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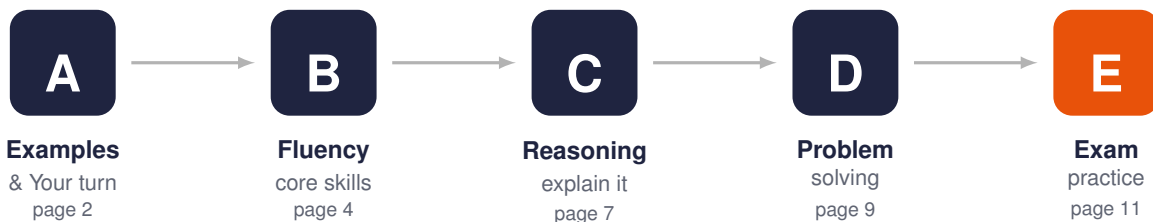
GCSE MATHEMATICS • ALGEBRA

Inequalities

Worksheet

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

Free Inequalities worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: list the integers that satisfy an inequality • show and read inequalities on a number line • solve linear inequalities, including double inequalities and negative coefficients • use inequalities in problems • *Higher:* quadratic inequalities, set notation and regions.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: quadratic inequalities, set notation and regions on a graph. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	15
Higher marks	16	14	17	15
My score				

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Name

Class

Date



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A**Worked examples & Your turn**

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION*Everyone starts here***Worked example A1**

n is an integer and $-3 \leq n < 2$. Write down all the possible values of n .

$\leq$ includes -3 ; $<$ does not include 2

$-3, -2, -1, 0, 1$

Your turn A1

n is an integer and $-1 < n \leq 4$. Write down all the possible values of n .

Worked example A2

Solve $4x - 7 \geq 13$

Solve it like an equation, but keep the inequality sign.

$$4x \geq 20$$

$$x \geq 5$$

Your turn A2

Solve $6x + 5 < 2x - 7$

Worked example A3

Solve $10 - 3x > 4$

$-3x > -6$. *Dividing by a negative number reverses the sign.*

$$x < 2$$

Your turn A3

Solve $5 - 2x \leq 11$



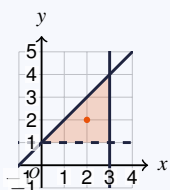
HIGHER*Higher only: quadratic inequalities, regions and set notation***Worked example A4: a double inequality**Solve $-3 \leq 2x + 5 < 11$ *Do the same to all three parts: subtract 5, then divide by 2*

$$-8 \leq 2x < 6$$

$$-4 \leq x < 3$$

Your turn A4Solve $1 < 3x - 2 \leq 13$ **Worked example A5: a quadratic inequality**Solve $x^2 - 2x - 8 > 0$ *Roots: $(x+2)(x-4) = 0$, so -2 and 4 . The U-shaped graph is above the x -axis outside the roots.*

$$x < -2 \text{ or } x > 4$$

Your turn A5Solve $x^2 + x - 6 \leq 0$ **Worked example A6: points in a region**The region R is $y > 1$,
 $x \leq 3$ and $y \leq x + 1$. Is
 $(2, 2)$ in R ?*Test every inequality: $2 > 1$,
 $2 \leq 3$ and $2 \leq 3$* 

yes

Your turn A6The region R is $y \geq 2$, $x + y < 6$ and $y \leq 2x$. Which of $(1, 3)$, $(2, 2)$ and $(3, 5)$ are in R ?**Worked example A7: set notation**Solve $3x - 2 \leq 10$ and give the answer in set notation. *$3x \leq 12$, so $x \leq 4$. Set notation: the set of all x with $x \leq 4$*

$$\{x : x \leq 4\}$$

Your turn A7Solve $x^2 < 16$ and give the answer in set notation.

B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION*Everyone starts here*

B1 n is an integer. Write down all the possible values of n .

(a) $-2 < n < 3$

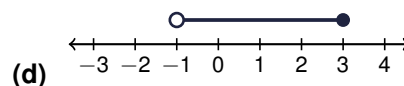
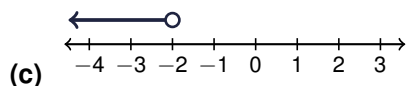
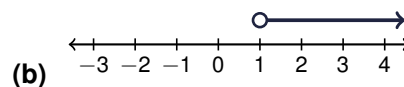
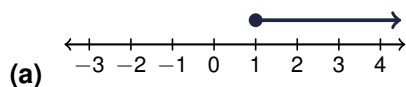
(b) $-2 \leq n < 3$

(c) $-2 < n \leq 3$

(d) $0 < 2n \leq 8$

[4 marks]

B2 Write down the inequality shown on each number line.



