



eClassroom

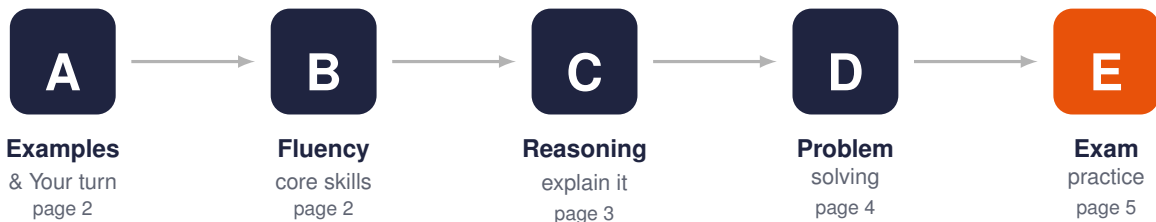
GCSE MATHEMATICS • ALGEBRA

Inequalities

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Full worked solutions for the free Inequalities worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Inequalities worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

Question sheet

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A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 -1 is not included; 4 is included $\boxed{0, 1, 2, 3, 4}$

A2 $4x + 5 < -7$ $4x < -12$ $\boxed{x < -3}$

A3 $-2x \leq 6$. Divide by -2 and reverse the sign: $\boxed{x \geq -3}$

HIGHER

A4 Add 2: $3 < 3x \leq 15$ Divide by 3: $\boxed{1 < x \leq 5}$

A5 $(x + 3)(x - 2) \leq 0$: roots -3 and 2 . The graph is below the axis between the roots. $\boxed{-3 \leq x \leq 2}$

A6 $(1, 3)$: $y = 3$ is greater than $2x = 2$, so **not in R** $(2, 2)$: $2 \geq 2$, $4 < 6$, $2 \leq 4$, so **in R** $(3, 5)$: $x + y = 8$, which is not less than 6 , so **not in R**

A7 $x^2 < 16$ gives $-4 < x < 4$ $\boxed{\{x : -4 < x < 4\}}$

B**Fluency solutions**

One mark for each correct part. The notes in italics explain why each sequence was chosen.

FOUNDATION

B1 (a) $\boxed{-1, 0, 1, 2}$ (b) $\boxed{-2, -1, 0, 1, 2}$ (c) $\boxed{-1, 0, 1, 2, 3}$ (d) $0 < n \leq 4$: $\boxed{1, 2, 3, 4}$
 $\leq$ includes the end; $<$ does not.

B2 (a) $\boxed{x \geq 1}$ (b) $\boxed{x > 1}$ (c) $\boxed{x < -2}$ (d) $\boxed{-1 < x \leq 3}$ *A filled circle means the end is included.*

B3 (a) $\boxed{x > 4}$ (b) $\boxed{x \leq 4}$ (c) $\frac{x}{2} \geq 4$: $\boxed{x \geq 8}$ (d) $3x < 9$: $\boxed{x < 3}$



B4 (a) $x < -4$ (b) $x \geq -4$ (c) $-x < -3$: $x > 3$ (d) $15 \geq 5x$: $x \leq 3$

Each time you divide by a negative, the sign reverses.

B5 (a) $1 < x < 6$ (b) $-2 \leq x < 3$ (c) $4 < 2x \leq 10$: $2 < x \leq 5$

B6 (a) $3 + 2m \leq 20$, $m \leq 8.5$: **8** miles (b) $12t \leq 100$, $t \leq 8.3$: **8** tickets

(c) $4(x + 2) \geq 30$: $x \geq 5.5$ (d) $3a - 4 < 20$, $a < 8$: **7** years

HIGHER

B7 (a) $-5 < x < 5$ (b) $x \leq -3$ or $x \geq 3$ (c) $(x - 2)(x - 3) < 0$: $2 < x < 3$ (d) $(x + 5)(x - 3) \geq 0$:
 $x \leq -5$ or $x \geq 3$

B8 (a) $1 \geq 1$, $2 > 1$, $3 \leq 6$: **yes** (b) $y = 2$ is not greater than $x = 2$: **no** (c) $2 \geq 1$, $4 > 2$, $6 \leq 6$: **yes**
(d) $0 \geq 1$ is false: **no**

A point on a solid boundary is in the region; on a dashed boundary it is not.

