



THIRD SPACE
LEARNING

Diagnostic Questions

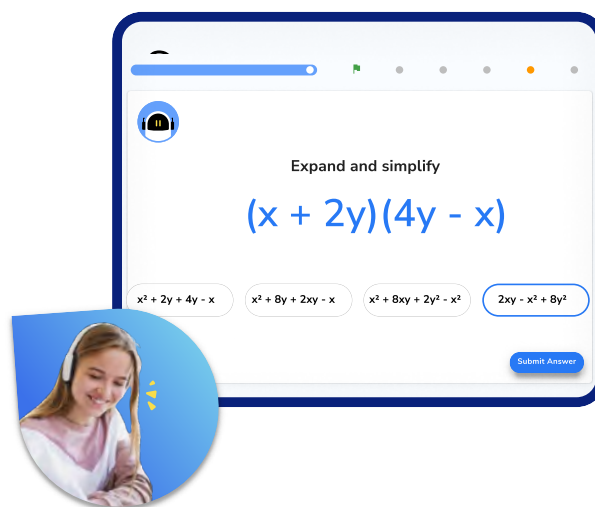
Solving Linear Equations | Algebra

This resource in a nutshell

Diagnostic questions are a quick and easy way of assessing your students' knowledge and understanding of a particular topic.

Students may be struggling with **solving linear equations** for a number of different reasons. Diagnostic questions can help to identify the particular misconception that the student has and help to determine the specific support they will need in order to improve.

They are low stakes and support students developing metacognition around how their learning is progressing and what they need to do to improve further.



At Third Space Learning, we use diagnostic questions before and after online tutoring sessions to identify gaps and track progress, an example of this is shown above.

How to use the questions in this resource

There are 20 multiple choice questions, each designed to assess each of the key skills required to master **solving linear equations**. Each question has **one correct answer** and **three carefully chosen incorrect answers** that are designed to identify and highlight fundamental misconceptions, including: **Expanding single brackets**, **Order of operations**, **Negative numbers**, **Collecting like terms**, and **Calculations with fractions**.

When answering these questions, students should be **encouraged to explain why they have chosen a particular answer**, and why the other three answers are incorrect. This can be done verbally in small groups, or written down on the worksheet or in their books.

This resource has been designed to be as **flexible** as possible with questions that can be easily chopped up and reordered, and come with a separate answer sheet that details all of the misconceptions highlighted in the answers.

Diagnostic Questions: Topic

1. Solve:

$$x + 3 = 9$$

A) $x = 12$	B) $x = 27$
C) $x = 6$	D) $x = 3$

2. Solve:

$$y - 6 = 12$$

A) $y = 18$	B) $y = 6$
C) $y = 2$	D) $y = 72$

3. Solve:

$$3a = 21$$

A) $a = 18$	B) $a = 7$
C) $a = 24$	D) $a = 63$

Diagnostic Questions: Topic

4. Solve:

$$\frac{x}{5} = 10$$

A) $x = 15$	B) $x = 5$
C) $x = 2$	D) $x = 50$

5. Solve:

$$2x + 8 = 20$$

A) $x = 14$	B) $x = 6$
C) $x = 2$	D) $x = 18$

6. Solve:

$$5x - 3 = 12$$

A) $x = 3$	B) $x = \frac{9}{5}$
C) $x = 45$	D) $x = 57$

Diagnostic Questions: Topic

7. Solve:

$$\frac{x + 4}{2} = 7$$

A) $x = 18$	B) $x = 6$
C) $x = 22$	D) $x = 10$

8. Solve:

$$\frac{x}{8} - 5 = 1$$

A) $x = 48$	B) $x = -32$
C) $x = \frac{3}{4}$	D) $x = 13$

9. Solve:

$$\frac{3x + 2}{4} = 2$$

A) $x = 18$	B) $x = \frac{10}{3}$
C) $x = 2$	D) $x = 10.5$

Diagnostic Questions: Topic

10. Solve:

$$\frac{4x}{7} - 2 = 6$$

A) $x = 11$	B) $x = 10$
C) $x = 7$	D) $x = 14$

11. Solve:

$$\frac{36}{x} = 3$$

A) $x = 33$	B) $x = 108$
C) $x = \frac{1}{12}$	D) $x = 12$

12. Solve:

$$2x - 7 = x + 5$$

A) $x = -2$	B) $x = 12$
C) $x = -4$	D) $x = 4$

Diagnostic Questions: Topic

13. Solve:

$$7x - 3 = 4x + 15$$

A) $x = 4$	B) $x = \frac{18}{11}$
C) $x = 6$	D) $x = 18$

14. Solve:

$$5(x - 3) = 10$$

A) $x = \frac{13}{5}$	B) $x = 65$
C) $x = 5$	D) $x = -1$

15. Solve:

$$3(x - 3) = 6(x + 5)$$

A) $x = -13$	B) $x = -\frac{8}{3}$
C) $x = 7$	D) $x = 13$

Diagnostic Questions: Solving Linear Equations

16. Solve:

$$\frac{x + 3}{2} = \frac{x + 4}{3}$$

A) $x = -6$	B) $x = -1$
C) $x = 1$	D) $x = 17$

17. Solve:

$$\frac{3x + 1}{2} = \frac{2x - 2}{4}$$

A) $x = -1$	B) $x = -3$
C) $x = -\frac{3}{8}$	D) $x = 0$

18. Form an equation and solve to find Raj's age.

Raj is x years old.

