



Sketching a parabola from factorised form ($a=1$)

Mana Maths

Te reo Māori terms



whārite pūrua

quadratic equation

Open in Te Aka

haukotinga

intercept

Open in Te Aka

hangarite

symmetry

Open in Te Aka

koi

vertex

Open in Te Aka

Parabola factorised form ($a=1$ only)



Factorised Form ($a = 1$)

Key idea

With $a = 1$: $y = (x-p)(x-q)$. The roots are $x = p$ and $x = q$. The axis of symmetry is the midpoint of p and q .

Reading roots and axis

For $y = (x-2)(x-6)$: roots 2 and 6. Axis: $x = \frac{2+6}{2} = 4$.

Finding the turning point

Same parabola, at $x = 4$: $y = (4-2)(4-6) = 2(-2) = -4$.
Turning point $(4, -4)$.

Common mistake

Read the bracket signs carefully. In $y = (x+2)(x-5)$, the roots are -2 and 5 , not 2 and -5 .



= copy this into your book. Boxes without a pencil are just to read.



Parabola factorised form (a=1 only)

Building the Equation from Roots



From two roots



Roots 1 and 8: each bracket is zero at that root, so $y = (x - 1)(x - 8)$.

Repeated root



Touches the x-axis once, at $x = 3$: $y = (x - 3)^2$. Both roots equal, so the axis is also $x = 3$.

Common mistake

The turning point isn't always on the x-axis just because the roots are – it usually sits above or below.



