Applications of quadratic equations

Year 9 Mathematics
Mainstream

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Learning Objectives

By the end of the lesson I hope that you understand and can apply the following to a range of questions from the Year 9 Mathematics course.

- Know how to identify a quadratic equations question
- Know how to apply quadratics to solve an application style question
- Know that we need to check the solutions to quadratic equations to ensure they make sense.

RECAP

In the previous lessons we have been looking at the ways we can solve quadratic equations.

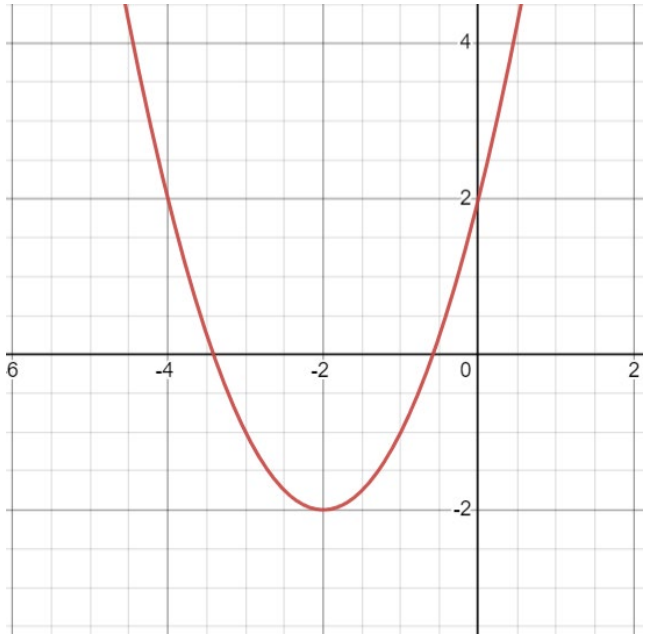
Before we solve any equation, we need to know why form the equation takes. This makes it easier for me to solve it.

Quadratic equations are generally given in three forms:

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

We would then choose to either:

- Square root,
- Factorise
- T-method factories



Quadratics can have two, one or zero solutions where a solution is where the graph crosses or touches the x-axis.

Yuck! Worded questions

Worded questions are challenging in Mathematics because it requires you to have good **comprehension** skills. If you can comprehend the question, the chances are you will be able to use Mathematics correctly.

This is a skill which takes practice. There are only so many ways we can ask you questions dealing with quadratics. The more questions you complete, the better you will get.

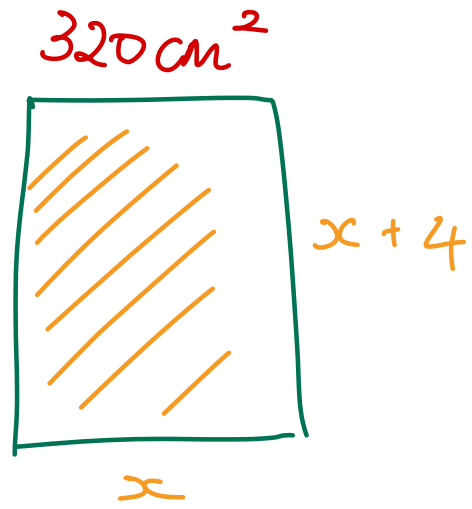
So, with that said, let's have a look at some questions and see if we can find ways to solve them.

Example: Area problems

A lot of problems we can use with quadratics revolve around areas.

Here is **one example**.

The length of a book is 4cm more than its width and the area of the face of the book is 320 cm^2. Find the dimensions of the face of the book.



$$x(x+4) = 320$$

$$x^2 + 4x = 320$$

$$x^2 + 4x - 320 = 0$$

$$(x-16)(x+20) = 0$$

$x - 16 = 0$ $\quad$ $x + 20 = 0$

$x = 16$ $\quad$ $x = -20$ ~~-20~~

$\therefore$ width = 16cm

Height = 20cm

	−320
1	320
2	160
4	80
5	64
8	40
10	32
−16	20

Example: Product of number problems

Here is **another example** of how we can hide quadratics.

The product of a number and two more than the same number is 48. Write an equation to solve and find the two possible solutions.