Sam is twice as old as Raj.

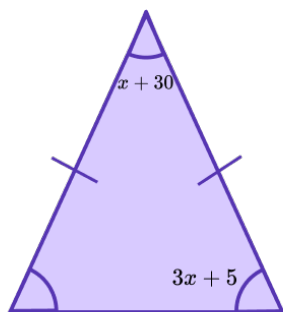
Tina is 2 years younger than Raj.

The total of their ages is 78 years.

A) $4x - 2 = 78$ and $x = 20$	B) $4x + 2 = 78$ and $x = 19$
C) $3x = 78$ and $x = 26$	D) $5x - 2 = 78$ and $x = 16$

Diagnostic Questions: Solving Linear Equations

19. Form an equation and solve to find x .



A) $5x + 65 = 180$ and $x = 23$	B) $7x + 40 = 180$ and $x = 20$
C) $3x = 78$ and $x = 26$	D) $7x + 40 = 180$ and $x = 31.43$

20. There are three bags of sweets.
 In the first bag there are n sweets.
 In the second bag there are $(n + 5)$ sweets.
 In the third bag there are $(2n - 3)$ sweets.

The mean number of sweets in the bags is 22.
 Form an equation and solve to find n .

A) $\frac{3n - 2}{4} = 22$ and $n = 30$	B) $\frac{3n + 2}{3} = 22$ and $n = 21.33\dots$
C) $\frac{4n + 2}{3} = 22$ and $n = 17$	D) $\frac{4n + 2}{3} = 22$ and $n = 16$

Diagnostic Questions: Answers

1. Solve:

$$x + 3 = 9$$

- A) $x = 12$ Student used incorrect inverse operation and added 3
B) $x = 27$ Student used incorrect inverse operation and multiplied by 3
C) $x = 6$ Correct answer
D) $x = 3$ Student used incorrect inverse operation and divided by 3

2. Solve:

$$y - 6 = 12$$

- A) $y = 18$ Correct answer
B) $y = 6$ Student used incorrect inverse operation and subtracted 6
C) $y = 2$ Student used incorrect inverse operation and divided by 6
D) $y = 72$ Student used incorrect inverse operation and multiplied by 6

3. Solve:

$$3a = 21$$

- A) $a = 18$ Student used incorrect inverse operation and subtracted 3
B) $a = 7$ Correct answer
C) $a = 24$ Student used incorrect inverse operation and added 3
D) $a = 63$ Student used incorrect inverse operation and multiplied by 3

Diagnostic Questions: Answers

4. Solve:

$$\frac{x}{5} = 10$$

- A) $x = 15$ Student used incorrect inverse operation and added 5
B) $x = 5$ Student used incorrect inverse operation and subtracted 5
C) $x = 2$ Student used incorrect inverse operation and divided by 5
D) $x = 50$ Correct answer

5. Solve:

$$2x + 8 = 20$$

- A) $x = 14$ Student performed incorrect first step of adding 8
B) $x = 6$ Correct answer
C) $x = 2$ Student used correct inverses but in the wrong order
D) $x = 18$ Student may have divided by 2 before then adding 8

6. Solve:

$$5x - 3 = 12$$

- A) $x = 3$ Correct answer
B) $x = \frac{9}{5}$ Student performed incorrect first step of subtracting 3
C) $x = 45$ Student performed incorrect second step of multiplying by 5
D) $x = 57$ Student may have multiplied by 5 before then subtracting 3

Diagnostic Questions: Answers

7. Solve:

$$\frac{x + 4}{2} = 7$$

- A) $x = 18$ Student performed incorrect second step of adding 4
B) $x = 6$ Student used correct inverses but in the wrong order
C) $x = 22$ Student may have added 4 before then multiplying by 2
D) $x = 10$ Correct answer

8. Solve:

$$\frac{x}{8} - 5 = 1$$

- A) $x = 48$ Correct answer
B) $x = -32$ Student performed incorrect first step of subtracting 5
C) $x = \frac{3}{4}$ Student performed incorrect second step of dividing by 8
D) $x = 13$ Student used correct inverses but in the wrong order

9. Solve:

$$\frac{3x + 2}{4} = 2$$

- A) $x = 18$ Student performed incorrect third step of multiplying by 3
B) $x = \frac{10}{3}$ Student performed incorrect second step of adding 2
C) $x = 2$ Correct answer
D) $x = 10.5$ Student may have, divided by 4, then added 2 before then multiplying by 3