[4 marks]

B3 Solve

(a) $x + 5 > 9$

(b) $3x \leq 12$

(c) $\frac{x}{2} - 1 \geq 3$

(d) $4x + 3 < x + 12$

[4 marks]

B4 Solve

(a) $-x > 4$

(b) $-3x \leq 12$

(c) $5 - x < 2$

(d) $8 - 3x \geq 2x - 7$

[4 marks]



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FOUNDATION*continued: double inequalities and problems***B5** Solve

(a) $3 < x + 2 < 8$

(b) $-6 \leq 3x < 9$

(c) $1 < 2x - 3 \leq 7$

[3 marks]**B6** Form an inequality and solve it.**(a)** A taxi costs £3 plus £2 per mile. Ali has £20. What is the greatest whole number of miles he can travel?**(b)** Tickets cost £12 each. Kim has £100. What is the greatest number of tickets she can buy?**(c)** A square has side $(x + 2)$ cm. Its perimeter is at least 30 cm. Find the possible values of x .**(d)** Three times Sam's age, minus 4, is less than 20. What is the greatest age Sam could be, in whole years?**[4 marks]****HIGHER***Higher tier only***B7** Solve

(a) $x^2 < 25$

(b) $x^2 \geq 9$

(c) $x^2 - 5x + 6 < 0$

(d) $x^2 + 2x - 15 \geq 0$

[4 marks]**B8** The region R is $x \geq 1$, $y > x$ and $x + y \leq 6$. Is each point in R ? Give a reason.

(a) $(1, 2)$

(b) $(2, 2)$

(c) $(2, 4)$

(d) $(0, 3)$

[4 marks]

HIGHER*continued: set notation and combined inequalities***B9** Write each answer in set notation.

(a) $x > 3$

(b) the solution of $2x - 1 \leq 9$

(c) the integers n with $-2 < n \leq 2$

(d) the solution of $x^2 > 4$

[4 marks]**B10** Find the integers that satisfy both inequalities.

(a) $x > 2$ and $x \leq 7$

(b) $2x + 1 > 5$ and $3x - 2 < 13$

(c) $x^2 < 20$ and $x > 1$

(d) $x^2 - 6x + 5 \leq 0$ and x is even

[4 marks]

C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Tom solves $-2x > 6$ and writes $x > -3$

Explain Tom's mistake, and give the correct answer.

[2 marks]

- C2** Sam solves $3x + 1 > 10$ and writes the answer as 3

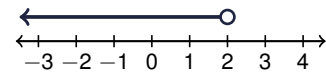
Explain what is wrong with Sam's answer.

[2 marks]

- C3** Kim shows $x \leq 2$ on a number line like this.

(a) Explain Kim's mistake.

(b) List the positive integers that satisfy $x \leq 2$



[3 marks]

- C4** Show that $x = 4$ satisfies $2x - 3 > 4$ but $x = 3$ does not. Hence find the smallest integer that satisfies it.

[3 marks]



HIGHER*Higher tier only*

- C5** John says, "The solution of $x^2 > 64$ is $x > 8$ "
Explain why John's answer is not complete, and give the full solution. [3 marks]
- C6** Explain why $x^2 + 4 < 0$ has no solutions, but $x^2 + 4 > 0$ is true for every value of x [3 marks]
- C7** On a graph, the region $y < 2x + 1$ has a dashed boundary, but the region $y \geq 3$ has a solid boundary.
Explain why the boundaries are drawn differently. [3 marks]
- C8** A triangle has sides x cm, $(x + 2)$ cm and $(x + 5)$ cm, where x is a whole number. Its perimeter is less than 40 cm.
- (a) The two shorter sides must add up to more than the longest side. Show that $x > 3$
- (b) Find all the possible values of x .
- (c) The triangle has an obtuse angle when $x^2 + (x + 2)^2 < (x + 5)^2$. For which of your values of x is the triangle obtuse? [5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** A phone plan costs £15 a month plus 10p for each minute of calls. Kai wants his monthly bill to be less than £25
What is the greatest number of whole minutes he can use? [3 marks]
- D2** A rectangle has length $(2x + 1)$ cm and width x cm, where x is a whole number. Its perimeter is at most 50 cm.
Find the greatest possible area of the rectangle. [4 marks]
- D3** n is an integer and $-6 < 3n \leq 9$. Find the sum of all the possible values of n . [3 marks]
- D4** Find the integers that satisfy both $2x - 1 > 3$ and $5 - x > -2$ [3 marks]



