Unit 4 · Relations and Functions Cheat Sheet

Unit 4 focus: relations, functions, domain and range, and function notation

1 KEY VOCABULARY

relation	Any set of ordered pairs (inputs and outputs).	$\{(1,3),(2,5)\}$
function	Each input has exactly ONE output.	$y = 2x + 1$
domain	All the inputs (x-values).	$\{1,2\}$
range	All the outputs (y-values).	$\{3,5\}$
independent	The input variable x.	hours worked
dependent	The output variable y.	money earned

2 IS IT A FUNCTION?

Form	Function when…
ordered pairs	no x-value repeats with a different y
mapping diagram	each input has only one arrow
table	no input is listed with two outputs
graph	it passes the **vertical line test**
equation	each x gives one y ($x = y^2$ is not)

✔ Outputs may repeat: $\{(1,5),(2,5)\}$ is a function.

3 DOMAIN & RANGE

Domain = inputs (x). Range = outputs (y). List each value once, in order.

Example: $\{(-2,4),(0,1),(3,4),(5,-1)\}$
Domain: $\{-2,0,3,5\}$
Range: $\{-1,1,4\}$
Answer: D $\{-2,0,3,5\}$**, R** $\{-1,1,4\}$

4 FUNCTION NOTATION

$f(x)$ is read "f of x" and means the output when the input is x. It does NOT mean f times x.

Example: $f(x) = 3x^2 - 1$. Find $f(-2)$.
Substitute: $3(-2)^2 - 1$
Simplify: $3(4) - 1 = 11$
Answer: $f(-2) = 11$

5 SOLVING F(X) = K

When the OUTPUT is given, set the rule equal to it and solve for x.

Example: $g(x) = 2x - 5$. When is $g(x) = 9$?
Set equal: $2x - 5 = 9$
Solve: $2x = 14,\ x = 7$
Answer: $x = 7$

6 QUICK REMINDERS & COMMON MISTAKES

✔ Do remember

- Domain → x, Range → y.
- Use parentheses when you substitute a negative.
- A vertical line hitting a graph twice means NOT a function.

✘ Common mistakes

- $f(3)$ is not $f \cdot 3$: it means "put 3 in for x"
- repeated outputs: are fine; repeated INPUTS with different outputs are not
- $f(x) = 9$: is solving, not evaluating

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More practice: rate of change, linear vs. nonlinear, sequences and reading graphs

1 RATE OF CHANGE

Rate of change = how much y changes for each 1 unit change in x.

Example: From $(2, 7)$ to $(6, 19)$:

Formula: $\frac{y_2 - y_1}{x_2 - x_1}$

Substitute: $\frac{19 - 7}{6 - 2} = \frac{12}{4}$

Answer: 3 **per unit**

2 LINEAR OR NONLINEAR?

Linear	Nonlinear
constant rate of change	rate of change varies
graph is a straight line	graph curves
$y = mx + b$	$y = x^2$, $y = 2^x$
x: 0, 1, 2 → y: 1, 4, 7 (+3)	x: 0, 1, 2 → y: 1, 2, 4 (×2)

3 ARITHMETIC SEQUENCES

Add the same number d (common difference) each time.

$a_n = a_1 + (n - 1)d$

Example: $4, 10, 16, 22, \ldots$: find a_{30}.

d: $10 - 4 = 6$

Rule: $a_n = 4 + (n - 1)6 = 6n - 2$

n = 30: $6(30) - 2 = 178$

Answer: 178

4 READING GRAPHS

- **Increasing**: the graph rises from left to right. **Decreasing**: it falls.
- **Constant**: a flat (horizontal) piece.
- **x-intercept**: where the graph crosses the x-axis (y = 0).
- **y-intercept**: where it crosses the y-axis (x = 0): the starting value.
- **Maximum / minimum**: the highest / lowest point.

5 FOUR WAYS TO SHOW A FUNCTION

Words	Equation	Table
Earn $8 per hour plus a $5 bonus.	$y = 8x + 5$	x: 0, 1, 2 y: 5, 13, 21

Graph: a line starting at $(0, 5)$ that rises 8 for every 1 to the right.

6 CHECK YOURSELF

- Did I use x for the domain and y for the range?
- Did I substitute with parentheses?
- Is the rate of change constant (linear) or not?
- Does my sequence rule give the first term when $n = 1$?