JUNIOR CYCLE MATHS · FREE REVISION SHEET

Inequalities

↗ Léim

Learning outcomes (2018 specification): AF.4, AF.7c, U.6. Play the game: **leim.ie/number-line-shade.html**

1. The four signs

<	>	≤	≥
less than	greater than	less than or equal to	greater than or equal to

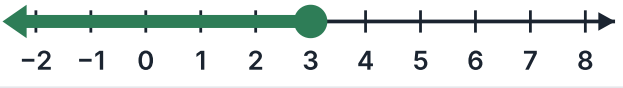
at least 5 → x ≥ 5 · **at most** 5 → x ≤ 5 · **more than** 5 → x > 5 · **under** 5 → x < 5

2. On a number line

x > 3: open dot (3 not included)



x ≤ 3: closed dot (3 included)



−1 ≤ x < 4: shade from dot to dot

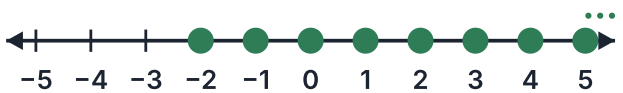


3. ℕ, ℤ or ℝ?

x < 4, x ∈ ℕ (1, 2, 3 …): dots only



x ≥ −2, x ∈ ℤ (negatives too): dots and …



x ≥ −2, x ∈ ℝ (every number): a shaded line



4. Solving

Just like an equation: do the same to both sides.

4x − 3 ≤ 2x + 9
2x − 3 ≤ 9 (subtract 2x) → 2x ≤ 12 (add 3) → **x ≤ 6** (÷ 2)

Check with a number from your answer: x = 0 → −3 ≤ 9 ✓

5. Whole-number answers

2x + 1 < 9, x ∈ ℕ → x < 4 → {1, 2, 3}. ℕ starts at 1.
2x + 3 > 8, x ∈ ℤ → x > 2.5 → smallest value 3.
−1 < x ≤ 3, x ∈ ℤ → {0, 1, 2, 3}: 4 values.

6. Real life and graphs

€4 + €2 per km, €15 to spend: 4 + 2k ≤ 15 → k ≤ 5.5 → **5 km**. Round **down** for a limit, **up** for a target. From a graph: find where the line crosses the level, then read which side is below or above.

7. Higher Level

5 − 2x > 11
−2x > 6 → divide by −2 and **FLIP**: x < −3

−1 < 2x + 3 ≤ 11
all three parts: −4 < 2x ≤ 8 → −2 < x ≤ 4

(x + 2)/3 ≥ 4
× 3: x + 2 ≥ 12 → x ≥ 10

Classic mistakes: open and closed dots mixed up · 0 in an ℕ answer · a shaded line when x ∈ ℤ · forgetting to flip when dividing by a negative · rounding the wrong way in a word problem.

Exam tip: one step per line. On a number line, check three things: the dot (open or closed), the direction, and dots or a shaded line.

PRACTICE · 34 QUESTIONS

Have a go

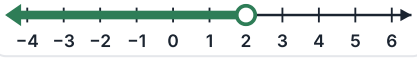
↗ Léim

A. Read and write

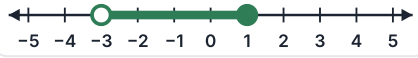
(1)



(2)



(3)



1. Write the inequality shown in picture (1). _____
2. Picture (2). _____
3. Picture (3). _____
4. Write as an inequality: x is at least 7. _____
5. Write as an inequality: x is at most −2. _____
6. Which of −3, 0, 2 and 5 make $x > 0$ true? _____

B. Solve, $x \in \mathbb{R}$

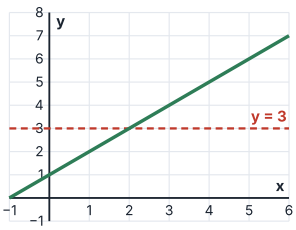
7. Solve $x + 5 < 9$, $x \in \mathbb{R}$. _____
8. Solve $x - 3 \geq -1$, $x \in \mathbb{R}$. _____
9. Solve $3x \leq 12$, $x \in \mathbb{R}$. _____
10. Solve $2x + 1 > 9$, $x \in \mathbb{R}$. _____
11. Solve $5x - 4 \geq 11$, $x \in \mathbb{R}$. Show it on a number line. _____
12. Solve $3x + 2 < x + 10$, $x \in \mathbb{R}$. _____
13. Solve $4(x - 1) \leq 12$, $x \in \mathbb{R}$. _____
14. Solve $7 + 2x > 1$, $x \in \mathbb{R}$. _____

