COLLEGE ALGEBRA · STUDY GUIDE

Exam 1 Study Guide

This guide covers the first two chapters. You will sort numbers into their sets, name the properties that justify each step, work expressions in the right order and use the exponent rules. Then you will solve linear equations, rearrange formulas, translate word problems and solve inequalities. Work one chapter at a time. Read the "what to know" paragraphs, copy the tables out by hand, then try each worked example with the steps covered. Finish each chapter with its ten self-test items. The cram sheet at the end puts every rule in one place.

WHAT THIS GUIDE COVERS

- Chapter 1 · number sets, repeating decimals, the properties of real numbers, order of operations with signs, the exponent rules and scientific notation.
- Chapter 2 · solving linear equations, fractions and restrictions, identities and contradictions, literal equations, word problems, inequalities, compound and absolute value inequalities.

CHAPTER 1

Real Numbers and Exponents

Read it in full: **Chapter 1 in the textbook**. Practice it in the lab: **Where Does This Number Live?** and **The Five Exponent Rules**.

What to know

Numbers come in sets that sit inside one another. The **natural numbers** are the counting numbers 1, 2, 3 and on. Add 0 and you have the **whole numbers**. Add the negatives and you have the **integers**. Each new set keeps everything the old one had and adds the piece that was missing.

A **rational number** is any number you can write as a/b, where a and b are integers and b ≠ 0. Every integer is rational (7 = 7/1). Every terminating decimal is rational (0.25 = 1/4). Every

repeating decimal is rational too. In decimal form a rational number either stops or falls into a repeating block. There is no third option.

An **irrational number** has a decimal that never ends and never repeats: π, e, and roots such as √2 that do not come out evenly. Careful: √9 = 3 is rational. The rationals and irrationals together make the **real numbers**, every point on the number line. An even root of a negative, such as √(−4), is not a real number.

To turn a repeating decimal into a fraction, name it x, multiply by 10 raised to the length of the repeating block, and subtract the original. The endless tails cancel. Never decide rational or irrational from a calculator screen. A screen that shows 3.141592654 has simply run out of room.

The properties name the moves you are allowed to make. **Commutative** means order can change: a + b = b + a and ab = ba. **Associative** means grouping can change. Both apply to addition and multiplication only. Subtraction and division have neither. The **distributive** property, a(b + c) = ab + ac, expands when read left to right and factors when read right to left. The identities are 0 for addition and 1 for multiplication. The inverses are the opposite −a and the reciprocal 1/a, and 0 has no reciprocal.

Division by zero is undefined. Asking for 6 ÷ 0 asks what number times 0 gives 6, and nothing does. That is why every fraction carries a silent "denominator ≠ 0."

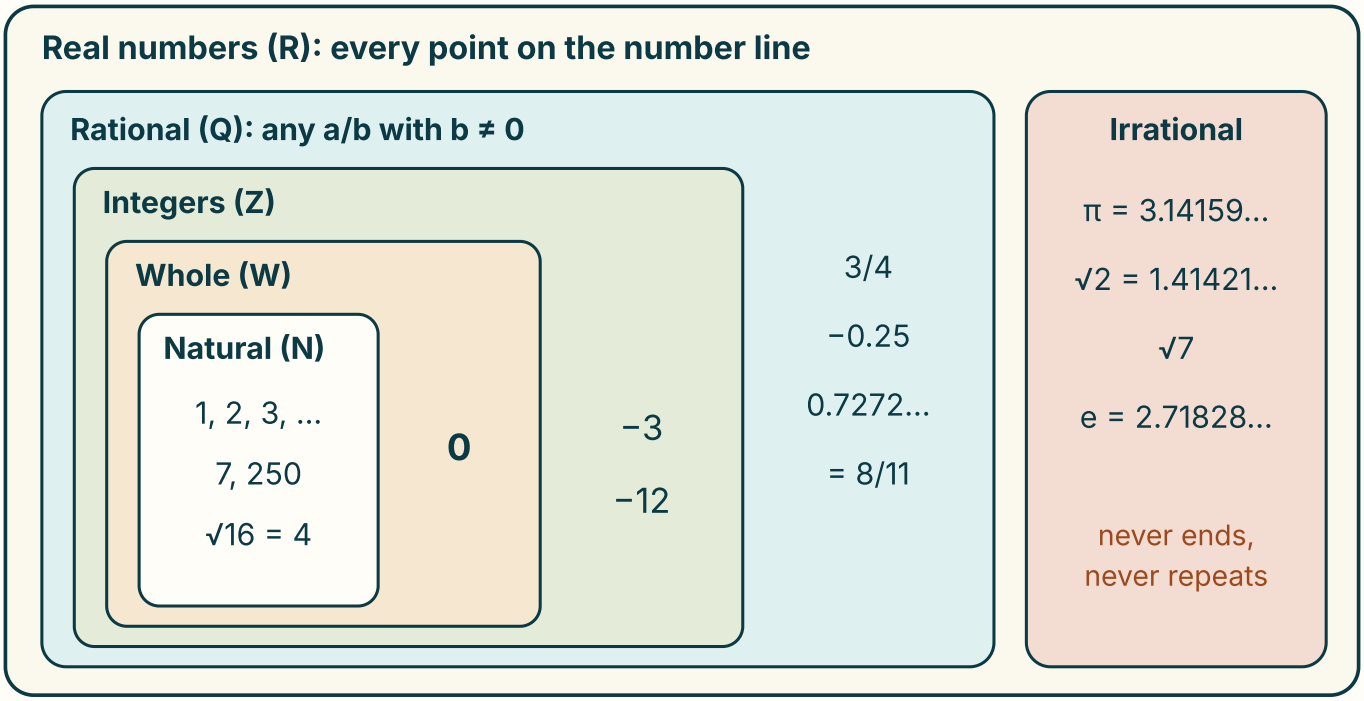
The **order of operations** has four levels: grouping, then exponents, then multiplication and division from left to right, then addition and subtraction from left to right. PEMDAS has four levels, not six, so 8 ÷ 2 × 4 = 16, not 1. Fraction bars, radicals and absolute value bars are hidden grouping symbols. In -3^2 the base is 3, so the value is −9. In $(-3)^2$ the base is −3, so the value is 9. Put every substituted negative in parentheses.

