EXAM READY MATHEMATICS

Exam Ready Mathematics

GRADE 7

Study Guide, Worked Examples and Practice Tests for Grade 7



✓ 7 units with clear key ideas, worked examples and “Watch out!” boxes
✓ 105 worked examples and 168+ practice questions at three levels
✓ 140 unit-quiz questions and 3 full mock exams (60 MCQ each)
✓ Diagnostic test · Key Facts Sheet · Top 20 Mistakes · teacher notes

Follows the units and order of the Ethiopian Grade 7 Mathematics textbook

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Exam Ready Mathematics

Grade 7 · Study Guide, Worked Examples and Practice Tests

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This is an independent study guide. It follows the units and order of the Ethiopian Grade 7 Mathematics student textbook, but it is not published or endorsed by the Ministry of Education. All explanations, examples and questions are original. Keep your textbook and your teacher's notes beside this book.

The answers were calculated and checked before printing, but no book is free of errors. If you find a mistake or disagree with an answer, please tell the author on Telegram (@Ermias_Wedaje) and it will be reviewed for the next edition.

How to Use This Book

Each unit follows the same pattern, so you always know where to look.

Key ideas
The rules and facts of the section, short and clear.

Worked examples
Step-by-step solutions. Cover the solution and try first.

⚠ Watch out!
The mistakes students make most often, and the right way.

Practice
Level 1 Basic · Level 2 Standard · Level 3 Challenge.

Unit quiz
20 multiple-choice questions in the style of the national examination.

For the Teacher
Timing, starters, misconceptions, activities and assessment.

For students

- Begin with the Diagnostic Test. It shows which units need the most work.
- Read the key ideas, then study each example with the solution covered.
- Do Level 1 and Level 2 practice for every section; try Level 3 when you are ready.
- Take each quiz in 30 minutes, mark it, and redo every question you got wrong.
- In the last weeks, learn the Key Facts Sheet and the Top 20 Mistakes page, and sit the three mock exams. Their answer keys show which unit each question comes from.

For teachers

- Each unit follows the textbook sections, so the book can sit beside your lessons.
- The “For the Teacher” page gives timing, starters, misconceptions and activities.
- The quizzes and mock exams can be used as class tests; every answer has a short reason.

For parents

- Ask your child to explain one worked example to you each day. Teaching is the best way to learn.
- Look at the quiz score after each unit, and celebrate progress, not only high marks.

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Diagnostic Test · Where Should I Start?

16 questions · 15 minutes. Take this test before you start the book. There are two questions on each unit. Your score only shows you where to spend your time.

1. A set is a collection of

A. only letters
B. only numbers
C. any objects
D. well-defined objects

2. n({a, e, i, o, u}) =

A. 4
B. 26
C. 5
D. 6

3. The set of whole numbers is

A. {1, 2, 3, ...}
B. {..., −1, 0, 1, ...}
C. {0, 1, 2, 3, ...}
D. {−1, −2, ...}

4. The opposite of −12 is

A. −12
B. 1/12
C. 12
D. 0

5. A variable is

A. always 0
B. a fixed number only
C. a letter that represents a number
D. a sign

6. Simplify 5x + 3x − 2x.

A. $6x^2$
B. 6x
C. 6
D. 10x

7. A ratio compares

A. only prices
B. different units freely
C. only angles
D. quantities of the same kind

8. Solve 3/5 = x/20.

A. x = 15
B. x = 12
C. x = 4
D. x = 33

9. The angles of a triangle add up to

A. 360°
B. 270°
C. 90°
D. 180°

10. A trapezium has

A. four right angles
B. two pairs of parallel sides
C. one pair of parallel sides
D. no parallel sides

11. Congruent figures have the same

A. colour
B. size and shape
C. shape only
D. size only

12. If △ABC ≅ △XYZ, then ∠C =

A. ∠A
B. ∠Z
C. ∠X
D. ∠Y

13. A tally chart records

A. counts with strokes
B. only names
C. only prices
D. only angles

14. Frequencies 4, 7, 5, 4 total

A. 22
B. 20
C. 19
D. 16

Unit 1 · Basic Concepts of Sets

By the end of this unit you will be able to:

- describe sets and write them using braces
- identify equal, equivalent, empty, subset and proper subset relations
- find the union and intersection of sets and use Venn diagrams

Before you start — check yourself. (a) Is {a, b} equal to {b, a}? (b) How many elements has { }? (c) If A = {1, 2}, B = {2, 3}, find A ∩ B.
Answers: (a) yes (b) none (c) {2}

Key words: set · element · empty set · equal sets · equivalent sets · subset · union · intersection

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Sets and Their Elements
- Relations Among Sets
- Union and Intersection

1.1 Sets and Their Elements

Key ideas

- A **set** is a **collection of well-defined objects**. The objects are the **elements (members)**. We name sets with capital letters (A, B) and list elements inside **braces { }** separated by commas, e.g. A = {1, 2, 3}.
- ∈ means "is an element of" and ∉ means "is not an element of": 2 ∈ A, 5 ∉ A. The order of elements does not matter and **an element is not repeated**.
- **Two ways of describing a set:** listing (roster) A = {2, 4, 6, 8} and description (rule) A = {even numbers less than 10}.
- The **empty set** { } (or ∅) has no element. The number of elements of A is written n(A).

