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MATHS

QUADRATIC EQUATION

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Standard form of Q. E.

$$ax^2 + bx + c = 0$$

$2x^2 + 4x + 4 = 0$

$a = 2$, $b = 4$, $c = 4$

$x^2 = 4$

$x^2 - 4 = 0$

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

$a = 1$, $b = 0$, $c = -4$

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Check whether following is a quadratic equation or not.

Q.E

$\sqrt{3}x^2 - 2x + \frac{1}{2} = 0$

$x + \frac{1}{x} = 1$

$ax^2+bx+c = 0$

degree = 2

$x^4 - 4 = 0$

$a = \sqrt{3}$, $b = -2$, $c = 1/2$

✓ $\sqrt{3}x^2 - 2x + \frac{1}{2} = 0$

$\sqrt{3}x - 2x + \frac{1}{2} = 0$

$a = 1$
$b = -1$
$c = 1$

$\frac{x}{1} + \frac{1}{x} = 1$

$\Rightarrow \frac{x^2+1}{x} = 1 \Leftrightarrow x^2+1 = x$

$\Rightarrow x^2 - x + 1 = 0$

Solving a quadratic equation

$2x^2 - 2x - 4 = 0$

$x = -1, 2$

LHS $\Rightarrow 2(-1)^2 - 2(-1) - 4$

$= 2 + 2 - 4$

$= 0 = RHS \rightarrow$ Eqn is satisfied

$LHS = 2(2)^2 - 2(2) - 4$

$= 8 - 4 - 4$

$= 0 = RHS$

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Methods to find roots Of Quadratic Equation

1. Factorization

2. Formula [Sridharacharya Formula]

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Factorization method (Identities)

① ✓ $(a \pm b)^2 = a^2 + b^2 \pm 2ab$

② ③ $(a-b)(a+b) = a^2 - b^2$

$ax^2 + bx + c = 0$

Q. $x^2 - 4 = 0$

$x^2 - 2^2 = 0 \Rightarrow (x-2)(x+2) = 0$

$x = 2 \quad x = -2$

Q. $x^2 + 4x + 4 = 0$

$(x)^2 + 2(2)(x) + 2^2 = 0 \Leftrightarrow (x+2)^2 = 0$

$a \quad b \quad a \quad b$

$(x+2)(x+2) = 0$

$x = -2, -2$

Split the middle term.

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Q. Solve:

$$9x^2 - 3x - 2 = 0$$

$9x^2 - 6x + 3x - 2 = 0$

$3x(3x-2) + 1(3x-2) = 0$

$(3x-2)(3x+1) = 0$

$3x - 2 = 0$

$3x = 2$

$x = 2/3$

$3x + 1 = 0$

$3x = -1$

$x = -1/3$

$(9x^2)(-2)$

$-18x^2$

$9x$	$2x$
$+3x$	$-6x$

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Q. Solve:

$$\frac{1}{x-1} - \frac{1}{x+5} = \frac{6}{7}, \underbrace{x \neq 1, -5}$$

$$\Rightarrow \frac{1}{x-1} - \frac{1}{x+5} = \frac{6}{7}$$

$$\Rightarrow \frac{x+5-(x-1)}{(x-1)(x+5)} = \frac{6}{7}$$

$$\Rightarrow \frac{\cancel{x}+5-\cancel{x}+1}{x^2+5x-x-5} = \frac{6}{7}$$

$$\Rightarrow \frac{\overset{1}{\cancel{6}}}{x^2+4x-5} = \frac{\overset{1}{\cancel{6}}}{7}$$

$$\Rightarrow 7 = x^2+4x-5$$

$$x^2+4x-5-7=0$$

$$x^2+4x-12=0$$

$$x^2+6x-2x-12=0$$

$$x(x+6)-2(x+6)=0$$

$$(x+6)(x-2)=0$$

$$\left.\begin{array}{l} x=-6 \\ x=2 \end{array}\right\} \text{roots}$$

$-12x^2$

$6 \quad 2$

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Q. Solve:

