



THIRD SPACE
LEARNING

Diagnostic Questions

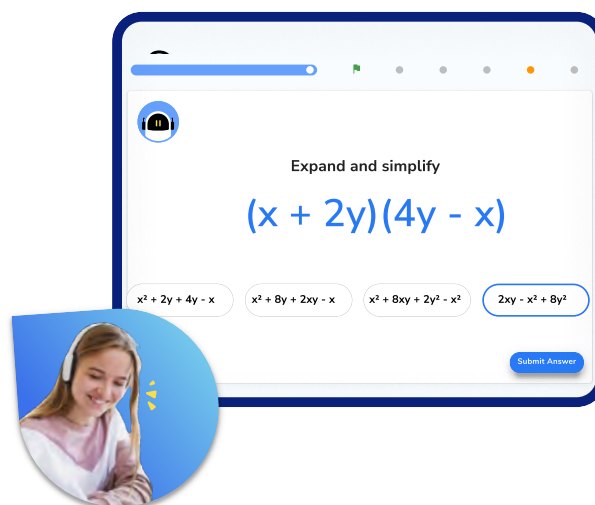
Substitution | Algebra

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 **substitution** 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 23 multiple choice questions, each designed to assess each of the key skills required to master **substitution**. Each question has **one correct answer** and **three carefully chosen incorrect answers** that are designed to identify and highlight fundamental misconceptions, including: **Order of operations**, **Negative numbers**, and **Laws of indices**.

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: Substitution

1. If $k = 7$, find the value of:

$$k + 3$$

A) 4	B) 10
C) 73	D) $7k + 3$

2. If $m = 3$, find the value of:

$$23 - m$$

A) 2	B) $23 - 3m$
C) 26	D) 20

3. If $d = 6$, find the value of:

$$5d$$

A) 11	B) 56
C) 30	D) 25

Diagnostic Questions: Substitution

4. If $t = 4$, find the value of:

$$3t + 5$$

A) 27	B) 39
C) 17	D) 12

5. If $p = -4$, find the value of:

$$2p + 9$$

A) 1	B) 17
C) 7	D) 33

6. If $h = -2$, find the value of:

$$8 - 4h$$

A) 0	B) 4
C) 16	D) 2

Diagnostic Questions: Substitution

7. If $c = 10$, find the value of:

$$\frac{c}{2}$$

A) 8	B) 5
C) $\frac{1}{5}$	D) $5c$

8. If $j = 9$, find the value of:

$$\frac{45}{j} - 6$$

A) 30	B) $4\frac{1}{3}$
C) 1	D) -1

9. If $u = 4$, find the value of:

$$3 - \frac{12}{u}$$

A) -9	B) -1
C) 0	D) $2\frac{2}{3}$

Diagnostic Questions: Substitution

10. If $p = 7$, and $q = 2$, find the value of:

$$3p + 5q$$

A) 31	B) 89
C) 41	D) 56

11. If $m = 3$ and $n = 4$, find the value of:

$$5mn$$

A) 12	B) 534
C) 45	D) 60

12. If $t = 1.1$ and $u = 1.6$, find the value of:

$$4t - u$$

A) 6	B) -0.5
C) 2.8	D) -2

Diagnostic Questions: Substitution

13. If $a = -3$ and $b = 5$, find the value of:

$$b^2 - a$$

A) 4	B) 28
C) 22	D) -8

14. If $p = 3$, $q = 1$ and $r = \frac{1}{4}$, find the value of:

$$r(3p - q)$$

A) 32	B) 8
C) $\frac{10}{4}$	D) 2

15. If $x = -2$, $y = -1$ and $z = 0.8$, find the value of:

$$\frac{5z - 8y}{x}$$

A) 2	B) -6
C) 12	D) $\frac{5}{8}$

Diagnostic Questions: Substitution

16. If $d = 25$ and $e = -9$, find the value of:

$$\frac{3\sqrt{d} - e}{4}$$

A) 6	B) 1.5
C) -6	D) 3

17. If $x = \frac{3}{4}$ and $y = \frac{1}{4}$, find the value of:

$$x^2 + xy - y^2$$

A) $\frac{13}{16}$	B) $2\frac{3}{4}$
C) $\frac{11}{16}$	D) $\frac{19}{16}$

18. Given a force applied, $F = 3.5N$ and a distance moved, $d = 5m$ calculate the work done, W , in joules (J) using the formula:

