

WA8MNALE1

Linear and non-linear equations and inequalities

Core + Challenge

Solving Equations with up to Three Operations — Marking Key

I can solve linear equations with up to three operations, including negatives and fractions, and verify by substitution.

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	$x = 6$	$2x = 12 \rightarrow x = 6$
2	$x = 5$	$3x = 15 \rightarrow x = 5$
3	$x = 24$	$\frac{x}{4} = 6 \rightarrow x = 24$
4	$x = 8$	$x - 2 = 6 \rightarrow x = 8$
5	$x = 9$	$x + 6 = 15 \rightarrow x = 9$
6	$x = -2$	$4x = -8 \rightarrow x = -2$
7	$x = 4$	$-3x = -12 \rightarrow x = 4$
8	$x = -4$	$-2x = 8 \rightarrow x = -4$
9	$x = -3$	$6x = -18 \rightarrow x = -3$
10	$x = 5$	$2(x + 3) = 16 \rightarrow x + 3 = 8 \rightarrow x = 5$
11	$x = -20$	$\frac{x}{5} = -4 \rightarrow x = -20$
12	$x = 7$	$2x + 1 = 15 \rightarrow 2x = 14 \rightarrow x = 7$
13	$x = \frac{5}{2}$	$4x = 10 \rightarrow x = \frac{5}{2} = 2.5$
14	$x = -2$	$x - 4 = -6 \rightarrow x = -2$
15	$x = -6$	$-\frac{x}{2} = 3 \rightarrow x = -6$
16	$x = 3$	$3(2x - 1) = 15 \rightarrow 2x - 1 = 5 \rightarrow x = 3$

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B

Core answers, working and marks

/ 22 marks

Q	Answer	Working / sample response	Marks
1	$3(x + 4) - 5 = 16; x = 3$	$16 + 5 = 21, 21 \div 3 = 7, 7 - 4 = 3$ Check: $3(3 + 4) - 5 = 16 \checkmark$ <i>1 mark: equation</i> <i>1 mark: $x = 3$</i>	2
2	$\frac{2x-3}{5} = 7; x = 19$	$7 \times 5 = 35, 35 + 3 = 38, 38 \div 2 = 19$ Check: $(38 - 3) \div 5 = 7 \checkmark$ <i>1 mark: equation</i> <i>1 mark: $x = 19$</i>	2
3	$x = -3$	$-4x = 12 \rightarrow x = -3$ Check: $15 - 4(-3) = 15 + 12 = 27 \checkmark$ <i>1 mark: $x = -3$</i> <i>1 mark: check</i>	2
4	$x = \frac{5}{2}$	$2(3x - 5) = 5$ $3x - 5 = \frac{5}{2} \rightarrow 3x = \frac{15}{2}$ $x = \frac{5}{2}$ (check: $2(3 \times 2.5 - 5) + 7 = 2(2.5) + 7 = 12 \checkmark$) <i>1 mark: subtract 7</i> <i>1 mark: divide by 2</i> <i>1 mark: $x = \frac{5}{2}$</i>	3
5	$x = -8$	$-\frac{3x}{4} = 6 \rightarrow 3x = -24 \rightarrow x = -8$ Check: $5 - (-6) = 11 \checkmark$ <i>1 mark: working</i> <i>1 mark: $x = -8$</i>	2
6	No; $x = 4.8$	$5(4 - 2) + 3 = 13 \neq 17$, so Sam is wrong $5(x - 2) = 14 \rightarrow x - 2 = 2.8 \rightarrow x = 4.8$ Check: $5(2.8) + 3 = 17 \checkmark$ <i>1 mark: substitution shows 13</i> <i>1 mark: working</i> <i>1 mark: $x = 4.8$</i>	3
7	$x = -3.5$	$\frac{4x+2}{3} = -4 \rightarrow 4x + 2 = -12 \rightarrow 4x = -14 \rightarrow x = -3.5$ <i>1 mark: working</i> <i>1 mark: $x = -3.5$</i>	2
8	45°C	$1.8C + 32 = 113 \rightarrow 1.8C = 81 \rightarrow C = 45$ <i>1 mark: equation</i> <i>1 mark: 45°C</i>	2
9	$x = 9.5$	$5 - x = -4.5 \rightarrow -x = -9.5 \rightarrow x = 9.5$ (or expand: $-10 + 2x = 9 \rightarrow 2x = 19$) Check: $-2(5 - 9.5) = -2(-4.5) = 9 \checkmark$ <i>1 mark: working</i> <i>1 mark: $x = 9.5$</i>	2

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Q	Answer	Working / sample response	Marks
10	$l = 30.5 \text{ m}$	$2(l + 15.25) = 91.5 \rightarrow l + 15.25 = 45.75 \rightarrow l = 30.5$ <i>1 mark: equation</i> <i>1 mark: 30.5 m</i>	2

C Reasoning *sample answers and marking criteria*

/ 9 marks

Q	Answer	Working / sample response	Marks
1	$x = 18$	She multiplied $\frac{x}{3}$ by 3 but not the -4 ($x - 12 = 6$ would be correct). Better: add 4 first: $\frac{x}{3} = 6 \rightarrow x = 18$ Check: $18 \div 3 - 4 = 2 \checkmark$ ($x = 10$ gives $-\frac{2}{3}$) <i>1 mark: identifies error</i> <i>1 mark: $x = 18$</i> <i>1 mark: verification</i>	3
2	Last operation done is the first undone	Like taking off shoes and socks: the last thing done (outermost operation) must be undone first to get back to x . <i>1 mark: reverse order</i> <i>1 mark: clear reason</i>	2
3	True, $x = 2$	Both give $x = 2$ (the second is the first multiplied by -1 on both sides). <i>1 mark: true</i> <i>1 mark: justification</i>	2
4	$x = -4$	$-3x$ means $-3 \times x$, so divide both sides by -3 : $x = -4$ <i>1 mark: explanation</i> <i>1 mark: $x = -4$</i>	2

D Challenge *solutions and marking criteria*

/ 11 marks

Q	Answer	Working / sample response	Marks
1	$\frac{23}{5} (= 4.6)$	$\frac{3n-5}{-2} + 9 = n$ Multiply by -2 : $3n - 5 - 18 = -2n \rightarrow 5n = 23$ $n = 4.6$; check: $(13.8 - 5) \div (-2) + 9 = 4.6 \checkmark$ <i>1 mark: equation</i> <i>1 mark: $5n = 23$</i> <i>1 mark: 4.6</i>	3
2	$k = -\frac{14}{5} (= -2.8)$	Substitute $x = -2$: $\frac{-2k+4}{3} - k = 6$ $-2k + 4 - 3k = 18 \rightarrow -5k = 14$ $k = -2.8$ <i>1 mark: substitution</i> <i>1 mark: $-5k = 14$</i> <i>1 mark: k</i>	3

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Q	Answer	Working / sample response	Marks
3	$x = \frac{17}{6}$	$2(3(2x - 1) + 4) = 36 \rightarrow 3(2x - 1) + 4 = 18$ $3(2x - 1) = 14 \rightarrow 2x - 1 = \frac{14}{3}$ $2x = \frac{17}{3} \rightarrow x = \frac{17}{6}$ <i>1 mark: $3(2x - 1) + 4 = 18$</i> <i>1 mark: $2x - 1 = \frac{14}{3}$</i> <i>1 mark: $x = \frac{17}{6}$</i>	3
4	(a) $a = -3$ (b) $a = 0$	(a) $a(-4) = 12 \rightarrow a = -3$ (b) $a = 0$ gives $0 = 12$, which is never true <i>1 mark each</i>	2