Example 1.1 — Notation

Write "the set of vowels in the English alphabet" by listing.

Solution. {a, e, i, o, u}.

Example 1.2 — Element

A = {2, 4, 6, 8}. True or false: 6 ∈ A and 5 ∈ A.

Solution. 6 ∈ A is true; 5 ∈ A is false (5 ∉ A).

Example 1.3 — Count

Find n(A) for A = {days of the week}.

Solution. n(A) = 7.

Example 1.4 — Exam Booster · Rule

Describe {1, 3, 5, 7, 9} by a rule.

Solution. Odd numbers less than 10.

Example 1.5 — Exam Booster · Empty

Is {0} the empty set?

Solution. No. {0} has one element, 0.

⚠ Watch out!

× Wrong	✓ Right
{1, 2, 2, 3} has 4 elements.	Repeats are not counted: {1, 2, 3} has 3 elements.
{0} is the empty set.	The empty set has no element at all.
A = {a, b}, so c ∈ A.	c ∉ A.

Practice 1.1

Level 1 — Basic

1. Write the set of even numbers less than 9.
2. n({a, e, i})?
3. Is 3 ∈ {1, 2, 3}?

Level 2 — Standard

4. List the months with 30 days.
5. Describe {10, 20, 30} by rule.
6. Write ø in braces.

Level 3 — Challenge

7. List the set of factors of 12 and find its number of elements.
8. Describe by a rule: {1, 4, 9, 16}.

1.2 Relations Among Sets

Key ideas

- **Equal sets** have exactly the same elements ({1, 2, 3} = {3, 2, 1}). **Equivalent sets** have the same **number** of elements, n(A) = n(B), but not necessarily the same elements ({a, b} ~ {1, 2}). **All equal sets are equivalent, but not all equivalent sets are equal.**
- **A is a subset of B (A ⊆ B)** if every element of A is also in B. **A is a proper subset (A ⊂ B)** if A ⊆ B and B has at least one more element. Every set is a subset of itself; the empty set is a subset of every set.
- **Number of subsets:** a set with n elements has $\mathbf{2^n}$ subsets (and $2^n - 1$ proper subsets).
- A **Venn diagram** shows sets as circles inside a rectangle (the universal set).

Example 1.6 — Equal

Are A = {1, 2, 3} and B = {3, 1, 2} equal?

Solution. Yes, same elements.

Example 1.7 — Equivalent

Are {a, b} and {5, 6} equal or equivalent?

Solution. Equivalent (both have 2 elements) but not equal.

Example 1.8 — Subsets

List all subsets of {x, y}.

Solution. { }, {x}, {y}, {x, y}: $2^2 = 4$ subsets.

Example 1.9 — Exam Booster · Number

How many subsets has {a, b, c}?

Solution. $2^3 = 8$.

Example 1.10 — Exam Booster · Proper

Is {1, 2} a proper subset of {1, 2}?

Solution. No. A set is not a proper subset of itself.

⚠ Watch out!

× Wrong	✓ Right
Equivalent sets are always equal.	Equal sets are equivalent, not the reverse.
The empty set is not a subset of {1, 2}.	∅ is a subset of every set.
{a, b} has 3 subsets.	{a, b} has 4 subsets.

Practice 1.2

Level 1 — Basic

1. Are {1,2} and {2,1} equal?
2. Subsets of {a}?
3. Is every set a subset of itself?

Level 2 — Standard

4. Number of subsets of a 4-element set?
5. Proper subsets of {x, y}?
6. Name two equivalent sets.

Level 3 — Challenge

7. List all proper subsets of {1, 2, 3}.
8. Explain equal vs equivalent.

1.3 Union and Intersection

Key ideas

- The **union A ∪ B** is the set of all elements that belong to **A or B or both**. The **intersection A ∩ B** is the set of elements that belong to **both** A and B.
- **Example:** A = {1, 2, 3, 4}, B = {3, 4, 5}. A ∪ B = {1, 2, 3, 4, 5}; A ∩ B = {3, 4}. If A ∩ B = { }, the sets are **disjoint**.
- **Rules:** if A ⊆ B then A ∩ B = A and A ∪ B = B. Also A ∪ A = A and A ∩ A = A.
- **Counting:** n(A ∪ B) = n(A) + n(B) − n(A ∩ B).

Example 1.11 — Union

A = {1, 2, 3}, B = {3, 4}. Find A ∪ B.