Diagnostic Questions: Answers

10. Solve:

$$\frac{4x}{7} - 2 = 6$$

- A) $x = 11$ Student multiplied by 7 first, then added 2 before dividing by 4
B) $x = 10$ Student multiplied by 7 first, then subtracted 2 before dividing by 4
C) $x = 7$ Student performed incorrect first step of subtracting 2
D) $x = 14$ Correct answer

11. Solve:

$$\frac{36}{x} = 3$$

- A) $x = 33$ Student has subtracted 3 from 36
B) $x = 108$ Student has multiplied 36 by 3
C) $x = \frac{1}{12}$ Student has divided 3 by 36
D) $x = 12$ Correct answer

12. Solve:

$$2x - 7 = x + 5$$

- A) $x = -2$ Student incorrectly subtracted 7 from the right hand side
B) $x = 12$ Correct answer
C) $x = -4$ Student subtract 5 from both sides but then added the x to get $3x$ before dividing
D) $x = 4$ Student added 7 to both sides but then added the x to get $3x$ before dividing

Diagnostic Questions: Solving Linear Equations Answers

13. Solve:

$$7x - 3 = 4x + 15$$

A) $x = 4$ Student incorrectly subtracted 3 from the right hand side

B) $x = \frac{18}{11}$ Student incorrectly added $4x$ to the left hand side

C) $x = 6$ Correct answer

D) $x = 18$ Student forgot to divide by 3

14. Solve:

$$5(x - 3) = 10$$

A) $x = \frac{13}{5}$ Student applied inverse operations in the wrong order

B) $x = 65$ Student added 3 before then multiplying by 5

C) $x = 5$ Correct answer

D) $x = -1$ Student expanded the brackets, then subtracted 15 before dividing by 5

15. Solve:

$$3(x - 3) = 6(x + 5)$$

A) $x = -13$ Correct answer

B) $x = -\frac{8}{3}$ Student solved $3x - 3 = 6x + 5$

C) $x = 7$ Student expanded the brackets but added 30 to the left hand side instead of subtracting 30

D) $x = 13$ Student may have forgotten the sign or confused the order of a subtraction

Diagnostic Questions: Solving Linear Equations Answers

16. Solve:

$$\frac{x + 3}{2} = \frac{x + 4}{3}$$

A) $x = -6$ Student solved $2(x + 3) = 3(x + 4)$

B) $x = -1$ Correct answer

C) $x = 1$ Student solved $3x + 3 = 2x + 4$

D) $x = 17$ Student cross multiplied correctly but added 9 to 8

17. Solve:

$$\frac{3x + 1}{2} = \frac{2x - 2}{4}$$

A) $x = -1$ Correct answer

B) $x = -3$ Student solved $2(3x + 1) = 4(2x - 2)$

C) $x = -\frac{3}{8}$ Student incorrectly expanded brackets and solved $12x + 1 = 4x - 2$

D) $x = 0$ Student correctly cross multiplied but then added 4 to the right hand side

18. Form an equation and solve to find Raj's age.

Raj is x years old.

Sam is twice as old as Raj.

Tina is 2 years younger than Raj.

The total of their ages is 78 years.

A) $4x + 2 = 78$ and $x = 20$ Correct answer

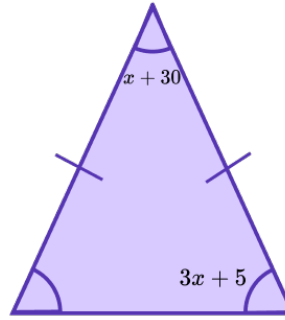
B) $4x + 2 = 78$ and $x = 19$ Student did $x + 2x + x + 2 = 78$

C) $3x = 78$ and $x = 26$ Student used $x + 2$ instead of $2x$ for Sam

D) $5x - 2 = 78$ and $x = 16$ Student used Tina being 2 years younger than Sam

Diagnostic Questions: Solving Linear Equations Answers

19. Form an equation and solve to find x .



- A) $5x + 65 = 180$ and $x = 23$ Student doubled the wrong angle
 B) $7x + 40 = 180$ and $x = 20$ Correct answer
 C) $4x + 35 = 180$ and $x = 36.25$ Student forgot to double the base angle
 D) $7x + 40 = 180$ and $x = 31.43$ Student added 40 to 180

20. There are three bags of sweets.

In the first bag there are n sweets.

In the second bag there are $(n + 5)$ sweets.

In the third bag there are $(2n - 3)$ sweets.

The mean number of sweets in the bags is 22.

Form an equation and solve to find n .

- A) $\frac{3n - 2}{4} = 22$ and $n = 30$ Incorrect equation formed
 B) $\frac{3n + 2}{3} = 22$ and $n = 21.33\ldots$ Student did not add the n for the first bag
 C) $\frac{4n + 2}{3} = 22$ and $n = 17$ Student added 2 when solving
 D) $\frac{4n + 2}{3} = 22$ and $n = 16$ Correct answer

Where to go next?

For more diagnostic questions, and GCSE maths revision resources and worksheets to support students in fixing any misconceptions take a look at the free Third Space Learning [GCSE maths revision](#) pages.

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