MATHS FIELD GUIDE · GRADE 8

Functions connect inputs, tables and graphs

OPENING PROBLEM

What stays constant?

x	−1	0	1
y = 2x + 1	−1	1	3

02 Move between a rule, a table and a line
03 Rules and worked cases
04 Input and output at the pump
05 Track the jump and the starting point
06 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Move between a rule, a table and a line

For y = mx + b, b sets the vertical intercept and m is the change in y per unit change in x.

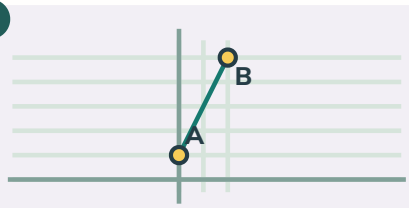
1

x	−1	0	1
y = 2x + 1	−1	1	3

What stays constant?

Each x-step of one raises y by two. The value at zero is one.

2



A (0, 1)
B (2, 5)

Find rise and run between the points.

Rise 4, run 2. Slope = 4/2 = 2.

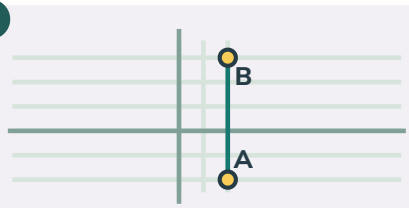
3

$$y = 3x - 2$$
$$\downarrow$$
$$10 = 3x - 2$$
$$\downarrow$$
$$x = 4$$

Which input produces output ten?

Undo subtraction, then divide by three. Check: 3 × 4 − 2 = 10.

4



A (2, -2)
B (2, 3)

Does this vertical line have slope zero?

No. Its run is zero, so rise divided by run is undefined. A horizontal line has slope zero.

y = 4
horizontal, slope zero.

x = 4
vertical, slope undefined.

CHAPTER PROBLEM

Why does y = 2x + 1 represent more points than (0,1), (1,3) and (2,5)?

Other allowed inputs, including non-integers in a real domain, also have outputs satisfying the rule.

MATHS REFERENCE · GRADE 8

Functions connect inputs, tables and graphs

A function assigns exactly one output to each permitted input. A rule, table and graph can represent that same relationship.

The domain states the allowed inputs. It may be whole-number counts, a measurement interval or another specified set.

Four cases to recognise

Situation	What to do and why
f(x) = 3 − 2x at x = −1	f(−1) = 3 + 2 = 5.
Input pairs (2,5) and (2,7)	One input has two outputs. The relation fails the function test.
Pairs (2,5) and (4,5)	Distinct inputs may share one output. These pairs can form a function.
A line rises 6 as x rises 2	Rate = 3 per x-unit. If it passes through (0,4), its rule is y = 3x + 4.

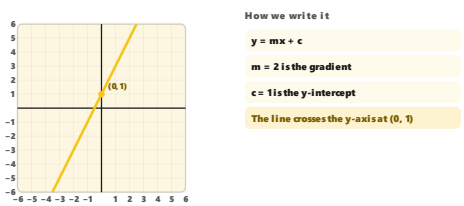
Read the model

Build the idea

For y = 2x + 1, inputs 0, 1, 2 give outputs 1, 3, 5. Plot the coordinate pairs (0,1), (1,3), (2,5).

If all real inputs are allowed, intermediate inputs also produce outputs. Input 0.5 gives output 2, so the graph contains (0.5,2).

y = mx + c



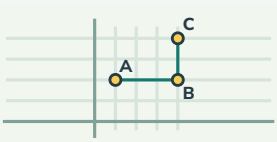
Gradient and intercept, read off the line

Why it works

Each unit increase of x adds two to y. That constant rate produces a straight line. The output at x = 0 is one, giving its y-intercept.

The graph consists of all permitted pairs satisfying the relationship, not only the few points used to draw it.

function A rule assigning one output to each permitted input.
domain The allowed inputs.
gradient Change in y per unit change in x.
intercept Where a graph crosses an axis.



A (1, 2)
B (4, 2)
C (4, 4)

Describe A to C via B.

Go three right, then two up. The total route length is five grid units.

WORKED INVESTIGATION

Input and output at the pump

An empty test tank already connected to a 3 L reservoir has a combined starting volume of 3 L. A pump adds 2 L per minute. While it runs, V = 3 + 2t.

Look at this part	What it tells you
0 minutes	3 L
2 minutes	7 L
5 minutes	13 L

Work it through

For a target of 19 L solve 19 = 3 + 2t. The pump needs eight minutes because it supplies only the additional 16 L.

Catch the mistake

The ratio V/t changes with t because the initial 3 L are already present. The constant rate is the change in volume divided by the change in time.

Compare the cases

Follow an example

A rule for two dollars per ticket plus a one-dollar booking fee is y = 2x + 1. For three tickets the total is seven dollars.

If x counts tickets, only non-negative whole-number inputs are appropriate. A connected line can help show the algebra, but does not make half a ticket purchasable.

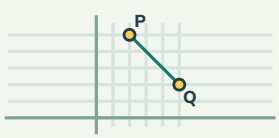
What changes? What stays true?

The line y = 2x + 1 is linear but is not direct proportion because it misses the origin.

A table supplies examples of a relationship. A rule and domain describe all permitted cases.

Change one condition

If the system holds at most 23 L and the pump stops when full, the linear rule applies only through ten minutes.



P (2, 5)
Q (5, 2)

Are the points the same if the coordinates swap?

No. Each has its horizontal and vertical distances exchanged.

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

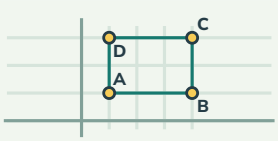
A function is given by f(x) = 3x − 2. Find f(−1) and the input that produces 10.

f(−1) = −3 − 2 = −5. For the second part solve 3x − 2 = 10, giving x = 4.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Can a rule give two different outputs for the very same input and still be a function?	No. Each allowed input has one output.
02 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 A volume of 15 L is recorded. How long since the pump started and how much will it hold two minutes later?	The pump supplied 12 L in six minutes. Two more minutes add 4 L for a total of 19 L.
04 For f(x) = x² − 1, can two inputs give output 8?	Yes. Both 3 and −3 have square nine. A function may share an output.
05 A tank loses 3 L/min from 24 L. For how long can V = 24 − 3t describe draining?	From t = 0 to 8 minutes inclusive. Beyond that it would predict negative water.



A (1, 1)
B (4, 1)
C (4, 3)
D (1, 3)

How can you recognise this rectangle?

Opposite sides have the same lengths. Horizontal and vertical neighbours meet at right angles.

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