An exponent is repeated multiplication. Multiplying like bases adds exponents, dividing subtracts them, and a power of a power multiplies them. $a^0 = 1$ for $a \neq 0$, because $a^n \div a^n$ equals both 1 and a^0. A negative exponent moves a factor across the fraction bar: $a^{-n} = 1/a^n$. It never makes the value negative. Powers spread over products and quotients, never over sums: $(x + y)^2 \neq x^2 + y^2$.

Scientific notation writes a number as $a \times 10^n$ with $1 \le |a| < 10$ and n an integer. Big numbers get a positive exponent and numbers between 0 and 1 get a negative one. To multiply, multiply the decimals and add the exponents. To divide, divide and subtract. To add, first match the powers of ten. Then fix the form if the decimal part lands outside 1 to 10.

LOCK THESE IN

- Natural ⊂ whole ⊂ integer ⊂ rational ⊂ real. Irrationals fill the gaps.
- Rational means a/b with integers and $b \neq 0$; its decimal stops or repeats.
- Commutative and associative work for addition and multiplication only.
- Order: grouping, exponents, multiply and divide left to right, add and subtract left to right.
- $-a^2$ squares first, then negates. $(-a)^2$ squares the negative.
- Add exponents to multiply, subtract to divide, multiply for a power of a power.
- $a^0 = 1$ and $a^{-n} = 1/a^n$, both with $a \neq 0$.
- Scientific notation needs $1 \le |a| < 10$; match exponents before adding.



Each set holds every set drawn inside it. Not real: $\sqrt{(-4)}$.

Natural sits inside whole, inside integer, inside rational. Rationals and irrationals together fill the real line. A radical is irrational only when it does not come out evenly, so $\sqrt{16} = 4$ is a natural number.

Exponent rules and when to use them

Rule	Statement	Restriction	When to use it
Product	$a^m \cdot a^n = a^{m+n}$	Same base	Multiplying powers of one base: $x^4 \cdot x^6 = x^{10}$
Quotient	$a^m/a^n = a^{m-n}$	$a \neq 0$	Dividing powers of one base: $x^9/x^2 = x^7$
Power of a power	$(a^m)^n = a^{mn}$	$a \neq 0$ if an exponent is negative	A power raised again: $(x^3)^5 = x^{15}$
Power of a product	$(ab)^n = a^n b^n$	$a, b \neq 0$ if $n < 0$	An exponent outside parentheses: $(3x)^2 = 9x^2$
Power of a quotient	$(a/b)^n = a^n/b^n$	$b \neq 0$	A fraction raised to a power: $(x/2)^3 = x^3/8$
Zero exponent	$a^0 = 1$	$a \neq 0$; 0^0 is undefined	$(-5)^0 = 1$, but $-5^0 = -1$
Negative exponent	$a^{-n} = 1/a^n$	$a \neq 0$	Clearing negatives: $3^{-2} = 1/9$
Scientific notation	$a \times 10^n$, $1 \leq \lvert a \rvert < 10$	n an integer	Very large or very small numbers

