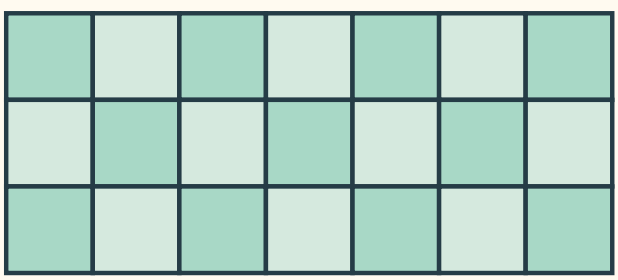
MATHS FIELD GUIDE · GRADE 5

# Symbols describe unknown and changing quantities

OPENING PROBLEM

## Split this 3 by 7 array after five columns. What equality appears?



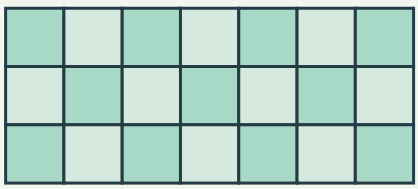
02 Split a rectangle to see the distributive law
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ILLUSTRATED PROBLEM SHEET

# Split a rectangle to see the distributive law

One common height multiplies every piece of the width.

1



### Split this 3 by 7 array after five columns. What equality appears?

$3 \times 7 = 3 \times 5 + 3 \times 2$. The two pieces cover exactly the original rectangle.

2

$$4(x + 3)$$
$$\downarrow$$
$$4x + 4 \times 3$$
$$\downarrow$$
$$4x + 12$$

### Which term is often missed?

The 3 is also multiplied by 4. At $x = 2$ both sides give 20.

3

$$5x + 15$$
$$\downarrow$$
$$5(x + 3)$$

### Can you reverse the split?

Both terms contain 5. Dividing each by 5 leaves x and 3 inside the bracket.

4

$$-2(x - 4)$$
$$\downarrow$$
$$-2x + 8$$

### Why is the constant positive?

It comes from multiplying two negative factors. Test $x = 0$: both sides give 8.

**$2(x + y)$**
**$2x + 2y$.**

**$2x + y$**
**only x has coefficient 2.**

CHAPTER PROBLEM

### Find $3b + 2$ when $b = 4$.

Fourteen. Three groups of four plus two gives fourteen.

MATHS REFERENCE · GRADE 5

# Symbols describe unknown and changing quantities

Algebra uses symbols to describe numerical relationships.

A variable can represent a changing quantity. In a particular problem, a symbol may represent an unknown value.

## Cases to recognise

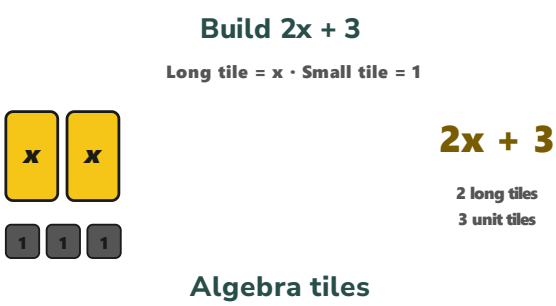
| Situation | What to do and why |
|---|---|
| **A box contains n beads and two are added** | n + 2 describes its count for every starting value. |
| **A pair of boxes each holds n + 2** | 2(n + 2) = 2n + 4 because both get two extras. |

## Read the model

### Define what the letter means

Each identical bag has x counters. Two bags and three loose counters hold 2x + 3 counters.

2x means 2 × x. Here x is the number in one bag, not the name of the bag.




### Match the symbol to the model

Each x-tile represents one bag's counter amount. The two x-tiles represent two identical bags.

The three unit tiles represent three loose counters. They are single counters, not three more bags.

**variable** A symbol for a quantity that can vary.
**expression** A description of a quantity.
**equation** A statement that two quantities are equal.
**substitution** Replace a symbol with its value.

x + 7 = 19
↓
x = 19 − 7
↓
x = 12

### Which change keeps both sides balanced?

Subtract seven from each side. Substitution gives 12 + 7 = 19.

WORKED INVESTIGATION

# Hiring a bicycle

A bicycle shop charges ₹30 to unlock a bike and ₹12 per hour. For h whole hours the cost in rupees is 30 + 12h.

| Look at this part | What it tells you |
|---|---|
| **1 hour** | ₹42 |
| **3 hours** | ₹66 |
| **5 hours** | ₹90 |

### Work it through

For a bill of ₹78, remove the fixed ₹30. The remaining ₹48 pays for four hours because 48 ÷ 12 = 4.