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Start Tasks



1. For $y = (x - 2)(x - 5)$, write the two x -intercepts.

2. For $y = (x + 1)(x - 4)$, write the two roots.

3. For $y = (x - 3)^2$, where does the graph touch the x -axis?

4. For $y = x(x - 6)$, write both x -intercepts.

5. For $y = (x + 2)(x + 7)$, write both roots.

6. What do the brackets in $y = (x - p)(x - q)$ tell you straight away?

7. For $y = (x - 1)(x - 9)$, what is the axis of symmetry?

8. For $y = (x + 4)(x - 2)$, what is the axis of symmetry?

9. For $y = (x - 5)^2$, what is the axis of symmetry?

Start Tasks – Answers



1. $x = 2, 5$

4. $0, 6$

7. $x = 5$

2. $-1, 4$

5. $-2, -7$

8. $x = -1$

3. $(3, 0)$

6. The
roots/intercepts

9. $x = 5$

Start Tasks



10. Write an equation in factorised form with roots $x = 1$ and $x = 6$.

11. Write an equation in factorised form with roots $x = -3$ and $x = 4$.

12. Write an equation in factorised form with roots $x = 0$ and $x = 7$.

13. Write an equation in factorised form with a repeated root $x = 2$.

14. For $y = (x - 2)(x - 8)$, is the axis of symmetry left of 5, at 5, or right of 5?

15. For $y = (x + 5)(x - 1)$, is the axis of symmetry left of 0, at 0, or right of 0?

16. If a parabola has roots -2 and 6 , what is the midpoint of the roots?

17. If a parabola has roots 3 and 11 , what is the midpoint of the roots?

18. Why is the midpoint of the roots useful for parabolas?

Start Tasks – Answers



10. $y = (x - 1)(x - 6)$

13. $y = (x - 2)^2$

16. 2

11. $y = (x + 3)(x - 4)$

14. At 5

17. 7

12. $y = x(x - 7)$

15. Left of 0

18. It gives the axis

Start Tasks



19. For $y = (x - 2)(x - 5)$, find the y -intercept by putting $x = 0$.

20. For $y = (x + 1)(x - 4)$, find the y -intercept.

21. For $y = x(x - 6)$, find the y -intercept.

22. Which has roots 2 and 5: $(x - 2)(x - 5)$ or $(x + 2)(x + 5)$?

23. Which has roots -3 and 4: $(x + 3)(x - 4)$ or $(x - 3)(x + 4)$?

24. If one root is 1 and the other is 9, what is the axis of symmetry?

25. If the roots are -4 and 2, what is the axis of symmetry?

26. Write a factorised equation with roots -1 and 8.

27. Write a factorised equation with roots -6 and -2 .

Start Tasks – Answers



19. 10

22. $(x - 2)(x - 5)$

25. $x = -1$

20. -4

23. $(x + 3)(x - 4)$

26. $y = (x + 1)(x - 8)$

21. 0

24. $x = 5$

27. $y = (x + 6)(x + 2)$

Build Tasks



1. For
 $y = (x - 2)(x - 6)$, find
the axis of symmetry
and the turning-point
x-value.

2. For
 $y = (x + 1)(x - 5)$, find
the axis of symmetry.

3. For
 $y = (x - 4)(x - 7)$, find
the turning-point
x-value.

4. For
 $y = (x - 2)(x - 6)$, find
the turning point by
substituting the
midpoint x-value.

5. For
 $y = (x + 1)(x - 5)$, find
the turning point.

6. For
 $y = (x - 4)(x - 7)$, find
the turning point.

7. Write
 $y = (x - 3)(x - 8)$ in
expanded form.

8. Write
 $y = (x + 2)(x - 5)$ in
expanded form.

9. Write
 $y = (x + 4)(x + 1)$ in
expanded form.

Build Tasks – Answers



1. Axis $x = 4$

4. $(4, -4)$

7. $x^2 - 11x + 24$

2. $x = 2$

5. $(2, -9)$

8. $x^2 - 3x - 10$

3. $x = \frac{11}{2}$

6. $\left(\frac{11}{2}, -\frac{9}{4}\right)$

9. $x^2 + 5x + 4$

Build Tasks



10. A parabola has roots 1 and 7. Write its factorised equation, then find the axis of symmetry.

11. A parabola has roots -2 and 4 . Write its factorised equation and its y -intercept.

12. A parabola has roots -5 and 3 . Write its factorised equation and its axis.

13. Which has axis $x = 2$: $(x - 1)(x - 3)$ or $(x + 1)(x - 3)$? Explain.

14. Which has a repeated root: $(x - 4)^2$ or $(x - 4)(x + 4)$?

15. Why does $(x - p)(x - q)$ make the roots easier to see than expanded form?

16. Find the turning point of $y = (x - 1)(x - 5)$.

17. Find the turning point of $y = (x + 3)(x - 1)$.

18. Find the turning point of $y = (x + 2)(x + 6)$.

Build Tasks – Answers



10. $y = (x - 1)(x - 7)$,
axis $x = 4$

13. $(x - 1)(x - 3)$

16. $(3, -4)$

11. $y = (x + 2)(x - 4)$,
 $y = -8$

14. $(x - 4)^2$

17. $(-1, -4)$

12. $y = (x + 5)(x - 3)$,
axis $x = -1$

15. The roots are
visible

18. $(-4, -4)$

Build Tasks



19. A parabola has roots 2 and 10. Find the turning-point x -value and the turning point.

20. A parabola has roots -4 and 2. Find its axis and turning point.

21. A parabola has roots -1 and 5. Find its axis and turning point.