The number sets

Set	Symbol	What is in it	Examples
Natural	N	1, 2, 3, ...	7, 250, √16
Whole	W	0, 1, 2, 3, ...	0, 19
Integer	Z	..., −2, −1, 0, 1, 2, ...	−12, 0, 45
Rational	Q	a/b with integers a, b and b ≠ 0	3/4, −0.25, 0.666...
Irrational	none	Decimals that never end and never repeat	π, √2, √10, e
Real	R	All rationals and irrationals	Every point on the line

Worked examples

WORKED EXAMPLE 1 · A REPEATING DECIMAL AS A FRACTION

Write 0.454545… as a fraction in lowest terms.

STEP 1 · NAME IT

Let x = 0.454545…

STEP 2 · SHIFT ONE BLOCK

The block "45" has two digits, so multiply by 100: 100x = 45.454545…

STEP 3 · SUBTRACT

100x − x = 45.4545… − 0.4545…, so 99x = 45. The endless tails cancel.

STEP 4 · SOLVE AND REDUCE

x = 45/99. Both divide by 9, so x = **5/11**.

CHECK IT

5 ÷ 11 = 0.4545…, the original decimal. Since 5 and 11 are integers, the number is rational.

WORKED EXAMPLE 2 · ORDER OF OPERATIONS WITH SIGNS

Evaluate $12 - 2(1 - 4)^2 \div 6 + (-3)$.

STEP 1 · INSIDE THE PARENTHESES

1 − 4 = −3, giving $12 - 2(-3)^2 \div 6 + (-3)$.

STEP 2 · EXPONENT

The base is −3 because of the parentheses: $(-3)^2 = 9$. Now $12 - 2 \cdot 9 \div 6 + (-3)$.

STEP 3 · MULTIPLY AND DIVIDE, LEFT TO RIGHT

2 · 9 = 18, then 18 ÷ 6 = 3. Now 12 − 3 + (−3).

STEP 4 · ADD AND SUBTRACT, LEFT TO RIGHT

12 − 3 = 9, then 9 + (−3) = **6**.

WHERE IT GOES WRONG

Squaring before the parentheses, or writing $-3^2 = 9$, changes the answer. The two sign steps are where the points are lost.

WORKED EXAMPLE 3 · SIMPLIFYING WITH NEGATIVE EXPONENTS

Simplify $(10a^4b^{-2})/(2a^{-1}b^3)$ with positive exponents only.

STEP 1 · STATE RESTRICTIONS

$a \neq 0$ and $b \neq 0$, since both sit in denominators.

STEP 2 · NUMBERS

$10 \div 2 = 5$.

STEP 3 · THE A FACTORS

Quotient rule: $4 - (-1) = 5$, giving a^5.

STEP 4 · THE B FACTORS

$-2 - 3 = -5$, giving b^{-5}.

STEP 5 · CLEAR THE NEGATIVE

$5a^5b^{-5} = \mathbf{5a^5/b^5}$.

CHECK WITH NUMBERS

Let $a = 1$ and $b = 2$. Original: $(10 \cdot 1 \cdot 1/4) \div (2 \cdot 1 \cdot 8) = 2.5 \div 16 = 0.15625$. Answer: $5 \div 32 = 0.15625$. They match.

WORKED EXAMPLE 4 · SCIENTIFIC NOTATION, THREE OPERATIONS

Find $(7.5 \times 10^{-4})(4.0 \times 10^9)$, then add $6.1 \times 10^5 + 4.0 \times 10^4$.

STEP 1 · MULTIPLY THE DECIMALS

$7.5 \times 4.0 = 30$.

STEP 2 · ADD THE EXPONENTS

$-4 + 9 = 5$, giving 30×10^5.

STEP 3 · FIX THE FORM

30 is not between 1 and 10. $30 = 3.0 \times 10^1$, so the product is $\mathbf{3.0 \times 10^6}$.

STEP 4 · MATCH EXPONENTS TO ADD

$4.0 \times 10^4 = 0.40 \times 10^5$. Now $(6.1 + 0.40) \times 10^5 = \mathbf{6.5 \times 10^5}$.