$$3\left(\frac{7x+1}{5x-3}\right) - 4\left(\frac{5x-3}{7x+1}\right) = 11$$

a/b $\quad$ b/a

Let $\frac{7x+1}{5x-3} = y$

$\Rightarrow \left[3y - \frac{4}{y} = 11\right] \times y$

$\Rightarrow 3y^2 - 4 = 11y$

$\Rightarrow 3y^2 - 11y - 4 = 0$

$\Rightarrow 3y^2 - 12y + 1y - 4 = 0$

$\Rightarrow 3y(y-4) + 1(y-4) = 0$

$\Rightarrow (y-4)(3y+1) = 0$

$\Leftrightarrow$

$y - 4 = 0 \Rightarrow y = 4$

$3y + 1 = 0 \Rightarrow y = -1/3$

$-12y^2$

$+1y \quad -12y$

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$$y = \frac{7x+1}{5x-3} \quad \Big| \quad 4 = \frac{7x+1}{5x-3}$$

$$20x - 12 = 7x + 1$$

$$20x - 7x = 1 + 12$$

$$13x = 13$$

$$\boxed{x = 1}$$

$$\frac{7x+1}{5x-3} = -1/3$$

$$\Rightarrow 21x + 3 = -5x + 5$$

$$\Rightarrow 26x = 0$$

$$\boxed{x = 0}$$

Q. Solve:

$$\frac{1}{a+b+x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{x}, \quad a+b \neq 0$$

$$\Rightarrow \frac{1}{(a+b+x)} - \frac{1}{x} = \frac{1}{a} + \frac{1}{b}$$

$$\Rightarrow \frac{x-(a+b+x)}{x(a+b+x)} = \frac{b+a}{ab}$$

$$\Rightarrow \frac{x-a-b-x}{ax+bx+x^2} = \frac{a+b}{ab}$$

$$\Rightarrow \frac{-(a+b)}{x^2+ax+bx} = \frac{(a+b)}{ab}$$

$$\Rightarrow -ab = x^2+ax+bx$$

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$$\Rightarrow 0 = x^2 + ax + bx + ab$$

$$\Rightarrow \underbrace{x^2 + ax} + \underbrace{bx + ab} = 0$$

$$\Rightarrow x(x+a) + b(x+a) = 0$$

$$\Rightarrow (x+a)(x+b) = 0$$

$$\Rightarrow \left.\begin{array}{l} x = -a \\ x = -b \end{array}\right\} \text{roots}$$

Nature of roots :

Discriminant (D)

$ax^2 + bx + c = 0$

$D = b^2 - 4ac$

(1) 2 distinct real roots

$D > 0$

(2) real but equal.

$D = 0$

(3) No real roots

$D < 0$

Q. $x^2 + x + 2 = 0$

$D = b^2 - 4ac = (1)^2 - 4(1)(2)$

$= 1 - 8 = -7 < 0$

$D < 0 \rightarrow$ no real roots

Q. $x^2 + x - 2 = 0$

$D = (1)^2 - 4(1)(-2)$

$= 1 + 8 = 9 > 0$

$D > 0$

real & distinct.

