^2 - x^2} = 1$$

$$\frac{24[18+x-18+x]}{324 - x^2} = 1$$

$$24(2x) = 324 - x^2$$

$$x^2 + 48x - 324 = 0$$

$$x^2 + 54x - 6x - 324 = 0$$

$$x(x+54) - 6(x+54) = 0$$

$$(x+54)(x-6) = 0$$

$$\begin{array}{|l} x+54=0 \\ \boxed{x=-54} \\ \text{(Neglected)} \end{array} \quad \begin{array}{|l} x-6=0 \\ \boxed{x=6} \end{array}$$

$$\therefore \text{Speed of the stream} = \boxed{6 \text{ km/h}}$$

Q. 15

Let the speed of the car be x .

$$\text{Time taken} = \frac{2}{x}$$

$$\text{Distance} = 2592 \text{ km}$$

ATQ,

$$S = \frac{D}{t}$$

$$x = \frac{2592}{2}$$

$$\frac{x}{2}$$

$$x = 2592 \times 2$$

$$x$$

$$x^2 = 5184$$

$$x = \pm \sqrt{5184}$$

$$x = \pm 72$$

$$x = -72$$

(Neglected)

$$x = 72$$

$$\therefore \text{Speed of car} = 72 \text{ km/h}$$

$$\text{Time taken} = \frac{2592}{x} = 36 \text{ hrs}$$

Let the speed of stream be x .

$$\text{Upstream speed} = 9 - x$$

$$\text{Downstream speed} = 9 + x$$

$$\text{Distance} = 15 \text{ km}$$

ATQ,

$$\frac{15}{9-x} + \frac{15}{9+x} = 3 \frac{3}{4}$$

$$\frac{15(9+x) + 15(9-x)}{(9-x)(9+x)} = 3 \frac{3}{4}$$

$$\frac{15[9+x+9-x]}{9^2 - x^2} = \frac{15}{4}$$

$$4(15 \times 18) = 81 - x^2$$

$$4 \times 18 = 81 - x^2$$

$$x^2 = 81 - 72$$

$$x = \pm \sqrt{9}$$

$$x = \pm 3$$

$$x = -3$$

(Neglected)

$$x = 3$$

$$\therefore \text{Speed of stream} = 3 \text{ km/h}$$