C. Whole numbers

15. List the values: $3x - 1 < 11$, $x \in \mathbb{N}$. _____
16. List the values: $x + 4 \leq 7$, $x \in \mathbb{N}$. _____
17. List the values: $-2 \leq x < 2$, $x \in \mathbb{Z}$. _____
18. How many values? $-1 < x \leq 4$, $x \in \mathbb{Z}$. _____
19. Smallest value of x: $2x + 3 > 8$, $x \in \mathbb{Z}$. _____
20. Largest value of x: $3x - 2 \leq 12$, $x \in \mathbb{Z}$. _____
21. Smallest value of x: $4x + 1 \geq 2x + 8$, $x \in \mathbb{Z}$. _____
22. List the values: $5x < 2x + 13$, $x \in \mathbb{N}$. _____

D. Words, graphs and Higher Level

23. A taxi costs €3 plus €2 per km. You have €20. What is the greatest whole number of km you can go? _____
24. A lift can carry 500 kg. A worker weighs 75 kg. Boxes weigh 20 kg each. What is the greatest number of boxes the worker can bring? _____
25. Ella has €40 and saves €15 a week. She needs €200. What is the fewest number of weeks? _____
26. The graph shows $y = x + 1$ and the dashed line $y = 3$. For which values of x is $y < 3$? _____



27. Higher Level: solve $4 - 3x \geq 10$. _____
28. Higher Level: solve $-3 \leq 2x + 1 < 9$. _____
29. Higher Level: solve $(x - 1)/2 > 3$. _____
30. Higher Level: list the values: $-5 < 3x + 1 \leq 10$, $x \in \mathbb{Z}$. _____

Questions 31–34 are on the next page.

EXAM-STYLE · THEN CHECK

Exam corner + answers

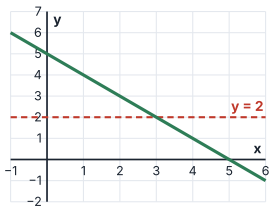
↗ Léim

E. Exam-style questions (show your work)

31. **Solve and show.** (a) Solve $3(x + 2) \leq x + 14$, $x \in \mathbb{R}$. (b) Show your answer on a number line. (c) List the values of x if $x \in \mathbb{N}$.

32. **The school bus.** A bus costs €120 to hire plus €8 for each student. The class has €400. (a) Write an inequality in s, the number of students. (b) What is the greatest number of students who can go?

33. **From a graph.** The graph shows $y = -x + 5$ and the dashed line $y = 2$. (a) Use the graph to find the values of x for which $y \geq 2$. (b) Check with algebra.



34. **Higher Level.** (a) Solve $2 - 5x < 17$. (b) List the values of x for which $-7 \leq 2x - 1 < 5$, $x \in \mathbb{Z}$, and show them on a number line.

Answers

A	1. $x \geq -1$ · 2. $x < 2$ · 3. $-3 < x \leq 1$ · 4. $x \geq 7$ · 5. $x \leq -2$ · 6. 2 and 5
B	7. $x < 4$ · 8. $x \geq 2$ · 9. $x \leq 4$ · 10. $x > 4$ · 11. $x \geq 3$ · 12. $x < 4$ · 13. $x \leq 4$ · 14. $x > -3$ (Q11: closed dot at 3, shaded right)
C	15. {1, 2, 3} · 16. {1, 2, 3} · 17. {−2, −1, 0, 1} · 18. 5 · 19. 3 · 20. 4 · 21. 4 · 22. {1, 2, 3, 4}
D	23. 8 · 24. 21 · 25. 11 · 26. $x < 2$ · 27. $x \leq -2$ · 28. $-2 \leq x < 4$ · 29. $x > 7$ · 30. {−1, 0, 1, 2, 3}
E	31. (a) $3x + 6 \leq x + 14 \rightarrow 2x \leq 8 \rightarrow$ **$x \leq 4$** (b) closed dot at 4, shaded left, arrow (c) **{1, 2, 3, 4}** · 32. (a) **$120 + 8s \leq 400$** (b) $8s \leq 280 \rightarrow s \leq 35$: **35 students** (exactly €400 is allowed) · 33. (a) the line meets $y = 2$ at $x = 3$ and is above it to the left: **$x \leq 3$** (b) $-x + 5 \geq 2 \rightarrow 3 \geq x$ ✓ · 34. (a) $-5x < 15 \rightarrow$ divide by −5, flip: **$x > -3$** (b) $-6 \leq 2x < 6 \rightarrow -3 \leq x < 3$: **{−3, −2, −1, 0, 1, 2}**, six dots

Got one wrong? Check: open or closed dot? Did ℕ start at 1? Did you flip the sign when you divided by a negative? Did you round the sensible way? Then play **Number-Line Shade** at leim.ie/number-line-shade.html: the "Go back over these" list at the end shows the rule for each mistake.

All questions written by Léim. Léim is independent and not connected with the State Examinations Commission or the NCCA.