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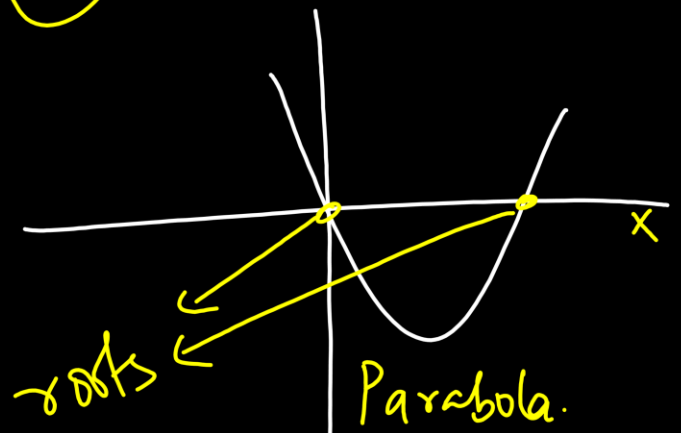
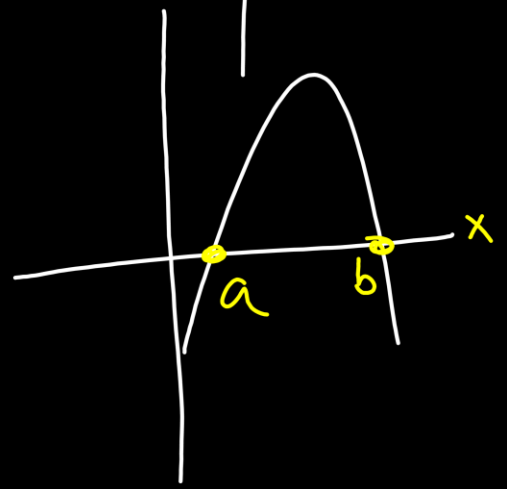
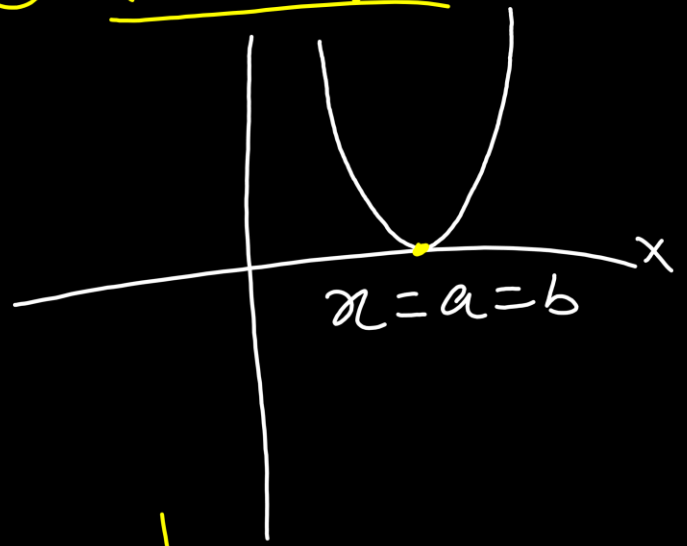
Nature of roots : Graphical method

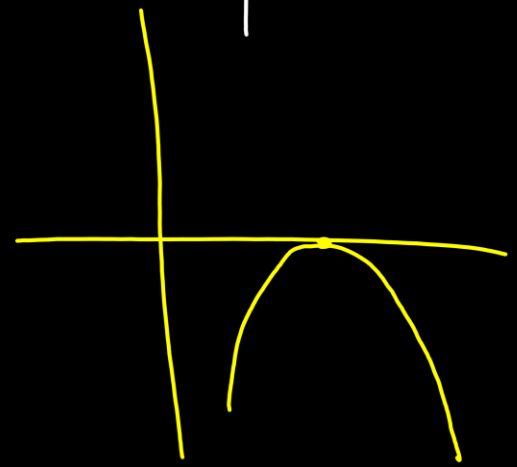
(i) (2) distinct Real roots.





