

WA8MNALE2

Linear and non-linear equations and inequalities

Core + Challenge

# Solving Equations of the Form $x^2 = k$ — Marking Key

I can solve  $x^2 = k$ , explain why there are two solutions when  $k > 0$ , and give exact or rounded answers.

*For tutors and parents. Award method marks for correct working even if the final answer is wrong.*

## Marks summary

Section A Fluency: 16 Section B Core: 22 Section C Reasoning: 9 Section D Challenge: 11 **Total: 58**

Fluency: 1 mark each; accept an equivalent unsimplified answer for half credit at tutor's discretion.

## A Fluency *answers and working*

/ 16 marks

| Q  | Answer                | Working                                         |
|----|-----------------------|-------------------------------------------------|
| 1  | $x = \pm 7$           | $7^2 = (-7)^2 = 49$                             |
| 2  | $x = \pm 9$           | $9^2 = 81$                                      |
| 3  | $x = \pm 12$          | $12^2 = 144$                                    |
| 4  | $x = 0$               | only $0^2 = 0$                                  |
| 5  | no solution           | squares are never negative                      |
| 6  | $x = \pm \frac{3}{5}$ | $\frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$ |
| 7  | $x = \pm 0.6$         | $0.6^2 = 0.36$                                  |
| 8  | $x = \pm 5$           | $x^2 = 25$                                      |
| 9  | $x = \pm 3$           | $x^2 = 9$                                       |
| 10 | $x = \pm 11$          | $x^2 = 121$                                     |
| 11 | $x = \pm 6$           | $x^2 = 36$                                      |
| 12 | $x = \pm \sqrt{20}$   | not a perfect square                            |
| 13 | $x \approx \pm 4.5$   | $\sqrt{20} = 4.472\dots$                        |
| 14 | $x \approx \pm 2.65$  | $\sqrt{7} = 2.6457\dots$                        |
| 15 | $x = 0$               | $x^2 = 0$                                       |
| 16 | no solution           | $x^2 = -9$ is impossible                        |

Solving Equations of the Form  $x^2 = k$  · WA8MNALE2**B****Core** answers, working and marks

/ 22 marks

| Q | Answer                                          | Working / sample response                                                                                                                                                                                                                 | Marks |
|---|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | $x = 3$ or $x = -3$                             | The line meets the parabola at $x = -3$ and $x = 3$<br>$3^2 = 9$ and $(-3)^2 = 9$<br><i>1 mark: both solutions</i><br><i>1 mark: explanation</i>                                                                                          | 2     |
| 2 | $x = \pm 5$                                     | $x^2 = 25$<br>$x = 5$ or $x = -5$<br><i>1 mark: <math>x^2 = 25</math></i><br><i>1 mark: <math>\pm 5</math></i>                                                                                                                            | 2     |
| 3 | $x = \pm 7$                                     | $x^2 = 49 \rightarrow x = \pm 7$<br>$7^2 - 13 = 36 \checkmark$ $(-7)^2 - 13 = 49 - 13 = 36 \checkmark$<br><i>1 mark: <math>\pm 7</math></i><br><i>1 mark: both checked</i>                                                                | 2     |
| 4 | 20 cm                                           | $s^2 = 400 \rightarrow s = \pm 20$<br>A length cannot be negative, so reject $-20$<br><i>1 mark: <math>s^2 = 400 \rightarrow s = \pm 20</math></i><br><i>1 mark: 20 cm, rejecting <math>-20</math> because a length can't be negative</i> | 2     |
| 5 | 7.7 m                                           | $s^2 = 60 \rightarrow s = \sqrt{60} = 7.745\dots$<br>$\approx 7.7$ m<br><i>1 mark: <math>\sqrt{60}</math></i><br><i>1 mark: 7.7 m</i>                                                                                                     | 2     |
| 6 | (a) $x = \pm\sqrt{50}$ (b) $x \approx \pm 7.07$ | $\sqrt{50} = 7.0710\dots$<br><i>1 mark each</i>                                                                                                                                                                                           | 2     |
| 7 | No solution                                     | $2x^2 = -6 \rightarrow x^2 = -3$<br>No real number squared is negative<br><i>1 mark: <math>x^2 = -3</math></i><br><i>1 mark: no solution with reason</i>                                                                                  | 2     |
| 8 | $x = \pm 10$                                    | $x^2 \div 5 = 20 \rightarrow x^2 = 100$<br>$x = \pm 10$<br><i>1 mark: <math>x^2 = 100</math></i><br><i>1 mark: <math>\pm 10</math></i>                                                                                                    | 2     |
| 9 | 17.8 cm                                         | $\pi r^2 = 1000$<br>$r^2 = 1000 \div \pi = 318.3\dots$<br>$r = \sqrt{318.3\dots} = 17.84\dots \approx 17.8$ cm (reject negative)<br><i>1 mark: equation</i><br><i>1 mark: <math>r^2</math></i><br><i>1 mark: 17.8 cm</i>                  | 3     |

