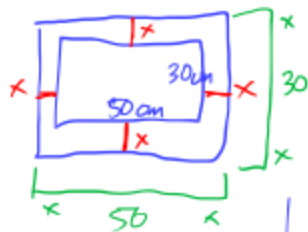


**Ex 1** A 30cm by 50cm picture has a frame surrounding it. If the frame is the same width all around, and the total area of the frame and picture is 1836 cm<sup>2</sup>, how wide is the frame?



$$\begin{aligned} \text{total area} &= 1836 = (50 + 2x)(30 + 2x) \\ 1836 &= 1500 + 60x + 100x + 4x^2 \end{aligned}$$

$$0 = 4x^2 + 160x - 336$$

$$0 = 4 \left[ (x^2 + 40x + 400) - 400 \right] - 336$$

$$\uparrow \left(\frac{1}{2}40\right)^2 = (20)^2 = 400$$

$$0 = 4 \left[ (x^2 + 40x + 400) - 400 \right] - 336$$

$$0 = 4(x+20)^2 - 4 \cdot 400 - 336 \Rightarrow 0 = 4(x+20)^2 - 1936$$

$$\Rightarrow 1936 = 4(x+20)^2$$

$$484 = (x+20)^2$$

$$\pm 22 = x+20$$

$$-20 \pm 22 = x$$

$$\boxed{x=2}, \quad \cancel{-42} \text{ width}$$

Check  $x=2$

$$1836 = (50+4)(30+4)$$

$$1836 = 54 \cdot 34$$

$$1836 = 1836$$

**Ex 2** The sum of a number and three times its reciprocal is  $\frac{28}{3}$ . What is the number?

$x$  - the number

$$x \left( x + \frac{1}{x} \cdot 3 \right) = \left( \frac{28}{3} \right) x$$

$$x^2 + 3 = \frac{28}{3}x$$

$$3(x^2 - \frac{28}{3}x + 3) = (0) \cdot 3$$

$$3x^2 - 28x + 9 = 0 \Rightarrow$$

$$\begin{array}{r} \textcircled{\times} 27 \mid (-27, -1) \\ \textcircled{\oplus} -28 \mid -28 \end{array}$$

$$\Rightarrow 3x^2 - 27x - x + 9 = 0$$

$$3x(x-9) - 1(x-9) = 0$$

$$(x-9)(3x-1) = 0$$

$$\begin{array}{l} \uparrow \\ x-9=0 \\ \boxed{x=9} \end{array}$$

$$\begin{array}{l} \uparrow \\ 3x-1=0 \\ \boxed{x=\frac{1}{3}} \end{array}$$

Check  $x=9$

$$9 + \frac{1}{9} \cdot 3 = \frac{28}{3}$$

$$\frac{27}{3} + \frac{1}{3} = \frac{28}{3} = \frac{28}{3} \checkmark$$

check  $x=\frac{1}{3}$

$$\frac{1}{3} + \frac{1}{\left(\frac{1}{3}\right)} \cdot 3 = \frac{28}{3}$$

$$\frac{1}{3} + 3 \cdot 3 = \frac{28}{3} \checkmark$$

**Ex 3** Mr. Raoul bikes to work, while Ms. Anderson drives to work, but they both live 8km away from the school. If they both leave at the same time, Ms. Anderson gets to school 12 minutes before Mr. Raoul. If Ms. Anderson drives 15km/h faster than Mr. Raoul can bike, what is the speed of each of them (answer to 1

**Ex 3** Mr. Raoul bikes to work, while Ms. Anderson drives to work, but they both live 8km away from the school. If they both leave at the same time, Ms. Anderson gets to school 12 minutes before Mr. Raoul. If Ms. Anderson drives 15km/h faster than Mr. Raoul can bike, what is the speed of each of them (answer to 1 decimal place)?

	Dist	Speed	time
Mr. R	8km	x	t
Ms. A	8km	x+15	t - <del>12 min</del> 0.2h

$\Rightarrow D = s \cdot t$

$8 = x \cdot t \Rightarrow t = \frac{8}{x}$

$8 = (x+15)(t-0.2)$

$8 = (x+15)\left(\frac{8}{x} - 0.2\right)$

$$\frac{1}{3} + 9 = \frac{28}{3} \checkmark$$

Mr. R  
Speed =  $\boxed{18.1 \frac{\text{km}}{\text{h}}}$

Ms. A = 18.1 + 15  
speed =  $\boxed{33.1 \frac{\text{km}}{\text{h}}}$

$$8 = x \cdot \frac{8}{x} + 15 \cdot \frac{8}{x} + x \cdot (-0.2) + 15 \cdot (-0.2)$$

$$8 = 8 + \frac{120}{x} - 0.2x - 3$$

$$x \cdot 0 = \left(\frac{120}{x} - 0.2x - 3\right) \cdot x$$

$$0 = 120 - 0.2x^2 - 3x$$

$$a = -0.2$$

$$b = -3$$

$$c = 120$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(-0.2)(120)}}{2(-0.2)}$$

$$= \frac{(3 \pm \sqrt{9 + 96})}{-0.4} = \boxed{18.1}, \text{ Speed } \cancel{-33.1}$$

**Ex 4** Mr. G and Mrs. Holman are marking PC 11 exams. Mrs. Holman can mark a class set of exams 10 minutes faster than Mr. G can. If they both work together, they can mark a class set in 1 hour. How long does it take

Ex 4 Mr. G and Mrs. Holman are marking PC 11 exams. Mrs. Holman can mark a class set of exams 10 minutes faster than Mr. G can. If they both work together, they can mark a class set in 1 hour. How long does it take each of them to mark a class set of exams (answer to the nearest minute)?

	time for 1 class set	Rate = $\frac{\text{Amount}}{\text{Time}}$
Mr. G	$x$	$\frac{1 \text{ class}}{x \text{ min}} = \frac{1}{x}$
Ms. H	$x - 10 \text{ min}$	$\frac{1 \text{ class}}{x - 10 \text{ min}} = \frac{1}{x - 10}$

combined:  
 When working together  $\Rightarrow$  Add rate  
 $\frac{1}{x} + \frac{1}{x - 10}$

$$\frac{1}{x} + \frac{1}{x - 10} = \frac{\text{Amount}}{\text{time}} = \frac{1 \text{ class}}{1 \text{ hour}} = \frac{1}{60 \text{ min}}$$

$$x(x - 10) \left( \frac{1}{x} + \frac{1}{x - 10} \right) = \left( \frac{1}{60} \right) x(x - 10)$$

$$60 \cdot ((x - 10) + x) = \left( \frac{1}{60} x(x - 10) \right) \cdot 60$$

$$60x - 600 + 60x = x^2 - 10x$$

$$0 = x^2 - 10x - 60x + 600$$

$$0 = x^2 - 130x + 600$$

$$\begin{aligned} a &= 1 \\ b &= -130 \\ c &= 600 \end{aligned}$$

$$x = \frac{-(-130) \pm \sqrt{(-130)^2 - 4(1)(600)}}{2(1)} = \frac{130 \pm \sqrt{16900 - 2400}}{2}$$

$$x = \boxed{125}, 5 \quad \leftarrow \text{min to mark class set of tests Mr. G}$$

$$\text{time Mr. G} = \boxed{125 \text{ min}}$$

$$\text{time Ms. H} = 125 - 10 = \boxed{115 \text{ min}}$$

$$\begin{aligned} 1 \text{ test per min} \\ 2 \text{ test per min} \end{aligned} \Rightarrow 3 \text{ test per min}$$