

Inequalities on a Number Line

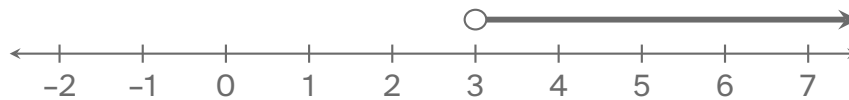
Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (1 mark)

Write down the inequality shown on this number line.



The circle at 3 is open, so 3 is not included.

The arrow points to the right, so x is greater than 3.

Answer: $x > 3$

Tip: Filled circle: the number **is** included ($\leq$ or $\geq$). Open circle: the number is **not** included ($<$ or $>$).

2 (2 marks)

Write down the inequality shown on this number line.



Filled circle at -1 , so -1 is included: $-1 \leq x$

Open circle at 4 , so 4 is not included: $x < 4$

Put them together, with x in the middle.

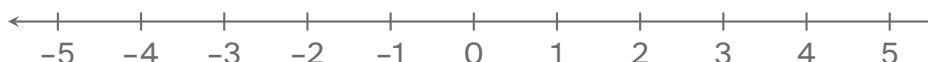
Answer: $-1 \leq x < 4$

Tip: Write one inequality with x in the middle, like $-1 \leq x < 4$. Do not write $-1 \leq 4$ or list the integers.

Marks: 2 marks for $-1 \leq x < 4$. 1 mark if one end is correct.

3 (2 marks)

On the number line below, show the inequality $-4 < t \leq 1$

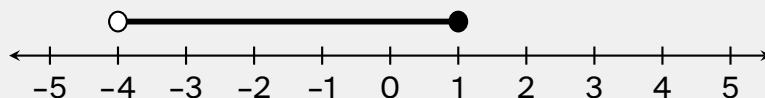


$-4 < t$: -4 is not included, so draw an open circle at -4 .

$t \leq 1$: 1 is included, so draw a filled circle at 1 .

Join the two circles with a line.

Answer:

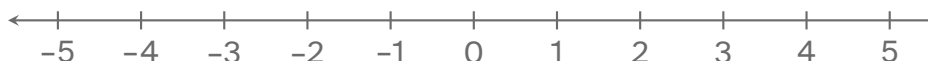


Tip: Use circles at the ends, not arrows or crosses, and join them with a line.

Marks: 2 marks for a fully correct diagram. 1 mark for one end correct, with a line.

4 (1 mark)

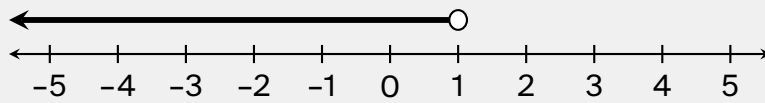
On the number line below, show the inequality $x < 1$



1 is not included, so draw an open circle at 1 .

x is less than 1, so draw an arrow to the left.

Answer:



5 (2 marks)

n is an integer.

$$-4 < n \leq 1$$

Write down every possible value of n .

$-4 < n$ uses $<$, so -4 is not included.

$n \leq 1$ uses $\leq$, so 1 is included.

So n can be $-3, -2, -1, 0$ or 1 .

Answer: $-3, -2, -1, 0, 1$

Tip: Remember that 0 is an integer. Check each end: $\leq$ includes the number, $<$ does not.

Marks: 2 marks for all five values and no others. 1 mark for four correct values and none wrong.

6 (2 marks)

(a) Write down the smallest integer that satisfies $x > -4$

$x > -4$, so -4 is not included.

The next integer bigger than -4 is -3 .

Answer: -3

(b) Write down the largest integer that satisfies $x < 2.5$

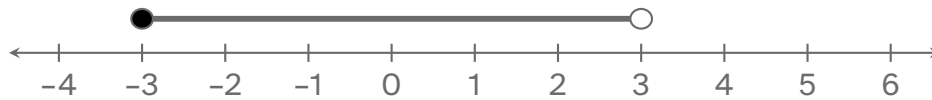
x must be less than 2.5.

The largest whole number below 2.5 is 2.

Answer: 2

7 (2 marks)

The number line shows the values of w that satisfy an inequality.



w is an integer.

Write down all the possible values of w .

Filled circle at -3 , so -3 is included.

Open circle at 3 , so 3 is not included.

The inequality is $-3 \leq w < 3$.

So w can be $-3, -2, -1, 0, 1$ or 2 .

Answer: $-3, -2, -1, 0, 1, 2$

Marks: 1 mark for $-3 \leq w < 3$ or at least four correct values. 1 mark for all six values and no others.

8 (1 mark)

Write down an inequality that has exactly three integer solutions: 4, 5 and 6

We need 4 and 6 included, but not 3 or 7.