(2) Real & Equal roots





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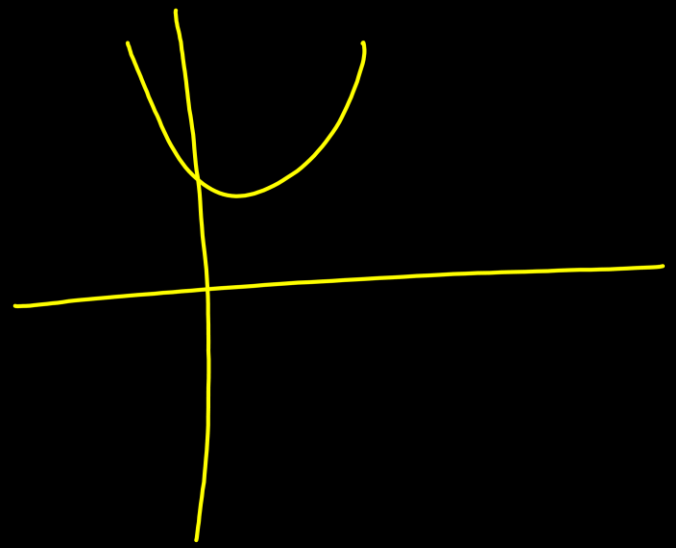
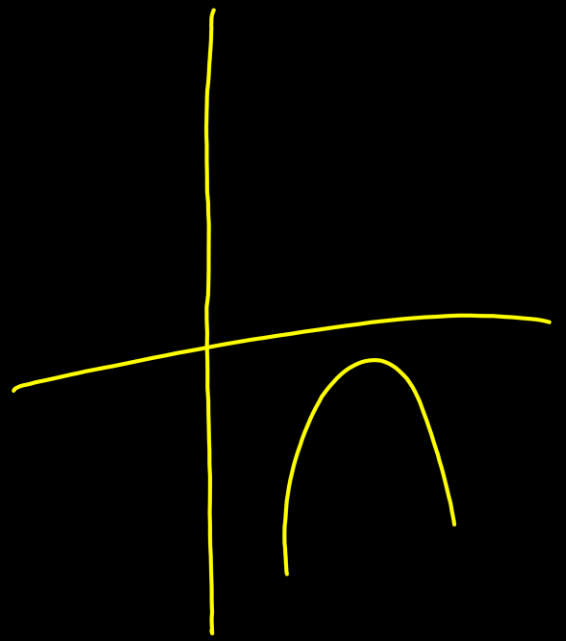
③ no real roots





Q. Check the nature of roots for the Q. E.

$16x^2 = 24x + 1$

$16x^2 - 24x - 1 = 0$

$D = b^2 - 4ac$

$= (-24)^2 - 4(16)(-1)$

$= 576 + 64$

$= 640 > 0$

roots are real & distinct.

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Q. Check the nature of roots for the Q. E.

$3a^2x^2 + 8abx + 4b^2 = 0, a \neq 0$

(a, b, c)

$D = b^2 - 4ac$

$= (8ab)^2 - 4(3a^2)(+4b^2)$

$= 64a^2b^2 - 48a^2b^2$

$= 16(a^2b^2)$

$D > 0$

real & distinct.

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Q. If the roots of the eqn.

$$(a^2+b^2)x^2-2(ac+bd)x+(c^2+d^2)=0$$

are equal. Then prove that

$\left(\frac{a}{b}=\frac{c}{d}\right)$ $(D=0)$

$a=a^2+b^2$; $b=-2(ac+bd)$; $c=c^2+d^2$

$D=b^2-4ac$

$=[-2(ac+bd)]^2-4(a^2+b^2)(c^2+d^2)$

$=4[a^2c^2+b^2d^2+2abcd]-4[a^2d^2+a^2c^2+b^2c^2+b^2d^2]$

$=4[a^2c^2+b^2d^2+2abcd-a^2d^2-a^2c^2-b^2c^2-b^2d^2]$

$D=4[-a^2d^2-b^2c^2+2abcd]$

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$$D = 4\left[-a^2d^2 - b^2c^2 + 2abcd\right]$$

$$= -4\left[a^2d^2 + b^2c^2 - 2abcd\right]$$

$$= -4\left[\underset{x}{(ad)}^2 + \underset{y}{(bc)}^2 - 2\underset{x}{(ad)}\underset{y}{(bc)}\right]$$