CHECK IT

$610{,}000 + 40{,}000 = 650{,}000 = 6.5 \times 10^5$.

TRAPS PEOPLE FALL INTO

- **Calling every radical irrational.** $\sqrt{16} = 4$ is a natural number. Only roots that do not come out evenly are irrational.
- **Doing multiplication before division because M comes first.** They share a level. Go left to right: $8 \div 2 \times 4 = 16$.
- **Treating -3^2 as 9.** The exponent attaches only to the 3, so $-3^2 = -9$.

- **Thinking a negative exponent makes a number negative.** $2^{-3} = 1/8$, a positive number.
- **Spreading a power over a sum.** $(3 + 4)^2 = 49$, not $9 + 16 = 25$.
- **Using commutative or associative on subtraction.** $(12 - 5) - 2 = 5$, but $12 - (5 - 2) = 9$.
- **Leaving 14.4×10^{-4} as an answer.** Proper form needs $1 \le |a| < 10$, so write 1.44×10^{-3}.
- **Adding decimals with different powers of ten.** Rewrite one term so both carry the same power first.

Chapter 1 self-test · ten items

1. Which list names every set that √25 belongs to?

A. Integer, rational and real, not natural

B. Irrational and real, nothing else

C. Natural, whole, integer, rational, real

D. Rational and real, but not integer

C. Natural, whole, integer, rational, real √25 = 5, a counting number, so it sits in every set from natural outward. A radical that comes out evenly is not irrational.

2. Write 0.181818… as a fraction in lowest terms.

A. 1/18

B. 2/11

C. 9/50

D. 18/100

B. 2/11 Let x = 0.1818…; 100x − x = 18, so x = 18/99 = 2/11. 18/100 is 0.18 exactly, which stops.

3. Name the property used in $(4 \cdot x) \cdot y = 4 \cdot (x \cdot y)$.

A. Associative property of multiplication
B. Commutative property of multiplication
C. Distributive property of multiplication
D. Multiplicative identity property

A. Associative property of multiplication Only the grouping changed, and the order stayed the same. That is the associative property.

4. Evaluate $18 - 12 \div 3 \times 2 + 2^3$.

A. 24
B. 6
C. 12
D. 18

D. 18 $2^3 = 8$. Then $12 \div 3 = 4$ and $4 \times 2 = 8$, left to right. Then $18 - 8 + 8 = 18$. Multiplying 3×2 first gives 24.

5. What is $-2^4 + (-2)^4$?

A. 16
B. 32
C. 0
D. −32

C. 0 $-2^4 = -16$ because the base is 2. $(-2)^4 = 16$. Their sum is 0.

6. Evaluate $b^2 - 4ac$ for $a = 1$, $b = -6$, $c = -7$.

A. 64

B. 8

C. −8

D. −64

A. 64 $(-6)^2 - 4(1)(-7) = 36 - (-28) = 36 + 28 = 64$.

7. Simplify $(3x^{-2}y^5)/(6x^4y^{-1})$ with positive exponents.

A. $2y^6/x^6$

B. $y^6/(2x^6)$

C. $y^6/(2x^2)$

D. $y^4/(2x^6)$

B. $y^6/(2x^6)$ 3/6 = 1/2. For x: −2 − 4 = −6. For y: 5 − (−1) = 6. So $y^6/(2x^6)$.

8. Write $(x^3)^4 \cdot x^{-5}$ as a single power of x.

A. x^{-60}

B. x^2

C. x^{17}

D. x^7

D. x^7 Power of a power: 3 · 4 = 12. Product rule: 12 + (−5) = 7.

9. Write $(4.0 \times 10^{-2})(6.0 \times 10^{5})$ in proper scientific notation.

A. 2.4×10^{4}

B. 2.4×10^{3}

C. 2.4×10^{-10}

D. 2.4×10^{2}

A. 2.4×10^{4} $4.0 \times 6.0 = 24$ and $-2 + 5 = 3$, giving 24×10^{3}. Rewrite 24 as 2.4×10^{1}: 2.4×10^{4}.

10. What is $-5^{0} + (-5)^{0}$?

A. -2

B. 2

C. 1

D. 0

D. 0 -5^{0} means $-(5^{0}) = -1$, while $(-5)^{0} = 1$. The sum is 0.

CHAPTER 2

Linear Equations and Inequalities

Read it in full: **Chapter 2 in the textbook**. Practice it in the lab: **Balance the Equation** and **Flip the Inequality**.