Using $\leq$ at both ends: $4 \leq x \leq 6$

Using $<$ at both ends also works: $3 < x < 7$

Answer: e.g. $4 \leq x \leq 6$ (any correct inequality)

9 (2 marks)

x and y are integers.

$$1 \leq x < 4 \quad -2 < y \leq 1$$

Work out the greatest possible value of $x - y$

To make $x - y$ as big as possible, make x big and y small.

$x < 4$, so the largest integer x is 3.

$-2 < y$, so the smallest integer y is -1 .

$$x - y = 3 - (-1) = 3 + 1 = 4$$

Answer: 4

Tip: Using $x = 4$ or $y = -2$ is a common mistake. Those end values are not included, because the signs are $<$.

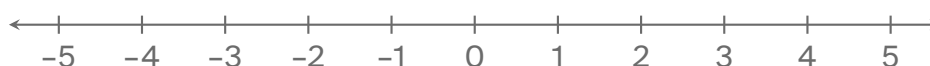
Marks: 1 mark for $x = 3$ and $y = -1$. 1 mark for 4.

10 (3 marks)

Here are two inequalities.

$$x > -2 \quad x \leq 3$$

- (a) On the number line below, show the set of values of x that satisfy **both** inequalities.

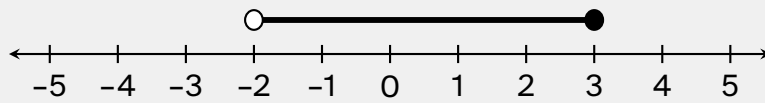


$x > -2$: -2 is not included, so draw an open circle at -2 .

$x \leq 3$: 3 is included, so draw a filled circle at 3 .

Both are true between -2 and 3 , so join the two circles with a line.

Answer:



Tip: Do not draw two separate arrows. Show only the part of the line where **both** inequalities are true.

Marks: 2 marks for a fully correct diagram. 1 mark for a line from -2 to 3 , or for an open circle at -2 , or a filled circle at 3 .

(b) How many integers satisfy both inequalities?

Together the inequalities give $-2 < x \leq 3$.

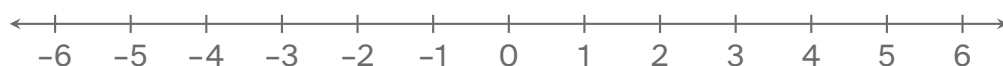
The integers are $-1, 0, 1, 2$ and 3 .

Answer: 5

11 (3 marks)

Solve $-5 < 2x + 1 \leq 7$

Show your solution on the number line below.



First solve the inequality.

Subtract 1 from all three parts: $-6 < 2x \leq 6$

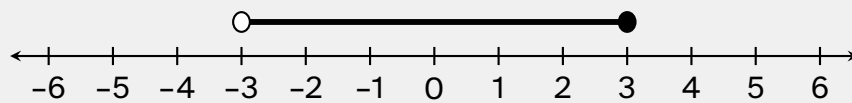
Divide all three parts by 2: $-3 < x \leq 3$

-3 is not included: draw an open circle at -3 .

3 is included: draw a filled circle at 3 .

Join the two circles with a line.

Answer:



Tip: Do not draw -5 to 7 straight from the question. Solve for x first, doing the same to **all three** parts.

Marks: 1 mark for $-3 < x \leq 3$. 1 mark for a line from -3 to 3 , or an open circle at -3 , or a filled circle at 3 . 1 mark for a fully correct diagram.

12 (4 marks)

Priya thinks of an integer, n .
She multiplies n by 3 and then adds 8.
Her answer is less than 30.

- (a) Work out the greatest possible value of n .

Write the information as an inequality: $3n + 8 < 30$

Subtract 8 from both sides: $3n < 22$

Divide both sides by 3: $n < 7\frac{1}{3}$

The greatest integer less than $7\frac{1}{3}$ is 7.

Answer: 7

Tip: Check your answer: $3 \times 7 + 8 = 29$, which is less than 30. But $3 \times 8 + 8 = 32$, which is too big.

Marks: 1 mark for $3n + 8 < 30$ or $3n < 22$. 1 mark for 7.

- (b) Priya's integer also satisfies the inequality $2n > 7$
Write down all the possible values of n .

Divide both sides of $2n > 7$ by 2: $n > 3.5$

From part (a), n is at most 7.

So n is an integer with $3.5 < n \leq 7$.

So n can be 4, 5, 6 or 7.

Answer: 4, 5, 6, 7

Tip: 3.5 is not an integer. The smallest integer greater than 3.5 is 4.

Marks: 1 mark for $n > 3.5$. 1 mark for all four values and no others.
