SETS, FUNCTIONS AND VARIABLES

Foundational Sessions Housekeeping

- The use of disrespectful language is prohibited in the questions, this is a supportive, learning environment for all - please engage accordingly. **(FBV: Mutual Respect.)**

- No question is daft or silly - **ask them!**

- There are **Q&A sessions** midway and at the end of the session, should you wish to ask any follow-up questions. Moderators are going to be answering questions as the session progresses as well.

- If you have any questions outside of this lecture, or that are not answered during this lecture, please do submit these for upcoming Open Classes. You can submit these questions here:

  SE Open Class Questions or **DS Open Class Questions**

Foundational Sessions Housekeeping cont.

- For all **non-academic questions**, please submit a query:
  www.hyperiondev.com/support

- Report a **safeguarding** incident:
  www.hyperiondev.com/safeguardreporting

- We would love your **feedback** on lectures: **Feedback on Lectures**

Reminders!

GLH requirements

Guided Learning Hours

By now, ideally you should have 7 GLHs per week accrued. Remember to attend any and all sessions for support, and to ensure you reach 112 GLHs by the close of your Skills Bootcamp.

Progression Criteria

✅ **Criterion 1: Initial Requirements**

- Complete 15 hours of Guided Learning Hours and the first four tasks within two weeks.

✅ **Criterion 2: Mid-Course Progress**

- Software Engineering: Finish 14 tasks by week 8.
- Data Science: Finish 13 tasks by week 8.

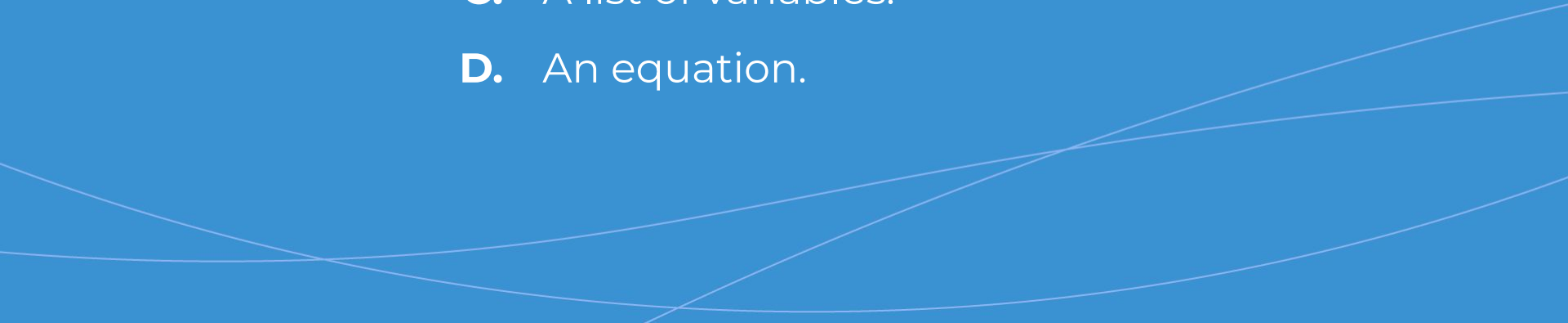✅ **Criterion 3: Post-Course Progress**

- Complete all mandatory tasks by 24th March 2024.
- Record an Invitation to Interview within 4 weeks of course completion, or by 30th March 2024.
- Achieve 112 GLH by 24th March 2024.

✅ **Criterion 4: Employability**

- Record a Final Job Outcome within 12 weeks of graduation, or by 23rd September 2024.
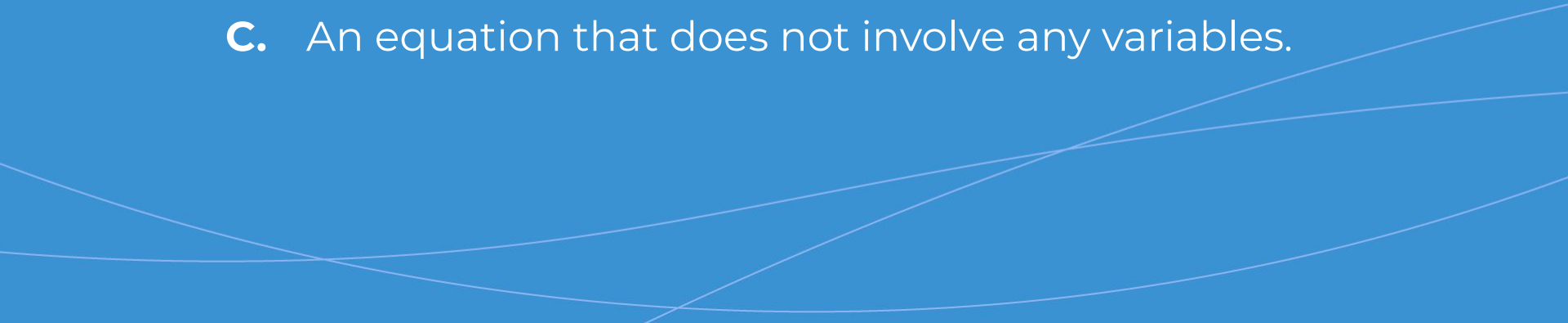
Which of the following best describes a set?