What to know

A **linear equation** in one variable has the variable only to the first power: no x^{2}, no $\sqrt{x}$, no x alone in a denominator. To solve it is to find every value that makes it true. That value is a **solution** (or root), and all of them together are the **solution set**.

You are not "moving things around." You do the same thing to both sides of a balance. Add, subtract, multiply by a nonzero number, or divide by a nonzero number. Each move gives an **equivalent equation** with the same solutions. The rhythm that always works: clear parentheses,

combine like terms, collect the variable on one side and the numbers on the other, divide, then check in the original.

Fractions are noisier, not harder. Multiply every term on both sides by the **least common denominator** (LCD) and the fractions disappear. Clear decimals with a power of ten. If the variable sits in a denominator, write the **restrictions** first. A value the algebra produces that breaks a restriction is an **extraneous solution** and must be thrown out.

A linear equation has one of three outcomes. A **conditional equation** ends with x = a number. An **identity** ends with a true statement like 4 = 4, so every real number works. A **contradiction** ends with a false statement like −15 = 1, so there is no solution, written ∅. Graph each side as a line: crossing lines give one solution, the same line twice gives all reals, and parallel lines give none. "x = 0" is never the way to write "no solution."

A **literal equation** is a formula with several letters. Solve it with the same moves. Undo in reverse order: strip addition and subtraction first, then multiplication and division. Undo a fraction by multiplying by its reciprocal. If the target letter appears twice, gather those terms, factor the letter out, and divide by the whole parenthesis, noting that the parenthesis cannot be zero.

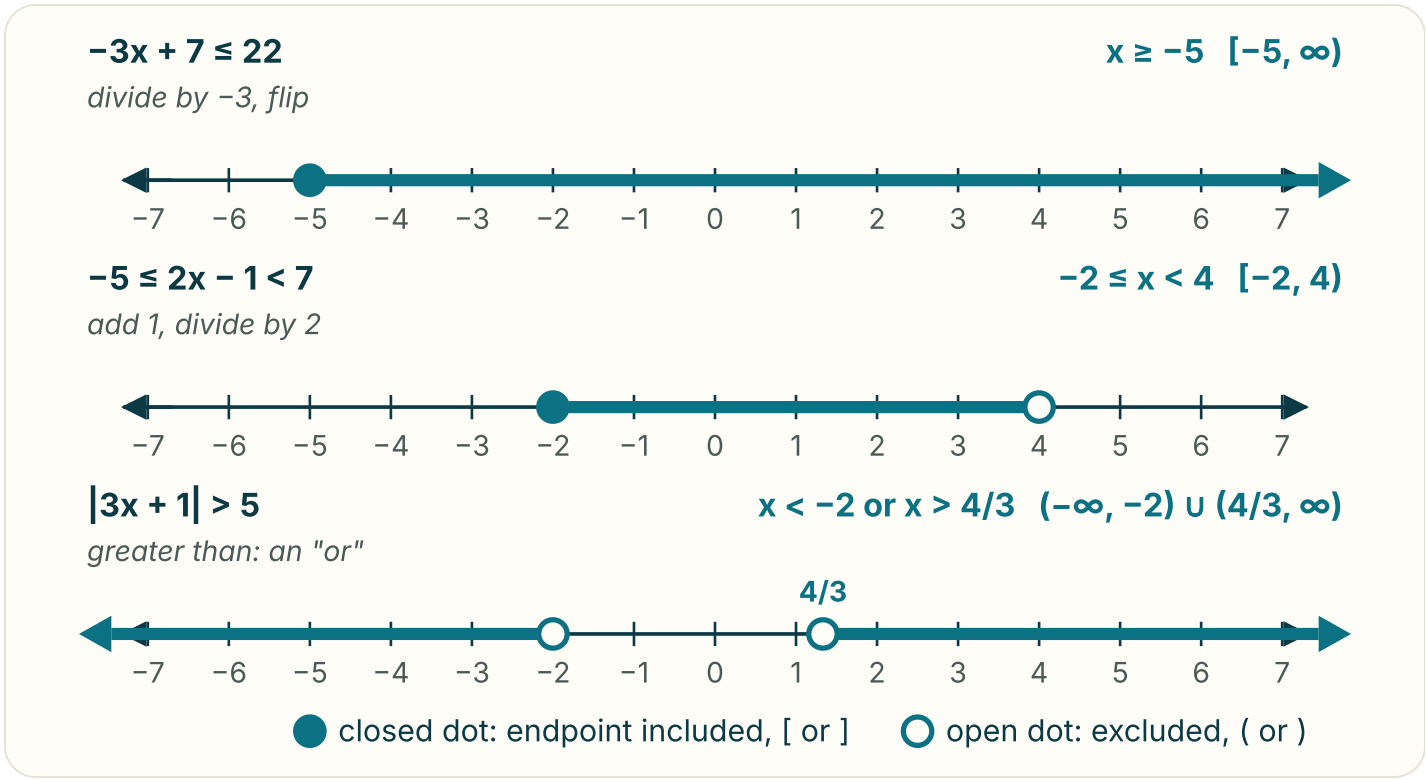
Word problems follow a fixed routine: read twice, define the variable with units, express any second unknown in terms of the first, translate phrase by phrase, solve, and answer the question asked. "Is" becomes =. "Of" means multiply. "7 less than a number" is x − 7, with the order reversed. Taking 15% off means keeping 85%, so the sale price is 0.85p.