B9 (a) $\{x : x > 3\}$ (b) $\{x : x \leq 5\}$ (c) $\{-1, 0, 1, 2\}$ (d) $\{x : x < -2\} \cup \{x : x > 2\}$

B10 (a) **3, 4, 5, 6, 7** (b) $x > 2$ and $x < 5$: **3, 4** (c) $x^2 < 20$ gives $-4.47 < x < 4.47$: **2, 3, 4** (d) $1 \leq x \leq 5$: **2, 4**

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 Tom divided by -2 but did not reverse the sign. $x < -3$

C2 The answer must be an inequality. $3x > 9$ gives $x > 3$: every number greater than 3, not just 3

C3 (a) $x \leq 2$ includes 2, so the circle at 2 should be filled in, not open. (b) **1, 2**



C4 $x = 4$: $8 - 3 = 5 > 4$, true. $x = 3$: $6 - 3 = 3$, which is not greater than 4. $2x > 7$, so $x > 3.5$ The smallest integer is **4**

HIGHER

C5 Negative numbers also have squares greater than 64, for example $(-9)^2 = 81$ **$x < -8$ or $x > 8$**

C6 $x^2 \geq 0$ for every x , so $x^2 + 4 \geq 4$. It can never be below 0, and it is always above 0

C7 $y < 2x + 1$ does not include points on the line $y = 2x + 1$, so the line is dashed. $y \geq 3$ includes points on $y = 3$, so the line is solid.

C8 (a) $x + (x + 2) > x + 5$, so $2x + 2 > x + 5$ and **$x > 3$**

(b) Perimeter: $3x + 7 < 40$, so $x < 11$ $3 < x < 11$: **4, 5, 6, 7, 8, 9, 10**

(c) $x^2 + x^2 + 4x + 4 < x^2 + 10x + 25$, so $x^2 - 6x - 21 < 0$ Roots $3 \pm \sqrt{30}$, so $x < 8.48$ Obtuse for **4, 5, 6, 7, 8**

D**Problem solving solutions**

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 $15 + 0.1m < 25$ $0.1m < 10$ $m < 100$ **99** minutes

D2 $2(2x + 1) + 2x \leq 50$ $6x + 2 \leq 50$ $x \leq 8$ Area = $17 \times 8 =$ **136** cm²

D3 $-2 < n \leq 3$: $n = -1, 0, 1, 2, 3$ Sum = **5**

D4 $2x > 4$, so $x > 2$ $-x > -7$, so $x < 7$ **3, 4, 5, 6**

HIGHER

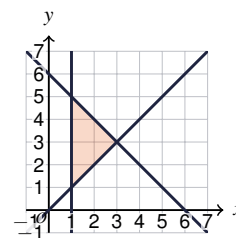
D5 $-x^2 + 12x - 20 > 0$ $x^2 - 12x + 20 < 0$ $(x - 2)(x - 10) < 0$ **$2 < x < 10$**



D6 (a) The triangle with corners (1, 1), (1, 5) and (3, 3), boundaries included.

(b) $x = 1$: 5 points; $x = 2$: 3 points; $x = 3$: 1 point

9



D7 $3x = k + 1$, so $x = \frac{k+1}{3}$ $\frac{k+1}{3} > 3$ $k+1 > 9$ **$k > 8$**

D8 (a) $2x^2 - x - 6 \leq 0$ $(2x+3)(x-2) \leq 0$ **$-\frac{3}{2} \leq x \leq 2$** (b) **$\{-1, 0, 1, 2\}$**

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

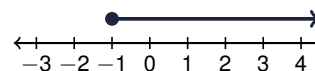
Foundation and Higher crossover

E1 **$-1, 0, 1, 2, 3$**

B2

E2 (a) A filled circle at -1 and an arrow to the right

(b) **$x < 2$**



B1 B1

E3 $5x > 20$

$x > 4$

M1

A1

E4 (a) $3x + 6 \leq x + 12$, so $2x \leq 6$

$x \leq 3$

M1

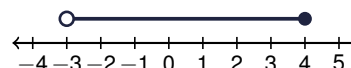
A1

(b) **3**

B1

E5 (a) $-6 < 2x \leq 8$ **$-3 < x \leq 4$**

(b) An open circle at -3 and a filled circle at 4 , joined



M1 A1 B1



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E6	$7 - 2x > 1$, so $-2x > -6$ and $x < 3$	M1
	Together with $x \geq -1$	M1
	$-1, 0, 1, 2$	A1

HIGHER

E7	$(x+3)(x-4) < 0$	M1
	Roots -3 and 4 ; below the axis between them	M1
	$-3 < x < 4$	A1

E8	$y \geq 1$, $x+y \leq 6$, $y < 2x$	B3
	$y = 2x$ is dashed, so that inequality is strict.	

E9	$2x > 10$, so $x > 5$	M1
	$x^2 \leq 49$, so $-7 \leq x \leq 7$	M1
	Both: $5 < x \leq 7$	M1
	$\{6, 7\}$	A1

E10	Area: $x(x+4) < 45$, so $x^2 + 4x - 45 < 0$	M1
	$(x+9)(x-5) < 0$, so $-9 < x < 5$	A1
	Perimeter: $2x + 2(x+4) > 16$, so $4x + 8 > 16$ and $x > 2$	M1
	A width must be positive, and both conditions hold	M1
	$2 < x < 5$	A1