$$W = Fd$$

A) 8.5 J	B) 17.5 J
C) 15 J	D) 3.58 J

Diagnostic Questions: Substitution

19. If C is the cost in pounds (£), and d is the number of days, find the cost of hiring a car for 6 days when the following formula is used:

$$C = 65 + 22d$$

A) £87	B) £197
C) £291	D) £132

20. If $x = 8$ and $y = 6$, evaluate z when:

$$z = \sqrt{x^2 + y^2}$$

A) 100	B) $\sqrt{14}$
C) 10	D) 14

21. Calculate the area of a circle with diameter 10cm .
Give your answer in terms of π .

A) 25cm^2	B) $10\pi\text{cm}^2$
C) 10π	D) $25\pi\text{cm}^2$

Diagnostic Questions: Substitution

22. The volume of a sphere can be calculated using the formula $V = \frac{4}{3}\pi r^3$.
Calculate the volume of a sphere with radius 4cm . Give your answer in terms of π .

A) $16\pi\text{cm}^3$	B) $\frac{256}{3}\text{cm}^3$
C) $\frac{256}{3}\pi\text{cm}^3$	D) 16cm^3

23. Solve the equation $2x^2 - 10x - 12$ using the quadratic formula below:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

A) $x = 6$ and $x = -1$	B) $x = 1$ and $x = -6$
C) $x = 12$ and $x = -2$	D) $x = 6$

Diagnostic Questions: Substitution Answers

1. If $k = 7$, find the value of:

$$k + 3$$

- A) 4 Student solved the equation $k + 3 = 7$
- B) 10 Correct answer
- C) 73 Student concatenated 7 and 3
- D) $7k + 3$ Student lacks the understanding of substitution

2. If $m = 3$, find the value of:

$$23 - m$$

- A) 2 Student removed the 3 from 23
- B) $23 - 3m$ Student attempted to find a new expression
- C) 26 Student did not perform subtraction correctly
- D) 20 Correct answer

3. If $d = 6$, find the value of:

$$5d$$

- A) 11 Student added 6 to 5
- B) 56 Student wrote the 6 in place of the d
- C) 30 Correct answer
- D) 25 Student multiplied incorrectly

Diagnostic Questions: Substitution Answers

4. If $t = 4$, find the value of:

$$3t + 5$$

- A) 27 Student performed operations in wrong order
- B) 39 Student concatenated 3 and 4, then added 5
- C) 17 Correct answer
- D) 12 Student forgot to add on the 5

5. If $p = -4$, find the value of:

$$2p + 9$$

- A) 1 Correct answer
- B) 17 Student multiplied by 4, instead of -4
- C) 7 Student subtracted 4 from 2, then added 9
- D) 33 Student concatenated 2 and 4 ignoring the negative sign

6. If $h = -2$, find the value of:

$$8 - 4h$$

- A) 0 Student multiplied by 2, instead of -2
- B) 4 Student ignored h
- C) 16 Correct answer
- D) 2 Student did the calculation as $8 - 4 - 2$

Diagnostic Questions: Substitution Answers

7. If $c = 10$, find the value of:

$$\frac{c}{2}$$

A) 8 Student subtracted instead of dividing

B) 5 Correct answer

C) $\frac{1}{5}$ Student inverted the fraction

D) $5c$ Student included variable in answer

8. If $j = 9$, find the value of:

$$\frac{45}{j} - 6$$

A) 30 Student made arithmetic errors

B) $4\frac{1}{3}$ Student did not follow rules for order of operations

C) 1 Student made a mistake dealing with negative numbers

D) -1 Correct answer

9. If $u = 4$, find the value of:

$$3 - \frac{12}{u}$$

A) -9 Student ignored the variable

B) -1 Student made arithmetic errors

C) 0 Correct answer

D) $2\frac{2}{3}$ Student made several errors

Diagnostic Questions: Substitution Answers

10. If $p = 7$ and $q = 2$, find the value of:

$$3p + 5q$$

A) 31 Correct answer

B) 89 Student did the calculation $37 + 52$

C) 41 Student mixed up the substitution of p and q

D) 56 Student used p for both variables

11. If $m = 3$ and $n = 4$, find the value of:

$$5mn$$

A) 12 Student did not multiply by coefficient

B) 534 Student does not understand substitution

C) 45 Student used m for both variables

D) 60 Correct answer

12. If $t = 1.1$ and $u = 1.6$, find the value of:

$$4t - u$$

A) 6 Student performed addition instead of subtraction

B) -0.5 Student did not multiply t by 4

C) 2.8 Correct answer

D) -2 Student subtracted u from t then multiplied by 4

Diagnostic Questions: Substitution Answers

13. If $a = -3$ and $b = 5$, find the value of:

$$b^2 - a$$

- A) 4 Student substituted variables incorrectly
- B) 28 Correct answer
- C) 22 Student made a mistake subtracting a negative number
- D) -8 Student did not square b