An **inequality** is solved with the same moves, with one exception: when you multiply or divide both sides by a negative number, flip the symbol. Adding or subtracting a negative never flips it. Answers go in **interval notation**: a bracket includes an endpoint, a parenthesis excludes it, and ∞ always takes a parenthesis.

A compound "and" is the overlap, usually one middle interval. A compound "or" is the union, usually two outward rays. Absolute value is distance from zero, so $|u| < c$ becomes $-c < u < c$ (an "and"), and $|u| > c$ becomes $u < -c$ or $u > c$ (an "or"). Isolate the bars before you split. $|u| < -3$ has no solution, and $|u| > -3$ is true for every real number.

LOCK THESE IN

- Same legal move on both sides; never multiply or divide by zero.
- Clear fractions by multiplying every term by the LCD.
- List restrictions first when x is in a denominator; discard extraneous values.
- Variable cancels: true statement means all reals, false statement means ∅.
- Literal equations: undo in reverse order; factor out a variable that appears twice.
- Multiplying or dividing by a negative flips the inequality.
- Bracket includes, parenthesis excludes, ∞ always gets a parenthesis.
- |u| < c is an "and"; |u| > c is an "or"; isolate the bars first.



Solutions are stretches of the line. A closed dot matches a bracket and an open dot matches a parenthesis. "Less than" in absolute value gives one middle piece; "greater than" gives two outward rays.

Solving rules and when to use them

Situation	Rule or form	When to use it
Parentheses present	$a(b + c) = ab + ac$	First step of almost every equation
Fractions present	Multiply every term by the LCD	Any equation with numeric or variable denominators
Variable in a denominator	State $x \neq$ values first	Rational equations; check for extraneous answers
Variable cancels	True: $(-\infty, \infty)$. False: $\varnothing$	Identity or contradiction
Formula for one letter	Undo + and − first, then × and ÷	Literal equations such as $A = \frac{1}{2}bh$
Letter appears twice	$ax + b = cx + d$ gives $x = (d - b)/(a - c)$, $a \neq c$	Gather, factor, divide
Distance problems	$d = rt$	Opposite directions: add the distances
Percent off	Sale price $= (1 - \text{rate})p$	15% off means $0.85p$
Inequality times a negative	Reverse the symbol	Only multiplying or dividing by a negative
$\lvert u \rvert < c$, $c > 0$	$-c < u < c$	One middle interval
$\lvert u \rvert > c$, $c > 0$	$u < -c$ or $u > c$	Two outward rays

Interval notation

Inequality	Interval	On a number line
$x < a$	$(-\infty, a)$	Open dot at a, shaded left
$x \geq a$	$[a, \infty)$	Closed dot at a, shaded right
$a \leq x < b$	$[a, b)$	Closed at a, open at b
$x < a$ or $x > b$	$(-\infty, a) \cup (b, \infty)$	Two rays pointing outward
Every real number	$(-\infty, \infty)$	The whole line

Worked examples

WORKED EXAMPLE 1 · A LINEAR EQUATION WITH PARENTHESES

Solve $3(x + 4) - 5 = 5x - 9$.

STEP 1 · DISTRIBUTE

$3x + 12 - 5 = 5x - 9$.

STEP 2 · COMBINE LIKE TERMS

$3x + 7 = 5x - 9$.

STEP 3 · COLLECT THE VARIABLE

Subtract $3x$ from both sides: $7 = 2x - 9$.

STEP 4 · COLLECT THE NUMBERS

Add 9: $16 = 2x$.

STEP 5 · DIVIDE

$x = \mathbf{8}$.

