Year 10 Mathematics Complete Study Guide

Complete study guide · Level 10 and 10A · AceGuides

This guide follows the **Victorian Curriculum F–10 Version 2.0 Mathematics** (VCAA), which is based on the Australian Curriculum Version 9.0 and is taught in Victorian schools from 2025. It covers every Level 10 content area across all six strands (Number, Algebra, Measurement, Space, Statistics and Probability), plus a clearly labelled optional **Level 10A extension** section for students planning to take VCE Mathematical Methods or Specialist Mathematics.

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About this guide

How to use it

Each topic section has the same layout: plain-English explanations with key terms in **bold**, fully worked examples, summary tables, exam tips, common mistakes, and a "Check your understanding" set of original practice questions. Full worked solutions to every question are in the Worked solutions section near the end, so you can check your method, not just your final answer.

- **First pass:** read a section, cover the worked examples and try them yourself, then compare.
- **Second pass:** do the "Check your understanding" questions without looking at the notes. Mark them using the worked solutions and redo anything you got wrong two days later.
- **Before a test:** read the One-page summary, then sit the practice exam under timed conditions.
- **Level 10A:** if your class does not cover 10A, you can skip that section. If you plan to do Methods or Specialist in Year 11, work through it: every topic in it appears again in VCE.

How Year 10 Mathematics is assessed

Year 10 Mathematics has no external exam. Your school sets its own assessment, so the exact

structure varies, but most Victorian schools use a mix of the following.

Task type	What it looks like	Typical conditions
Topic tests	Short and extended questions on one topic	50–70 minutes, often split into calculator-free and calculator-allowed parts
Analysis or modelling tasks	An extended problem (finance, modelling, statistics investigation) worked on over several lessons	Technology (CAS, spreadsheet) usually allowed
Semester exams	Questions from every topic studied in the semester	Often a technology-free section and a technology-active section
Homework and skills checks	Short regular quizzes	Usually low weighting

Many schools also use Year 10 results (and especially 10A results) to decide entry into VCE Mathematical Methods and Specialist Mathematics, so treat semester exams seriously.

Exam tip: Year 10 exams usually mirror VCE format: a technology-free section where exact answers and clear algebra are rewarded, and a technology-active section where you are expected to use a CAS or scientific calculator efficiently. Practise both styles.

Eight-week revision plan

Week	Focus	Tasks
1	Number and proportion; index laws	Section 1 notes and questions; redo index law errors
2	Algebra, equations and inequalities	Section 2; practise rearranging formulas daily
3	Linear relations and simultaneous equations	Section 3; draw every graph by hand once
4	Quadratics	Section 4; factorise ten quadratics a day

5	Exponentials, circles, algorithms and finance	Sections 5 and 6
6	Measurement, trigonometry and geometry	Sections 7, 8 and 9
7	Statistics and probability (and 10A if needed)	Sections 10, 11 (and 12)
8	Exam practice	Practice exam under time limits; review the One-page summary

Contents

1. Number, approximation and proportion
2. Algebraic expressions, equations and inequalities
3. Linear relations and simultaneous equations
4. Quadratic expressions, equations and graphs
5. Exponential functions, circles and algorithms
6. Financial mathematics: growth and decay
7. Measurement: surface area, volume and error
8. Pythagoras and trigonometry
9. Geometric reasoning: similarity, congruence and proof
10. Statistics
11. Probability
12. Level 10A extension (optional)
13. Exam technique
14. Practice exam
15. Worked solutions
16. Glossary
17. One-page summary

1. Number, approximation and proportion

Rational and irrational numbers

A **rational number** can be written as a fraction a/b where a and b are integers and b ≠ 0. Every terminating decimal (0.375 = 3/8) and every recurring decimal (0.333… = 1/3) is rational. An **irrational number** cannot be written as a fraction; its decimal goes on forever without repeating. Examples: √2, √5, π, and 0.101001000100001…

The **real numbers** are all the rational and irrational numbers together. Square roots of whole numbers that are not perfect squares (√2, √3, √10) are always irrational.

Worked example 1.1 – Recurring decimal to fraction

Write 0.363636… as a fraction in simplest form.