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| Q  | Answer    | Working / sample response                                                                                                                                                               | Marks |
|----|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 10 | 4 seconds | $5t^2 = 80 \rightarrow t^2 = 16$<br>$t = \pm 4$<br>Time cannot be negative: $t = 4$ s<br><i>1 mark: equation</i><br><i>1 mark: <math>\pm 4</math></i><br><i>1 mark: 4 s with reason</i> | 3     |

C

Reasoning *sample answers and marking criteria*

/ 9 marks

| Q | Answer                                         | Working / sample response                                                                                                                                                                                                                         | Marks |
|---|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | $\pm$ both square to 36; no square is negative | $6^2 = 36$ and $(-6)^2 = 36$ (negative $\times$ negative = positive).<br>Any number squared is 0 or positive, so it can never equal $-36$ .<br><i>1 mark each</i>                                                                                 | 2     |
| 2 | $x = \pm 3$                                    | Check: $1^2 + 16 = 17 \neq 25$<br>He took the square root of each term separately; $\sqrt{x^2 + 16}$ is not $x + 4$<br>$x^2 = 9 \rightarrow x = \pm 3$<br><i>1 mark: shows wrong</i><br><i>1 mark: error</i><br><i>1 mark: <math>\pm 3</math></i> | 3     |
| 3 | False                                          | $x^2 = 0$ has one solution (0); $x^2 = -4$ has none. Only $k > 0$ gives two.<br><i>1 mark: false</i><br><i>1 mark: examples</i>                                                                                                                   | 2     |
| 4 | 2, 1, 0                                        | $k > 0$ : the line crosses both arms (2 points).<br>$k = 0$ : touches at the lowest point (0, 0). $k < 0$ : the line is below the parabola (none).<br><i>1 mark: 2 and 1</i><br><i>1 mark: 0 with reason</i>                                      | 2     |

D

Challenge *solutions and marking criteria*

/ 11 marks

| Q | Answer              | Working / sample response                                                                                                                                                                                                  | Marks |
|---|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | $x = 8$ or $x = -2$ | $x - 3 = 5$ or $x - 3 = -5$<br>$x = 8$ or $x = -2$<br>Check: $5^2 = 25$ and $(-5)^2 = 25$ ✓<br><i>1 mark: <math>\pm 5</math></i><br><i>1 mark: <math>x = 8</math></i><br><i>1 mark: <math>x = -2</math></i>                | 3     |
| 2 | $125 \text{ cm}^3$  | $6s^2 = 150 \rightarrow s^2 = 25$<br>$s = 5$ (length is positive)<br>$V = 5^3 = 125 \text{ cm}^3$<br><i>1 mark: <math>6s^2</math></i><br><i>1 mark: <math>s = 5</math></i><br><i>1 mark: <math>125 \text{ cm}^3</math></i> | 3     |

Solving Equations of the Form  $x^2 = k$  · WA8MNALE2

| Q | Answer                                 | Working / sample response                                                                                                                                                                                                              | Marks |
|---|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3 | (a) $k < 18$ (b) $k = 18$ (c) $k > 18$ | $x^2 = \frac{18-k}{2}$ <p>Two solutions when <math>18 - k &gt; 0</math>; one when <math>18 - k = 0</math>; none when <math>18 - k &lt; 0</math></p> <p><i>1 mark each</i></p>                                                          | 3     |
| 4 | $k = 49$                               | <p>Solutions <math>\sqrt{k}</math> and <math>-\sqrt{k}</math> differ by <math>2\sqrt{k} = 14</math></p> <p><math>\sqrt{k} = 7 \rightarrow k = 49</math></p> <p><i>1 mark: <math>2\sqrt{k} = 14</math></i></p> <p><i>1 mark: 49</i></p> | 2     |