A. A sequence of numbers.

B. A collection of distinct objects.
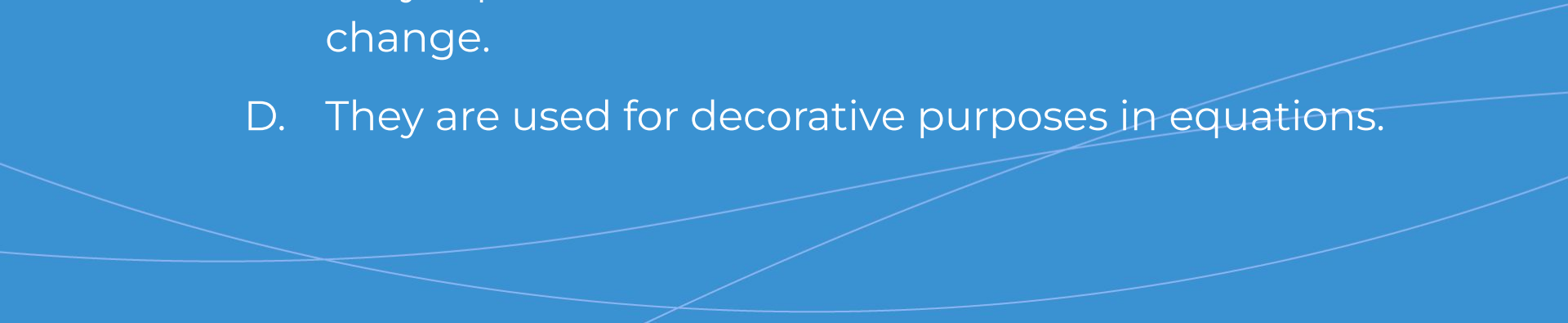
C. A list of variables.

D. An equation.

What defines a function in mathematics?

A. A relation that associates each element of a set with multiple elements of another set.

B. A collection of random variables.

C. An equation that does not involve any variables.

What role do variables play in mathematical equations?

A. They are used only as placeholders for numbers.

B. They represent constants that do not change.

C. They represent unknown values or values that can change.

D. They are used for decorative purposes in equations.

How can we model how much interest an individual would earn if they invest their money?

- How do we represent the relation between how long they invested their money for and how much interest they earned?

- How do we account for unknown or unspecified aspects in the problem like how long they are investing for and how much money they initially invested?

- How do we represent the multiple different interest values that we would calculate for each year?

Example: Compound Interest

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A is the future value of the investment
P is the initial amount invested
r is the annual interest rate
n is the number of times that interest is compounded per year
t is the number of years that the money is invested for

- A, P, r, n and t all represent values that are unspecified.

- If we replace **r**, **n** and **P** with known values, we can represent the relationship between future value of an investment and the number of years the money was invested.

VARIABLES

Symbols that represent values in mathematical expressions or algorithms.

- Symbols are usually letters like **x**, **y** or **z**, but they can be any symbol.

$$x = 3$$
$$y + 11 = 6z - 51$$
$$\sin(\theta) = 60°$$

- **Variables** are used in the place of an unspecified or **unknown value**.

1. Algebraic Expressions

- **Variables** can take on **any value**.

$$2(x + 4)$$

If $x = 3$:
$= 2(3 + 4)$
$= 2(7)$
$= 14$

2. Algebraic Equations

- **Variables are unknown** and we try to **solve the equation** to find them

$$13 + 5(y - 3) = 38$$

$5(y - 3) = 38 - 13$
$y - 3 = 25/5$
$y = 5 + 3$
$y = 8$

SETS

A collection of distinct, unordered objects also known as elements or members.

