WORKSHEET

A6.3 Sets

Theory of computation · A level · AQA 7517 4.4.2.2 · about 20 min

BugBotLab

Name _____ Class _____ Date _____

What this lesson is about

Set notation and comprehension, finite and countably infinite sets, cardinality, Cartesian product, subsets, union, intersection and difference.

- What a set is
- Set comprehension
- Finite and infinite sets, and cardinality
- Cartesian product
- Subsets and set operations

Questions

6 marks in all

1. A = {3, 5, 7} and B = {a, b, c, d}. What is |A × B|? [1 mark]

2. A = {1, 2, 3, 4} and B = {3, 4, 5}. List A \ B (the difference), as numbers separated by commas in ascending order. [1 mark]

3. Which set is $\{2x \mid x \in \mathbb{N} \wedge x < 4\}$? [1 mark]

- ☐ **A** {0, 2, 4, 6}
- ☐ **B** {2, 4, 6, 8}
- ☐ **C** {0, 1, 2, 3}
- ☐ **D** {2, 4, 6}

4. Which of these sets are countably infinite? [1 mark]

Tick every answer that is true.

- ☐ **A** The natural numbers $\mathbb{N}$
- ☐ **B** The integers $\mathbb{Z}$
- ☐ **C** $\{x \mid x \in \mathbb{N} \wedge x < 1000\}$
- ☐ **D** The set of all binary strings

5. A = {1, 3, 5}. Which statement is false? [1 mark]

- ☐ **A** $\{1, 5\} \subset A$
- ☐ **B** $A \subseteq A$
- ☐ **C** $A \subset A$
- ☐ **D** $\{\} \subseteq A$

6. What does this program print? [1 mark]

```
A = {1, 3, 7, 9}
B = {2, 3, 9}
print(sorted(A | B))
print(sorted(A & B))
print(len(A - B), len(B - A))
```

The task: two robots' sightings

Two robots patrolled the same room and logged the marker ids they saw, with repeats. Let A be the set of ids robot A saw and B the set robot B saw. - Start from the two lists in the starter. Do not type any of the answers. - Print exactly these eight lines, in this order. A list of ids is written in ascending order separated by single spaces: 1. `A:` then the members of A 2. `B:` then the members of B 3. `union:` then the members of A ∪ B 4. `intersection:` then the members of A ∩ B 5. `A minus B:` then the members of A \ B 6. `pairs:` then the cardinality of A × B, as a whole number 7. `subset:` then `True` or `False`: whether `{7, 9}` is a proper subset of A 8. `even:` then the members of `{x | x ∈ A ∪ B ∧ x is even}`, built with a set comprehension For example, if A were `{2, 5}` the first line would be `A: 2 5`.

```
# the two lines every program starts with: the commands, then the robot
from bugbot import *
connect()

seen_by_a = [3, 7, 1, 7, 9, 3]
seen_by_b = [7, 2, 9, 9, 4]
```

Plan your program here, then type it in and press Run.

Do it on the robot

www.bugbotlab.com/learn/a6-3-sets/

The simulator checks it and tells you when it passes. Nothing to install, no account.

Challenges

1. Write `{x² | x ∈ ℕ ∧ x < 6}` by listing its members, then check with a Python set comprehension.
2. What is `|A × B × C|` if `|A| = 3`, `|B| = 2` and `|C| = 4`? Why?
3. Is `{x | x ∈ ℤ ∧ x < 0}` finite, countably infinite, or neither? Show how to count it off.