$$x^2 + y^2 - 2xy = (x-y)^2$$

$$D = -4\left[ad - bc\right]^2$$

$$0 = -4\left[ad - bc\right]^2$$

$$0 = (ad - bc)^2$$

$$0 = ad - bc \iff ad = bc$$

$$\Rightarrow \boxed{\frac{a}{b} = \frac{c}{d}}$$

Sridharacharya Formula

$$roots = \frac{-b \pm \sqrt{D}}{2a}, where\ D = b^2 - 4ac$$

$x^2 + 4 + 4x = 0$

$x^2 + 4x + 4 = 0$

$a = 1,\ b = 4,\ c = 4$

$$roots = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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

$$= \frac{-4 \pm \sqrt{16 - 16}}{2} = \frac{-4 \pm 0}{2} = -2, -2$$

roots not real

$D < 0$

$\sqrt{D} = \sqrt{-ve}$

$\sqrt{-4}$ = not real

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Q. Check the nature of roots for the Q. E. & find the roots

$$\left(x + \frac{1}{x} = 3\right) x$$

$$\Rightarrow \quad x^2 + 1 = 3x \Rightarrow x^2 - 3x + 1 = 0$$

$$D = (-3)^2 - 4(1)(1)$$

$$= 9 - 4 = 5 > 0$$

$$\text{roots} = \frac{-b \pm \sqrt{D}}{2a}$$

$$= \frac{-(-3) \pm \sqrt{5}}{2}$$

$$= \frac{3 \pm \sqrt{5}}{2}$$

$$x_1 = \frac{3+\sqrt{5}}{2}$$

$$x_2 = \frac{3-\sqrt{5}}{2}$$

} Q. Pair

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Word problems on Q. E.

Steps:-

1. Read the problem out loud (if it is big problem break into multiple statements)
2. Identify the unknown and assign the variable to it.
3. Find the keywords & list down all what is given
4. Start writing your mathematical statements using the variables & given data

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Q. Find the whole numbers which when decreased by 20 is equal to 69 times its reciprocal.

→ let the whole no. be x

$$x - 20 = 69\left(\frac{1}{x}\right) \rightarrow \times x$$

$$\Rightarrow x^2 - 20x = 69$$

$$\Rightarrow x^2 - 20x - 69 = 0$$

$$\Rightarrow x^2 + 3x - 23x - 69 = 0$$

$$\Rightarrow x(x+3) - 23(x+3) = 0$$

$$\Rightarrow (x+3)(x-23) = 0$$

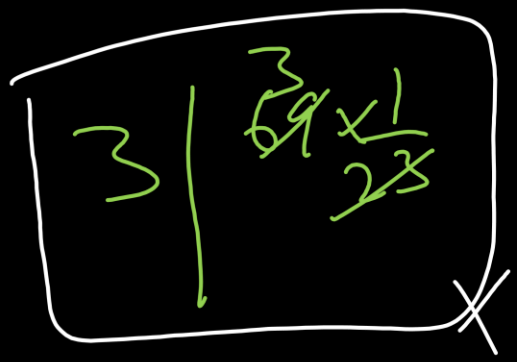
$$\Rightarrow x = \cancel{-3} \;\&\; +23$$

$$\boxed{x = 23}$$

$$\boxed{3 \mid \cancel{69}^{3} \times \frac{1}{\cancel{23}}}$$

$$-69x^2$$

$$+3x - 23x$$



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Q. The sum of a number and its positive square root is $\frac{6}{25}$. Find the number.