HIGHER*Higher tier only*

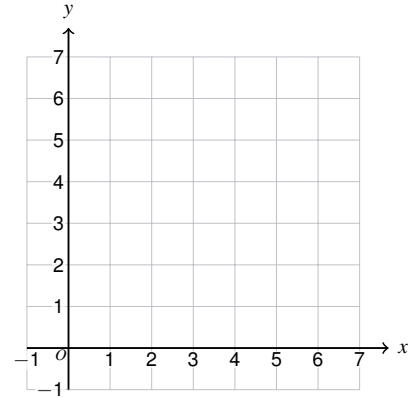
- D5** A company's profit, in thousands of pounds, when it makes x thousand items is $P = -x^2 + 12x - 20$

For which values of x does the company make a profit?

[4 marks]

- D6** (a) On the grid, show the region R that satisfies $x \geq 1$,
 $y \geq x$ and $x + y \leq 6$

(b) How many points with whole-number coordinates are in R , including its boundary?



[4 marks]

- D7** The equation $2x + k = 5x - 1$ has a solution x that is greater than 3

Find the range of possible values of k .

[4 marks]

- D8** (a) Solve $2x^2 \leq x + 6$

(b) Write down the integers that satisfy the inequality, in set notation.

[5 marks]



E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover*

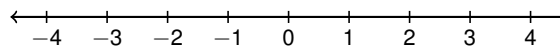
E1 n is an integer and $-2 < n \leq 3$

Write down all the possible values of n .

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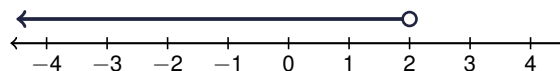
(Total for Question E1 is 2 marks)

E2 (a) Show the inequality $x \geq -1$ on the number line.



(1)

(b) Write down the inequality shown on this number line.



.....

(1)

(Total for Question E2 is 2 marks)

E3 Solve $5x - 3 > 17$

.....

(Total for Question E3 is 2 marks)



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E4 (a) Solve $3(x+2) \leq x+12$

.....
(2)

(b) Write down the largest integer that satisfies the inequality.

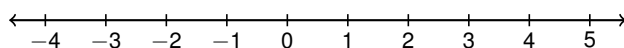
.....
(1)

(Total for Question E4 is 3 marks)

E5 (a) Solve $-5 < 2x+1 \leq 9$

.....
(2)

(b) Show your solution on the number line.



(1)
(Total for Question E5 is 3 marks)

E6 Find the integers that satisfy both $7-2x > 1$ and $x \geq -1$

.....
(Total for Question E6 is 3 marks)

HIGHER

Higher tier only

E7 Solve $x^2 - x - 12 < 0$

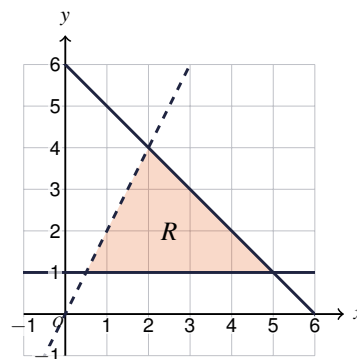
.....
(Total for Question E7 is 3 marks)



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- E8** Write down the three inequalities that define the shaded region R .



.....
(Total for Question E8 is 3 marks)

- E9** Find the integers that satisfy both $3x - 4 > x + 6$ and $x^2 \leq 49$. Give your answer in set notation.

.....
(Total for Question E9 is 4 marks)

- E10** A rectangle has width x cm and length $(x + 4)$ cm. Its area is less than 45 cm^2 and its perimeter is more than 16 cm.

Find the range of possible values of x .

.....
(Total for Question E10 is 5 marks)

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