Solution. {1, 2, 3, 4}.

Example 1.12 — Intersection

Same sets: find A ∩ B.

Solution. {3}.

Unit 2 · Integers

By the end of this unit you will be able to:

- describe natural numbers, whole numbers and integers and compare them on the number line
- add, subtract, multiply and divide integers
- identify even and odd integers

Before you start — check yourself. (a) Which is smaller, −5 or −2? (b) Find (−3) + 7. (c) Find (−4) × (−2).
Answers: (a) −5 (b) 4 (c) 8

Key words: natural number · whole number · integer · number line · opposite · successor · predecessor · even number

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Integers and Ordering
- Addition and Subtraction of Integers
- Multiplication, Division, Even and Odd

2.1 Integers and Ordering

Key ideas

- **Natural numbers** N = {1, 2, 3, ...}; **whole numbers** W = {0, 1, 2, ...}; **integers** Z = {..., −2, −1, 0, 1, 2, ...}. So N ⊂ W ⊂ Z.
- On the **number line**, numbers increase to the right. Every negative integer is less than every positive integer, and of two negatives the one **nearer to zero is greater** (−2 > −5).
- **Opposites** are the same distance from zero on opposite sides: the opposite of 7 is −7, of −3 is 3. The **successor** of n is n + 1, the **predecessor** is n − 1.
- **Absolute value** |a| is the distance from zero: |−6| = 6, |6| = 6.

Example 2.1 — Compare

Which is greater, −8 or −3?

Solution. −3 is greater (nearer to zero).

Example 2.2 — Order

Arrange from least to greatest: 3, −5, 0, −1.

Solution. −5, −1, 0, 3.

Key Facts Sheet

Learn these by heart. Cover the right-hand side and say each fact from memory.

Unit 1 · Sets

Equal: same elements ; equivalent: same number

n of subsets = 2^n ; proper = $2^n - 1$

A ∪ B = all ; A ∩ B = common

n(A ∪ B) = n(A) + n(B) − n(A ∩ B)

Unit 2 · Integers

Same signs add, keep sign ; different signs subtract

a − b = a + (−b)

(+)(+)=+ ; (−)(−)=+ ; (+)(−)=−

Even number of negatives → positive

Unit 3 · Linear equations

Like terms: same variable and exponent

Do the same to both sides

Brackets: expand all terms

(x, y): across first ; quadrants I II III IV

Unit 4 · Ratio and percentage

P = R × B ; % change = change ÷ original × 100

Profit % = profit ÷ CP × 100

SI = PRT ; CI: A = $P(1 + R)^n$

VAT 15% ; turnover tax 2%

Unit 5 · Perimeter and area

Triangle ½bh ; parallelogram bh ; trapezium ½(a+b)h

Rhombus and kite ½d_1d_2

Circle C = 2πr ; A = πr^2

Triangle 180° ; quadrilateral 360°

Unit 6 · Congruency

Same size and shape ≅

SSS ; SAS (included angle) ; ASA (included side)

AAA and SSA are not tests

Corresponding parts are equal

Unit 7 · Data handling

Mean = sum ÷ number ; mode = most often

Median = middle of ordered data

Range = highest − lowest

Pie angle = f ÷ total × 360°

Mock Examination 1

60 multiple-choice questions · 90 minutes · one mark each. Circle one answer. Mark with the answer key at the back and use the unit number to see where to revise.

1. A set is a collection of

A. only letters
B. only numbers
C. any objects
D. well-defined objects

2. The symbol ∈ means

A. is an element of
B. is not an element of
C. union
D. is a subset of

3. The empty set has

A. one element
B. two elements
C. infinite elements
D. no element

4. n({a, e, i, o, u}) =

A. 4 B. 26 C. 5 D. 6

5. {1, 2, 2, 3} has how many different elements?

A. 4 B. 3 C. 5 D. 2

6. Which is the empty set?

A. {0} B. {1} C. { } D. {ø, 0}

7. {1, 2, 3} and {3, 2, 1} are

A. empty B. disjoint C. unequal D. equal

8. {a, b} and {5, 6} are

A. disjoint only
B. subsets
C. equal
D. equivalent but not equal

9. Equal sets are always

A. equivalent B. disjoint C. unequal D. empty

10. The set of whole numbers is

A. {1, 2, 3, ...}
B. {..., −1, 0, 1, ...}
C. {0, 1, 2, 3, ...}
D. {−1, −2, ...}

11. The set of integers is

A. {1, 2, 3, ...}
B. {−1, 0, 1}
C. {0, 1, 2, ...}
D. {..., −2, −1, 0, 1, 2, ...}

12. Which is greater?

A. −2 B. −100 C. −9 D. −5

13. The opposite of −12 is

A. −12 B. 1/12 C. 12 D. 0

14. The successor of −4 is

A. 4 B. −5 C. −4 D. −3