- Objects in a set can be anything from numbers to physical entities.

$$\{4, 8, 12, 16\}$$
$$\{dog, cat, rabbit, pig\}$$
$$\{1, 2, buckle, my, shoe\}$$

- A set can have any number of elements, from 0 to infinite elements.

$$\{\}$$
$$\{1, 2, 3, 4, \dots\}$$

1. Roster notation

- Denotes sets with as a **list of defined elements**.
- Elements are listed between **curly** brackets **{}** and separated by commas.
- Ellipses can be used to show when a pattern continues infinitely.
- General form:

$$\{a_1, a_2, a_3, a_4, a_5, a_6, \dots\}$$

2. Interval notation

- Denotes sets as intervals from a set upper bound to a set lower bound.
- **Circle** brackets **()** are used when a **bound is excluded** from the interval.
- **Square** brackets **[]** are used when a **bound is included** from the interval.
- **+∞** and **-∞** are used to denote **unbounded** intervals.

$$[1, 6] = \{1, 2, 3, 4, 5, 6\}$$
$$(5, 8) = \{6, 7\}$$
$$(-4, 0] = \{-3, -2, -1, 0\}$$
$$(-\infty, -100] = \{-100, -99, -98, \dots\}$$

FUNCTIONS

A relation between a set of inputs and a set of permissible outputs with the property that each input is related to at most one output.

- The **set** that makes up the **input of a function** is known as the **domain** and the **set** that makes up the **output of a function** is known as the **range**.

- The **standard notation** for a function is:

$$f : A \rightarrow B$$

  where **f** is the name of the function, **A** the domain and **B** the range.

- The **elements** in the domain of the function are referred to with the variable **x** and the corresponding element in the range is referred to with **y**. This relationship is denoted as:

$$f(x) = y$$

Univariate and Multivariate Functions

- Univariate functions relate one input to at most one output.

$$f(x) = y$$

- Multivariate functions relate multiple inputs to at most one output.

$$f(x, y) = z$$

Function Representations

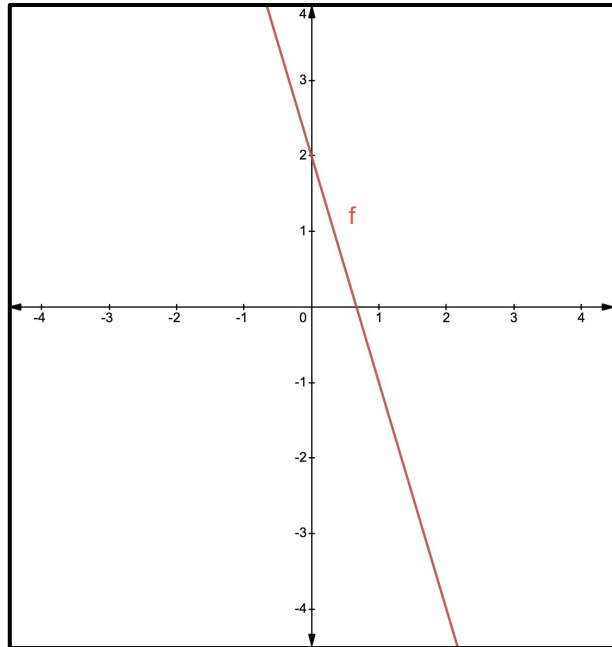- Functions can be represented as an algebraic equation using variables to refer to the input.
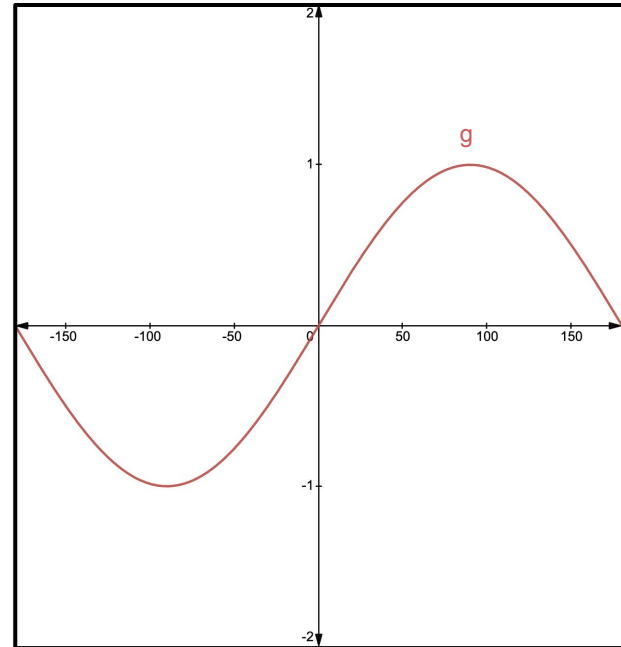
$$f(x) = 3x + 9$$
$$f(x) = \log(x)$$
$$f(x, y) = 4x^2 + 3xy - 6$$