- Let x = 0.363636…
- Two digits repeat, so multiply by 100: 100x = 36.363636…
- Subtract: 100x − x = 36, so 99x = 36.
- x = 36/99 = 4/11.

Common mistake: multiplying by 10 when two digits repeat. Multiply by 10^n, where n is the number of repeating digits, so the repeating parts line up and cancel.

Approximations and repeated calculations

When you round an irrational number and then use the rounded value in further calculations, the rounding error can grow. This is why the curriculum asks you to recognise **the effect of approximations in repeated calculations**.

Worked example 1.2 – Error growth

Exactly, $(\sqrt{2})^{10} = 2^5 = 32$.

- Using √2 ≈ 1.41: $1.41^{10} \approx 31.06$, an error of about 0.94.
- Using √2 ≈ 1.4142: $1.4142^{10} \approx 31.997$, an error of about 0.003.

A small error in the starting value (less than 0.005) became an error of nearly 1 after ten multiplications. In practice: keep full calculator values (use the answer memory or exact surds) and round only at the end.

Exam tip: In multi-part questions, use the unrounded value from an earlier part, not the

rounded answer you wrote down. Examiners deduct a mark for premature rounding.

Index laws and scientific notation

Law	Rule	Example
Multiplication	$a^m \times a^n = a^{m+n}$	$x^3 \times x^4 = x^7$
Division	$a^m \div a^n = a^{m-n}$	$y^9 \div y^2 = y^7$
Power of a power	$(a^m)^n = a^{mn}$	$(p^2)^5 = p^{10}$
Power of a product	$(ab)^n = a^n b^n$	$(3x)^2 = 9x^2$
Zero index	$a^0 = 1$ $(a \neq 0)$	$7^0 = 1$
Negative index	$a^{-n} = 1/a^n$	$2^{-3} = 1/8$

Worked example 1.3 – Simplify with index laws

Simplify $(2x^3y^{-2})^3 \times 4x^{-1}y^5$, giving the answer with positive indices.

- Power of a product: $(2x^3y^{-2})^3 = 8x^9y^{-6}$.
- Multiply: $8 \times 4 = 32$; $x^9 \times x^{-1} = x^8$; $y^{-6} \times y^5 = y^{-1}$.
- Answer: $32x^8y^{-1} = 32x^8/y$.

Scientific notation writes a number as $a \times 10^n$ where $1 \leq a < 10$. For example, $0.000\,46 = 4.6 \times 10^{-4}$ and $5\,300\,000 = 5.3 \times 10^6$.

Worked example 1.4 – Calculating in scientific notation

$(3.2 \times 10^5) \times (4 \times 10^{-2}) = (3.2 \times 4) \times 10^{5 + (-2)} = 12.8 \times 10^3 = 1.28 \times 10^4$.

Common mistake: leaving 12.8×10^3 as the final answer. The number in front must be at least 1 and less than 10.

Logarithmic scales

Some quantities range over huge sizes: sound intensity, earthquake strength, acidity. A **logarithmic scale** goes up by equal steps when the quantity is multiplied by a fixed factor (usually 10). One step on a base-10 logarithmic scale means "10 times as much".

Scale	Measures	One unit up means

Decibels (dB)	Sound intensity	+10 dB = 10 times the intensity
Richter magnitude	Earthquake size	+1 = 10 times the ground-shaking amplitude (about 32 times the energy)
pH	Acidity	−1 pH = 10 times the hydrogen ion concentration

Worked example 1.5 – Comparing on a log scale

A leaf blower measures 90 dB and normal conversation measures 60 dB. How many times more intense is the leaf blower's sound?

- Difference = 90 − 60 = 30 dB = 3 lots of 10 dB.
- Intensity ratio = 10^3 = 1000. The leaf blower is 1000 times as intense.

Common mistake: saying pH 3 is "twice as acidic" as pH 6 or "3 times" as acidic. The difference of 3 units means 10^3 = 1000 times the hydrogen ion concentration.

Direct and inverse proportion

Two variables are in **direct proportion** if y = kx (doubling x doubles y). The graph is a straight line through the origin, and k is the **constant of proportionality**.