CHECK IT

Left: $3(12) - 5 = 31$. Right: $5(8) - 9 = 31$. Both sides match.

WORKED EXAMPLE 2 · FRACTIONS CLEARED WITH THE LCD

Solve $x/2 - 1/3 = x/4 + 5/6$.

STEP 1 · FIND THE LCD

The LCD of 2, 3, 4 and 6 is 12.

STEP 2 · MULTIPLY EVERY TERM BY 12

$6x - 4 = 3x + 10$. No fractions remain.

STEP 3 · COLLECT

Subtract $3x$: $3x - 4 = 10$. Add 4: $3x = 14$.

STEP 4 · DIVIDE

$x =$ **14/3**, about 4.667.

CHECK IT

Left: $2.3333 - 0.3333 = 2.0000$. Right: $1.1667 + 0.8333 = 2.0000$. They match.

WORKED EXAMPLE 3 · AN EXTRANEOUS SOLUTION

Solve $x/(x + 2) = -2/(x + 2) + 3$.

STEP 1 · RESTRICTIONS FIRST

$x + 2 = 0$ when $x = -2$, so $x \neq -2$.

STEP 2 · MULTIPLY EVERY TERM BY (X + 2)

$x = -2 + 3(x + 2)$.

STEP 3 · SIMPLIFY

$x = -2 + 3x + 6 = 3x + 4$.

STEP 4 · SOLVE

Subtract $3x$: $-2x = 4$, so $x = -2$.

STEP 5 · TEST AGAINST THE RESTRICTION

$x = -2$ is excluded. It is extraneous, so the equation has **no solution**, ∅.

WORKED EXAMPLE 4 · AN ABSOLUTE VALUE INEQUALITY

Solve $|4x - 2| \leq 10$ and write the answer in interval notation.

STEP 1 · LESS THAN MEANS "AND"

$-10 \leq 4x - 2 \leq 10$.

STEP 2 · ADD 2 TO ALL THREE PARTS

$-8 \leq 4x \leq 12$.

STEP 3 · DIVIDE ALL THREE PARTS BY 4

Four is positive, so nothing flips: $-2 \leq x \leq 3$.

STEP 4 · INTERVAL

[−2, 3], brackets because ≤ includes the endpoints.

CHECK THE ENDPOINTS

x = 3: |12 − 2| = 10 ≤ 10, true. x = −2: |−8 − 2| = 10, true. x = 4 is outside: |14| = 14, false.

TRAPS PEOPLE FALL INTO

- **Writing "x = 0" for no solution.** Zero is a specific answer. A false last line means ∅.
- **Multiplying only some terms by the LCD.** Every term on both sides gets multiplied, including whole numbers.
- **Keeping an answer that a restriction forbids.** It is extraneous; check it against the denominators.
- **Writing W = P − L from P = 2L + 2W.** Divide the whole of P − 2L by 2: W = (P − 2L)/2.
- **Translating "7 less than x" as 7 − x.** "Less than" reverses the order: x − 7.
- **Flipping the symbol after subtracting a negative.** Only multiplying or dividing by a negative flips it.
- **Splitting |x − 1| before isolating it.** In 3|x − 1| + 4 < 19, subtract 4 and divide by 3 first.
- **Putting a bracket on ∞.** Infinity is a direction, so it always takes a parenthesis.

Chapter 2 self-test · ten items

1. Solve 6x + 5 = 2x − 11.

A. x = −2

B. x = 4

C. x = −4

D. x = −1.5

C. x = −4 Subtract 2x: 4x + 5 = −11. Subtract 5: 4x = −16. Divide by 4: x = −4.

2. Solve x/5 + 1/2 = x/2 − 1.

A. x = 5/3

B. x = 5

C. x = −5

D. x = 15

B. x = 5 Multiply every term by 10: 2x + 5 = 5x − 10. Then 15 = 3x, so x = 5.

3. What is the solution set of $3(2x - 4) = 6x - 12$?

A. Only the value $x = 0$
B. Only the value $x = 4$
C. No solution, $\varnothing$
D. All real numbers

D. All real numbers Distributing gives $6x - 12 = 6x - 12$. The variable cancels and leaves a true statement, so it is an identity.

4. What is the solution set of $4x + 7 = 2(2x + 3)$?

A. No solution, $\varnothing$
B. All real numbers
C. Only $x = 0$
D. Only $x = 1/2$

A. No solution, $\varnothing$ The right side is $4x + 6$. Subtracting $4x$ leaves $7 = 6$, which is false, so it is a contradiction.