14. If $p = 3$, $q = 1$ and $r = \frac{1}{4}$, find the value of:

$$r(3p - q)$$

- A) 32 Student multiplied by a fraction incorrectly
- B) 8 Student did not multiply by r
- C) $\frac{10}{4}$ Student did not evaluate the bracket correctly
- D) 2 Correct answer

15. If $x = -2$, $y = -1$ and $z = 0.8$, find the value of:

$$\frac{5z - 8y}{x}$$

- A) 2 Student made errors with negative numbers
- B) -6 Correct answer
- C) 12 Student did not divide by -2
- D) $\frac{5}{8}$ Student made several arithmetic errors

Diagnostic Questions: Substitution Answers

16. If $d = 25$ and $e = -9$, find the value of:

$$\frac{3\sqrt{d} - e}{4}$$

A) 6 Correct answer

B) 1.5 Student made a mistake subtracting a negative number

C) -6 Student made several arithmetic errors

D) 3 Student attempted to include e under the radical

17. If $x = \frac{3}{4}$ and $y = \frac{1}{4}$, find the value of:

$$x^2 + xy - y^2$$

A) $\frac{13}{16}$ Student added the value of y^2

B) $2\frac{3}{4}$ Student did not multiply denominators correctly

C) $\frac{11}{16}$ Correct answer

D) $\frac{19}{16}$ Student doubled variables instead of squaring

18. Given a force applied, $F = 3.5N$ and a distance moved, $d = 5m$, calculate the work done, W , in joules (J) using the formula:

$$W = Fd$$

A) 8.5 J Student found the sum, not the product

B) 17.5 J Correct answer

C) 15 J Student multiplied incorrectly

D) 3.58 J Student does not understand how to substitute into a formula

Diagnostic Questions: Substitution Answers

19. If C is the cost in pounds (£), and d is the number of days, find the cost of hiring a car for 6 days when the following formula is used:

$$C = 65 + 22d$$

- A) £87 Student did not multiply by the variable
- B) £197 Correct answer
- C) £291 Student does not understand how to substitute into a formula
- D) £132 Student did not add on the constant term

20. If $x = 8$ and $y = 6$, evaluate z when:

$$z = \sqrt{x^2 + y^2}$$

- A) 100 Student did not square root
- B) $\sqrt{14}$ Student did not square x and y
- C) 10 Correct answer
- D) 14 Student added variables before squaring

21. Calculate the area of a circle with diameter 10cm .
Give your answer in terms of π .

- A) 25 cm^2 Student ignored π
- B) $10\pi\text{ cm}^2$ Student incorrectly evaluated r^2 as $r \times 2$
- C) 10π Student confused the formula for area and circumference
- D) $25\pi\text{ cm}^2$ Correct answer

Diagnostic Questions: Substitution Answers

22. The volume of a sphere can be calculated using the formula $V = \frac{4}{3}\pi r^3$.
Calculate the volume of a sphere with radius 4cm . Give your answer in terms of π .

A) $16\pi \text{ cm}^3$ Student incorrectly evaluated r^3 as $r \times 3$

B) $\frac{256}{3} \text{ cm}^3$ Student correctly substituted, but forgot π

C) $\frac{256}{3}\pi \text{ cm}^3$ Correct answer

D) 16cm^3 Student incorrectly evaluated r^3 as $r \times 3$ and forgot π

23. Solve the equation $2x^2 - 10x - 12$ using the quadratic formula below:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

A) $x = 6$ and $x = -1$ Correct answer

B) $x = 1$ and $x = -6$ Student did not correctly apply $-b$

C) $x = 12$ and $x = -2$ Student did not multiply a by 2

D) $x = 6$ Student does not understand some quadratics have two solutions

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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