### Catch the mistake

The expression 42h would charge the unlock fee again in each hour. It agrees for one hour but fails for three.

## Compare the cases

### Use a known value

If each bag has four counters, x = 4.

Then 2x + 3 = 2 × 4 + 3 = 11.

Substitution means replacing the symbol with its value.

### Notice a changing rule

One more counter in every bag adds two counters to the total of two bags.

For x = 5, the total is thirteen. The expression describes every allowed bag size, not just one example.

**x = 3: 9** **x = 4: 11** **x = 5: 13**

### Change one condition

A second shop charges ₹18 to unlock and ₹15 per hour. Four hours cost ₹78 at either shop.

**3x − 4 = 14**
↓
**3x = 18**
↓
**x = 6**

### Which step undoes multiplication?

Dividing both sides by three. Check: 18 − 4 = 14.

SYMBOLS DESCRIBE UNKNOWN AND CHANGING QUANTITIES

# Compare the models

### Expression or equation?

2x + 3 is an expression. It names a quantity.

2x + 3 = 11 is an equation: it states that two quantities have the same value.

### A simple unknown is not a guess

For ☐ + 6 = 14, subtract six to find the missing amount: eight.

Check by substitution: 8 + 6 = 14. This is the inverse idea you already know.

### Write the intended grouping

Three more than twice a number is 2x + 3.

Twice the amount “a number plus three” is 2(x + 3). These descriptions are different.

### Keep the scope clear

We are describing quantities, substituting and using familiar missing-number relationships.

General multi-step symbolic equation methods are not introduced in this core chapter.

## Explain your reasoning

**Each box has b blocks. Write the total in three boxes and two loose blocks.**

3b + 2. b is the number of blocks in each identical box.

## Two more worked cases

| Situation | Reasoning |
|---|---|
| **When n = 5, compare 2n + 1 and 2(n + 1)** | Their values are eleven and twelve. |
| **Solve 3n + 4 = 25** | Subtract four, then divide by three: n = 7. |

$$2(x + 3) = 2x + 6$$
$$\downarrow$$
$$2x + 6 = 2x + 6$$
$$\downarrow$$
$$0 = 0$$

### What does this final equality mean?

Every allowed x satisfies the original equation.

ILLUSTRATED PROBLEM SHEET

# Track the jump and the starting point

A position counts terms. From the first to the nth term there are n − 1 gaps.

**1**

3 7 11 15 ?

### What is the next term if the rule is add four?

Nineteen. Each gap is four.

**2**

| Position | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Term | 3 | 7 | 11 | 15 |

### How do you reach term 4 straight from term 1?

Start at 3 and add three jumps of 4. The result is 15.

**3**

22 17 12 7 ?

### Can the jump be negative?

Yes. Subtract five each time. The next term is 2.

**4**

| Input | 1 | 2 | 3 |
|---|---|---|---|
| Output | 3 | 5 | 7 |

### Which rule doubles then adds one?

Output = 2 × input + 1. Input 6 gives 13.

**Rule “add six”, start two**
**term four is 20.**

**Rule “multiply by six”, start two**
**term four is 432.**

CHAPTER PROBLEM

### How is 3b + 2 different from 3b + 2 = 14?

The first names a quantity. The second states that the quantity has value fourteen.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

# Check your reasoning

| Try the problem | Solution and reasoning |
|---|---|
| **01**<br>Is 3a + 2b always 5ab? | No. With a = b = 2 the two sides are 10 and 20. Unlike terms cannot be merged that way. |
| **02**<br>Do the first two numbers 2, 4 fix the whole sequence? | No. Adding two gives 6 next. Doubling gives 8 next. A rule is needed. |
| **03**<br>A bill at the first shop is ₹114. How many hours were charged? | Remove the fixed fee: 114 − 30 = 84. Seven groups of ₹12 make ₹84, so the hire lasted seven hours. |
| **04**<br>If 2a + 7 = 25, what is a? | Subtract seven to leave 18. Divide by two to get nine. |
| **05**<br>A row has n desks, each with two books. Three books are borrowed. Write the new count. | Two per desk gives 2n. Remove three once to get 2n − 3. |

$$2(x + 3) = 2x + 7$$
$$\downarrow$$
$$6 = 7$$

**What if the variable disappears into a false statement?**

There is no solution. Subtracting the same 2x did not lose one.

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