5. Find x if $2/(x - 1) = 6/(x + 3)$.

A. $x = 1$
B. $x = 3/2$
C. $x = 3$
D. $x = -3$

C. x = 3 Restrictions: $x \neq 1, -3$. Cross multiply: $2(x + 3) = 6(x - 1)$, so $2x + 6 = 6x - 6$ and $x = 3$, which is allowed.

6. Solve V = (1/3)Bh for h.

A. h = 3B/V
B. h = V/(3B)
C. h = VB/3
D. h = 3V/B

D. h = 3V/B Multiply both sides by 3: 3V = Bh. Divide by B: h = 3V/B, with B ≠ 0.

7. One number is 5 less than three times another. Their sum is 31. What is the larger number?

A. 22
B. 26
C. 18
D. 9

A. 22 Let x be the smaller: x + (3x − 5) = 31, so 4x = 36 and x = 9. The larger is 3(9) − 5 = 22.

8. A freight train heading east at 40 mi/h and a passenger train heading west at 50 mi/h pull out of one station together. How many hours until 225 miles separate them?

A. After 9.0 hours
B. After 2.5 hours
C. After 5.6 hours
D. After 4.5 hours

B. After 2.5 hours Opposite directions add: 40t + 50t = 225, so 90t = 225 and t = 2.5 hours.

9. Solve $-2x - 5 \geq 7$.

A. $[-6, \infty)$

B. $(-\infty, -6)$

C. $[6, \infty)$

D. $(-\infty, -6]$

D. $(-\infty, -6]$ Add 5: $-2x \geq 12$. Divide by -2 and flip: $x \leq -6$. The endpoint is included, so it takes a bracket.

10. Which interval notation gives every x with $|x - 3| > 4$?

A. $(-\infty, 1) \cup (7, \infty)$

B. The middle interval $(-1, 7)$

C. $(-\infty, -1) \cup (7, \infty)$

D. $(-\infty, -7) \cup (1, \infty)$

C. $(-\infty, -1) \cup (7, \infty)$ Greater than gives an "or": $x - 3 < -4$ or $x - 3 > 4$, so $x < -1$ or $x > 7$.

ONE PAGE

Cram sheet

Everything from chapters 1 and 2 in one place. Cover the right column and see if you can rebuild each row.

Rules to know

Item	Rule	Note
Number sets	$N \subset W \subset Z \subset Q \subset R$	Irrationals: decimals that never end or repeat
Rational	a/b, integers, b ≠ 0	Decimal stops or repeats
Order of operations	Grouping, exponents, × ÷ left to right, + − left to right	Four levels, not six
Signs	$-3^2 = -9$; $(-3)^2 = 9$	Parenthesize substituted negatives
Properties	Commutative and associative: + and × only	Distributive expands and factors
Division by zero	Undefined	0 has no reciprocal
Equation outcomes	One value; all reals; ø	Conditional, identity, contradiction
Inequalities	Flip when multiplying or dividing by a negative	Never flip for adding or subtracting
Absolute value	$\|u\| < c$: and; $\|u\| > c$: or	$\|u\| <$ negative: ø; $\|u\| >$ negative: all reals

Formulas

Name	Formula	When to use it
Product rule	$a^m a^n = a^{m+n}$	Multiplying like bases
Quotient rule	$a^m / a^n = a^{m-n}$	Dividing like bases
Power rule	$(a^m)^n = a^{mn}$	A power of a power
Zero and negative	$a^0 = 1$; $a^{-n} = 1/a^n$	$a \neq 0$
Scientific notation	$a \times 10^n$, $1 \leq \lvert a \rvert < 10$	Multiply: add exponents; divide: subtract
Repeating decimal	$(10^k - 1)x$ = block, k = block length	0.4545… = 45/99 = 5/11
Variable twice	$x = (d - b)/(a - c)$	From $ax + b = cx + d$, $a \neq c$
Distance	$d = rt$	Travel problems
Temperature	$C = (5/9)(F - 32)$	From $F = (9/5)C + 32$
Simple interest	$I = Prt$; $A = P(1 + rt)$	Solve for r or t as needed

Steps that are not formulas

Topic	The rule
Solving rhythm	Distribute, combine, collect variables, collect numbers, divide, check.
Restrictions	Write $x \neq$ values before solving; discard extraneous answers.
Word problems	Define the variable with units, translate, solve, answer the question asked.
Interval notation	Bracket includes, parenthesis excludes, ∞ gets a parenthesis.
Absolute value	Isolate the bars first, then split.

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