Two variables are in **inverse proportion** if y = k/x, which means xy = k is constant (doubling x halves y). The graph is a hyperbola.

Worked example 1.6 – Inverse proportion

A road trip of 240 km takes 3 hours at 80 km/h. How long does it take at 96 km/h?

- Time is inversely proportional to speed: t = k/v, and k = 3 × 80 = 240.
- At 96 km/h, t = 240 ÷ 96 = 2.5 hours.

Worked example 1.7 – Direct proportion

The cost C of fuel is directly proportional to the number of litres L. 45 L costs $85.50. Find the cost of 60 L.

- k = 85.50 ÷ 45 = 1.90, so C = 1.90L.
- C = 1.90 × 60 = $114.00.

Exam tip: To decide which type of proportion applies, ask: "If one quantity doubles, does the other double (direct) or halve (inverse)?" More workers on a job means fewer days, so that is inverse.

Check your understanding: Section 1

Q1.1 Classify each number as rational or irrational: $\sqrt{49}$, $\sqrt{20}$, 0.125, π, 2/7, 0.1010010001…

Q1.2 Write 0.272727… as a fraction in simplest form.

Q1.3 Simplify $(3a^2b^{-1})^2 \times 2a^{-3}b^4$, giving your answer with positive indices.

Q1.4 Evaluate $(6.4 \times 10^8) \div (1.6 \times 10^{-3})$, giving your answer in scientific notation.

Q1.5 $(\sqrt{3})^8 = 81$ exactly. Calculate 1.73^8 correct to two decimal places and find the percentage error caused by rounding $\sqrt{3}$ to 1.73.

Q1.6 (a) A concert measures 105 dB and a busy street 85 dB. How many times more intense is the concert? (b) An earthquake of magnitude 6.2 is compared with one of magnitude 4.2. How many times larger is the ground-shaking amplitude?

Q1.7 Twelve identical pumps can empty a pool in 15 hours. How long would 9 of these pumps take?

Q1.8 (a) y is directly proportional to x, and y = 42 when x = 6. Find y when x = 15. (b) y is inversely proportional to x, and y = 8 when x = 3. Find y when x = 4.

2. Algebraic expressions, equations and inequalities

Expanding binomial products

To **expand** means to remove brackets by multiplying every term in one bracket by every term in the other. For two binomials, use FOIL (First, Outer, Inner, Last) or a grid.

Identity	Expansion
Perfect square (sum)	$(a + b)^2 = a^2 + 2ab + b^2$
Perfect square (difference)	$(a - b)^2 = a^2 - 2ab + b^2$
Difference of two squares	$(a + b)(a - b) = a^2 - b^2$

Worked example 2.1 – Expanding

(a) $(2x - 3)(x + 5) = 2x^2 + 10x - 3x - 15 = 2x^2 + 7x - 15$

(b) $(3x - 2)^2 = (3x)^2 - 2(3x)(2) + 2^2 = 9x^2 - 12x + 4$

> **Common mistake:** writing $(3x - 2)^2 = 9x^2 + 4$. Squaring a bracket always produces a middle term. Write it out as $(3x - 2)(3x - 2)$ if you are unsure.

Factorising

To **factorise** is to write an expression as a product. Always look for the **highest common factor (HCF)** first.

Worked example 2.2 – Common factors and grouping

(a) $6x^2y - 9xy^2$: the HCF of the numbers is 3 and of the pronumerals is xy, so $6x^2y - 9xy^2 = 3xy(2x - 3y)$.

(b) $5(x - 2) + x(x - 2)$: the common factor is the whole bracket $(x - 2)$, giving $(x - 2)(5 + x)$.

(c) Grouping in pairs: $xy - 4x + 3y - 12 = x(y - 4) + 3(y - 4) = (y - 4)(x + 3)$.

> **Exam tip:** Check a factorisation by expanding it again. It takes ten seconds and catches sign errors.

Algebraic fractions

Algebraic fractions follow the same rules as number fractions: add and subtract using a **lowest common denominator (LCD)**; multiply numerators and denominators; divide by multiplying by the reciprocal; cancel only common **factors**.