Let the no. be x

$\Rightarrow x + \sqrt{x} = \frac{6}{25}$

$\Rightarrow t^2 + t = \frac{6}{25}$

$\Rightarrow 25t^2 + 25t = 6$

$\Rightarrow 25t^2 + 25t - 6 = 0$

$\Rightarrow 25t^2 + 30t - 5t - 6 = 0$

$\Rightarrow 5t(5t+6) - 1(5t+6) = 0$

$\Rightarrow (5t+6)(5t-1) = 0$

$\pm\sqrt{}$

$\sqrt{x} = t \rightarrow$ [Sq. B. S.]

$x = t^2$

$-150t^2$

$+30t \quad -5t$

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$$(5t+6)(5t-1)=0$$

$5t+6=0$

$t=-\frac{6}{5}$ ✗

$5t-1=0$

$t=1/5$

$\sqrt{x}=1/5$

$$x=\frac{1}{25}$$

$$x+\sqrt{x}=\frac{6}{25}$$

$$\frac{1}{25}+\frac{1}{5}$$

$$=\frac{1+5}{25}=\frac{6}{25}$$

Q. 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. $= 3\ km/h$

$\Rightarrow$ Speed of Stream $= x$ km/h.

Speed of boat upstream $= (8 - x)$ km/h

~~Speed~~ downstream $= (8 + x)$ km/h

$$\text{time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\xrightarrow[(15\,km)]{UP} \qquad \xleftarrow[22\,km]{D.S} = 5 \text{ hours}$$

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

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

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

$$\Rightarrow \frac{120 + 15x + 176 - 22x}{8^2 - x^2} = 5$$

$$\Rightarrow 296 - 7x = 5(8^2 - x^2)$$

$$\Rightarrow 296 - 7x = 5 \times 64 - 5x^2$$

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

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

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

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

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

$x = 3$

$5x = -8$

$x = -8/5$

Speed of stream $= 3$ km/h

$64 \times 5 = 320$

24×5

$-120x^2$

$-15x \quad 8x$

Q. A plane left 40 minutes late due to bad weather and in order to reach its 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.

$\rightarrow x$ km/h

Distance = 1600 km

new speed = $x + 400$ km/hr

t_1 = time taken (usual speed) = $\frac{1600}{x}$ hr

t_2 = " " (new speed) = $\frac{1600}{x+400}$ hr

$t_1 > t_2$

$\Rightarrow t_1 - t_2 = \frac{40}{60}$

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$$\Rightarrow \frac{1600}{x} - \frac{1600}{x+400} = \frac{2}{3}\cancel{40}$$

$$\Rightarrow 1600\left[\frac{1}{x} - \frac{1}{x+400}\right] = 2/3$$

$$\Rightarrow 1600\left[\frac{\cancel{x}+400-x}{x(x+400)}\right] = 2/3$$

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

$$\Rightarrow \frac{\overset{800}{\cancel{1600}}(400)\times 3}{\cancel{2}} = x^2+400x$$

$$\Rightarrow 960000 = x^2+400x$$

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

$$960000x^2$$

$$+1200x \quad -800x$$

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

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

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

$$\Rightarrow x = -1200 \text{ km/h} \quad \times$$

$$\Rightarrow \boxed{x = 800 \text{ km/h}}$$

Usual Speed

Your Roadmap to Success

Stay on track with a structured schedule that covers every essential topic you need for mid-term success. Each class is designed to reinforce core concepts and provide ample practice to ensure you're fully prepared. Follow the timetable, access class PDFs, and watch video lessons—all at your own pace. Your journey to acing the exams starts here!

13th Sept 2024

Topic	PDF	Link
Real Numbers		
Life processes		

Download the class PDF now ! link in the description

Homework questions

1. Check the nature of roots for the Q. E. & find the roots

$3x^2 - 5x + 2 = 0$

D

$x + y = 8$

$y = (8 - x)$

2. The sum of two numbers is 8 and 15 times the sum of their reciprocals is also 8. find the numbers.

$x, (8 - x)$

3. An aeroplane take 1 hour less for a journey of 1200 km if its speed is increased by 100 km/hr from its usual speed. Find the usual speed.

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