Note: There are going to be two possible solutions.

$$x(x+2) = 48$$

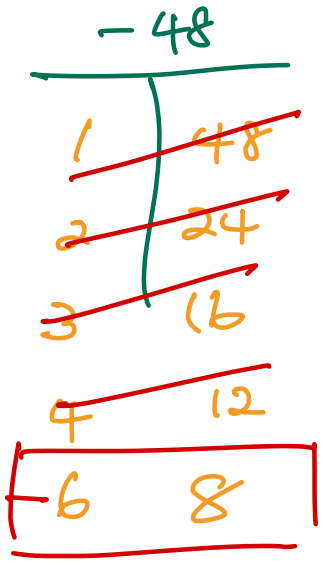
$$x^2 + 2x = 48$$

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

$$(x-6)(x+8) = 0$$

$x - 6 = 0$ or $x + 8 = 0$

$x = 6$ $\quad$ $x = -8$



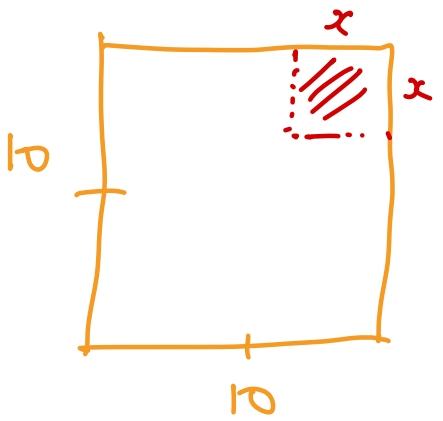
① 6, 8

② −8, −6

Example: Area problems with diagrams

A square of length 10 metres has a square of side length x metres removed from one corner.

- Write an expression for the area remaining after the square of side length x metres is removed.
- Find the value of x is the area remaining is 64 m^2



$100 - x^2$

$100 - x^2 = 64$

$0 = 64 - 100 + x^2$

$x^2 + 64 - 100 = 0$

$x^2 - 36 = 0$

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

$\therefore x - 6 = 0$ or $x + 6 = 0$

$x = 6$

$x = -6$

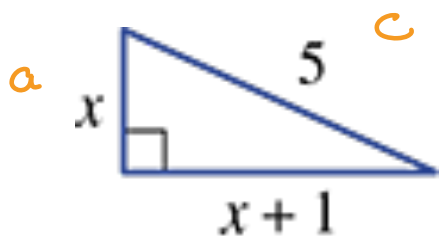
$\therefore x = 6\text{ m}$

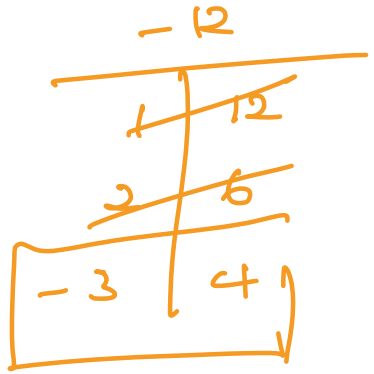
Example: Pythagoras' Theorem

Anything where a side can be squared could also be used in quadratics.

We have met Pythag before: $c^2 = a^2 + b^2$

Use Pythagoras' theorem to find the value of x in these right-angled triangles.





$c^2 = a^2 + b^2$

$25 = x^2 + (x+1)^2$

$25 = x^2 + x^2 + 2x + 1$

$2x^2 + 2x + 1 = 25$

$2x^2 + 2x - 24 = 0$

$x^2 + x - 12 = 0$

$(x-3)(x+4) = 0$

$(x+1)(x+1)$

$= x^2 + x + x + 1$

$= x^2 + 2x + 1$

$\therefore x - 3 = 0$

$x = 3$ ✓

$x + 4 = 0$

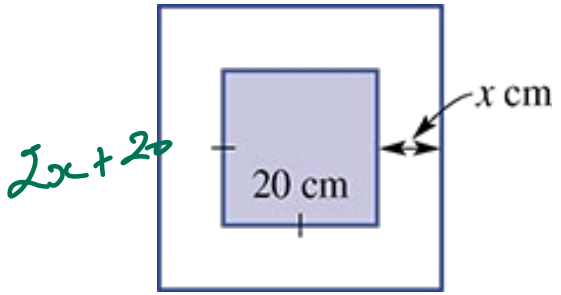
$x = -4$

Example: Picture frame

Again, we seem to notice that area questions are used a lot in this topic.

A square picture is to be edged with a border of width x cm. The inside picture has side length 20 cm.

- Write an expression for the total area
- Find the width of the frame if the total area of the picture is to be 1600 cm^2



• $(2x+20)^2$

$\sqrt{(2x+20)^2} = \sqrt{1600}$

$2x + 20 = \pm 40$

$2x = \pm 40 - 20$

$\therefore 2x = +40 - 20$

$2x = 20$

$x = 10$ ✓

$2x = -40 - 20$

$2x = -60$

$x = -30$

Questions to complete:

The questions I would like you to complete for this lesson are:

Exercise 10D Applications of quadratic equations
Questions: 1, 4, 6, 9, 10bc, 11, 12, 14

Extension: 16

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