Worked example 2.3 – Adding algebraic fractions

Simplify $(x + 1)/3 + (2x − 1)/4$.

- LCD = 12: $= 4(x + 1)/12 + 3(2x − 1)/12$
- $= (4x + 4 + 6x − 3)/12 = (10x + 1)/12$

Worked example 2.4 – Pronumeral in the denominator

$2/x + 3/(2x)$: LCD = 2x, so $= 4/(2x) + 3/(2x) = 7/(2x)$.

Common mistake: cancelling terms instead of factors. In $(x + 6)/6$ you cannot cancel the 6s, because 6 is not a factor of the whole numerator.

Solving linear equations

A **linear equation** has the variable to the power 1 only. Solve by doing the same operation to both sides until the variable is alone. With fractions, multiply every term by the LCD first.

Worked example 2.5 – Equation with fractions

Solve $(2x + 1)/3 − (x − 2)/5 = 2$.

- Multiply every term by 15: $5(2x + 1) − 3(x − 2) = 30$
- Expand: $10x + 5 − 3x + 6 = 30$
- Simplify: $7x + 11 = 30$, so $7x = 19$
- $x = 19/7$

Common mistake: in $5(2x + 1) − 3(x − 2)$, writing $−3x − 6$. The negative multiplies both terms: $−3 × −2 = +6$.

Substituting into and rearranging formulas

To **substitute**, replace each pronumeral with its value, using brackets around negatives. To **rearrange** (change the subject), undo the operations on the required variable in reverse order.

Worked example 2.6 – Rearranging

(a) Make a the subject of $v = u + at$: subtract u, then divide by t, so $a = (v − u)/t$.

(b) Make r the subject of $A = \pi r^2$ $(r > 0)$: $r^2 = A/\pi$, so $r = \sqrt{(A/\pi)}$.

(c) Make v the subject of $E = \frac{1}{2}mv^2$ ($v > 0$): $v^2 = 2E/m$, so $v = \sqrt{(2E/m)}$.

Worked example 2.7 – Substitution

Using $v = u + at$ with $u = 3$ m/s, $a = 2.5$ m/s^2 and $t = 4$ s: $v = 3 + 2.5 \times 4 = 13$ m/s.

Linear inequalities

An **inequality** uses <, >, ≤ or ≥. Solve it like an equation, with one extra rule: **when you multiply or divide both sides by a negative number, reverse the inequality sign**.

On a number line, use an open circle for < or > (end value not included) and a closed circle for ≤ or ≥ (included).

Worked example 2.8 – Solving an inequality

Solve $-3x + 4 \geq 13$.

- Subtract 4: $-3x \geq 9$
- Divide by −3 and reverse the sign: $x \leq -3$
- Number line: closed circle at −3, arrow pointing left.

Inequalities in two variables

An inequality such as $y > 2x - 1$ describes a **region** of the Cartesian plane.

- Draw the boundary line $y = 2x - 1$: **dashed** for < or > (points on the line are not included), **solid** for ≤ or ≥.
- Pick a test point not on the line, usually (0, 0). Here $0 > 2(0) - 1$ becomes $0 > -1$, which is true.
- Shade the side containing the test point (if it was false, shade the other side).

Worked example 2.9 – Modelling with inequalities

Phone plan A costs $30 per month plus $4 per GB. Plan B costs $50 per month plus $1.50 per GB. For how many GB is Plan A cheaper?

- $A < B$: $30 + 4g < 50 + 1.5g$
- $2.5g < 20$, so $g < 8$. Plan A is cheaper for usage under 8 GB per month.

> **Exam tip:** Always interpret an inequality answer in words, in the context of the question, and check that the answer makes sense (for example, g cannot be negative).

Check your understanding: Section 2

Q2.1 Expand and simplify: (a) $(x - 7)(x + 3)$ (b) $(4x + 1)(2x - 5)$ (c) $(2x - 3)^2$ (d) $(5 - x)(5 + x)$

Q2.2 Factorise: (a) $12a^2b + 18ab^2$ (b) $3x(x - 2) + 5(x - 2)$ (c) $ab + 2a + 5b + 10$

End of free sample

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