22. A student says $y = (x - 2)(x - 7)$ has axis $x = 7$. What should the axis really be?

23. A student says $y = (x + 3)(x - 4)$ has roots 3 and -4 . What are the actual roots?

24. If the axis is $x = 3$ and one root is 1, what is the other root?

25. If the axis is $x = -2$ and one root is 4, what is the other root?

26. Write a factorised equation with axis $x = 5$ and roots 3 and 7.

27. Write a factorised equation with axis $x = -1$ and roots -4 and 2.

Build Tasks – Answers



19. Axis $x = 6$, **TP**
 $(6, -16)$

22. $x = \frac{9}{2}$

25. -8

20. Axis $x = -1$, **TP**
 $(-1, -9)$

23. Roots $-3, 4$

26. $y = (x - 3)(x - 7)$

21. Axis $x = 2$, **TP**
 $(2, -9)$

24. 5

27. $y = (x + 4)(x - 2)$

Push Tasks



1. A parabola has roots 2 and 8. Find the factorised equation, axis, and turning point.

2. A parabola has roots -3 and 5 . Find its factorised equation, axis, and turning point.

3. A parabola has roots -6 and 2 . Find its equation, axis, and turning point.

4. A parabola has axis $x = 4$ and one root 1 . Find the other root and write the factorised equation.

5. A parabola has axis $x = -1$ and one root 3 . Find the other root and the factorised equation.

6. A parabola has axis $x = 6$ and one root 10 . Find the other root and the factorised equation.

7. Explain why the axis of symmetry is halfway between the roots in factorised form.

8. Why does a repeated factor $(x - a)^2$ mean the graph only touches the

9. Why is factorised form especially useful when solving a graph question?

Push Tasks – Answers



1. $y = (x - 2)(x - 8)$,
axis $x = 5$, **TP** $(5, -9)$

2. $y = (x + 3)(x - 5)$,
axis $x = 1$, **TP** $(1, -16)$

3. $y = (x + 6)(x - 2)$,
axis $x = -2$, **TP**
 $(-2, -16)$

4. Other root 7;
 $y = (x - 1)(x - 7)$

5. Other root -5 ;
 $y = (x + 5)(x - 3)$

6. Other root 2;
 $y = (x - 2)(x - 10)$

**7. Midpoint of equal
distances from roots**

**8. The same root
occurs twice**

**9. Roots and axis are
immediate**

Push Tasks



10. The roots are -2 and 6 . Without expanding, decide whether the turning point is above or

11. The roots are 1 and 9 . Find the turning point and explain why it is the minimum point.

12. The roots are -5 and -1 . Find the turning point and explain what the graph is doing there.

13. A student says the roots of $(x + 3)(x - 4)$ are 3 and -4 . Explain the sign mistake.

14. A student says the axis of $(x - 2)(x - 10)$ is $x = 8$. What went wrong?

15. A student says $y = (x - 1)(x - 7)$ has turning point $(4, 0)$. Is that right? Explain.

16. Find the turning point of $y = (x + 2)(x - 8)$ and state both intercepts.

17. Find the turning point of $y = (x - 4)(x + 6)$ and state the axis.

18. Find the turning point of $y = (x + 1)(x + 9)$ and state both roots.

Push Tasks – Answers



10. Below; midpoint gives a negative value

13. Signs reverse when solving brackets

16. TP $(3, -25)$, **roots** $-2, 8$

11. $(5, -16)$, minimum because it opens up

14. They averaged badly; axis is 6

17. TP $(-1, -25)$, **axis** $x = -1$

12. $(-3, -4)$, lowest point

15. No; $(4, -9)$

18. TP $(-5, -16)$, **roots** $-1, -9$

Push Tasks



19. A parabola has roots 1 and 5, and passes through $(0, 5)$. Is $y = (x - 1)(x - 5)$ consistent with that

20. A parabola has roots -2 and 4 , and passes through $(0, -8)$. Is $y = (x + 2)(x - 4)$ consistent?

21. A parabola has roots 3 and 7, and passes through $(0, 21)$. Is $y = (x - 3)(x - 7)$ consistent?

22. Write a factorised equation whose roots are symmetric about $x = 2$ and 3 units away from the axis.

23. Write a factorised equation whose roots are symmetric about $x = -1$ and 4 units away from the axis.

24. Write a factorised equation with axis $x = 0$ and roots equally spaced 5 units from the axis.

25. Describe one advantage of factorised form over expanded form.

26. Describe one limitation of factorised form compared with vertex form.

27. Write a short rule for spotting the roots and axis from $y = (x - p)(x - q)$.

Push Tasks – Answers



19. Yes; 5

22. $y = (x + 1)(x - 5)$

25. Easy to see roots

20. Yes; -8

23. $y = (x + 5)(x - 3)$

26. Turning point is less direct

21. Yes; 21

24. $y = (x - 5)(x + 5)$

27. Roots are opposite signs of the bracket numbers; axis is their midpoint