- Functions can also be represented as graphs by using the horizontal x-axis to represent the input to the function and the vertical y-axis to represent the output of the function. Points are then plotted in positions corresponding to an input to the function and its corresponding output.
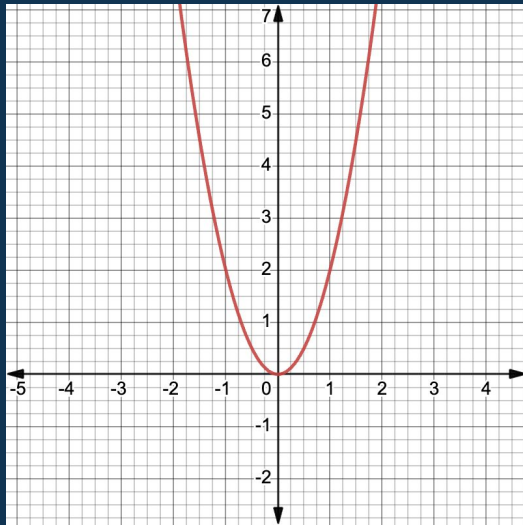
$$f(x) = y$$
$$y = -3x + 2$$

$$g(x) = y$$
$$y = \sin(x)$$

Worked Example

Determine the range, domain and equation of the function represented in the graph below.

1. Determine the range and domain of the function.

2. Determine the equation of the function.

Summary

Variables

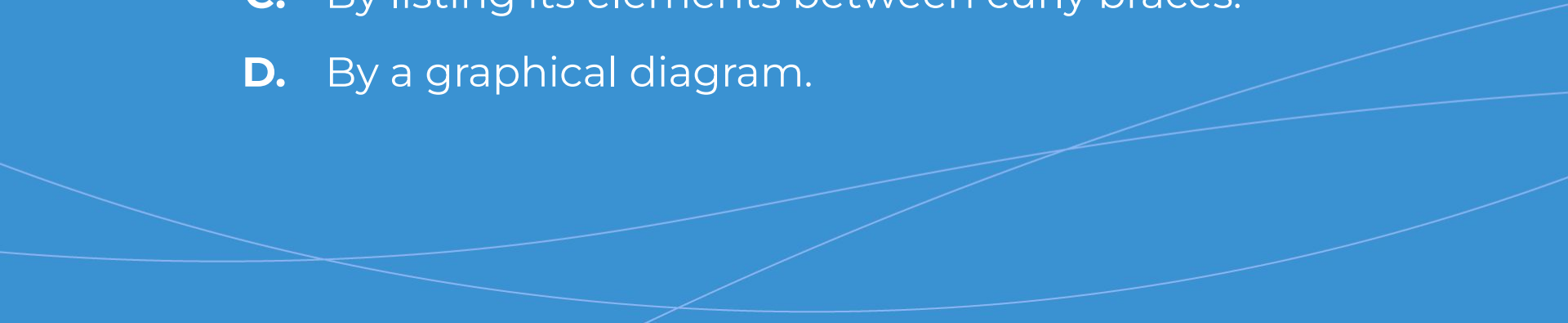★ Represent unspecified values in algebraic expressions and equations.

Sets

★ Store a collection of distinct objects known as elements.

Functions

★ Relations between a set of inputs and a set of permissible outputs.
★ Each input of a function is related to at most one output.

CoGrammar

How is a set typically represented in roster notation?

A. By an algebraic formula.

B. By listing its elements between square brackets.

C. By listing its elements between curly braces.

D. By a graphical diagram.

What is the difference between a single-variable function and a multivariate function?

A. Single-variable functions use letters, while multivariate functions use numbers.

B. Single-variable functions depend on one variable, multivariate functions depend on two or more variables.

C. There is no difference; both are the same.

D. Single-variable functions are for calculus, while multivariate functions are for algebra.

Questions and Answers

Questions around Sets, Functions and Variables