Unit 1 · Set

STUDY NOTES

Key terms

Set: a **well-defined** collection of objects.

Well defined: for anything at all, you can say **for certain** whether it belongs; everyone using the rule agrees.

Members (**elements**): the things in a set; small letters a, b, c when written as letters.

Name of a set: a capital letter, A, B, C, ...

Variable: a letter, often x, standing for each member in turn.

Set or not?

Collection	Set?
odd natural numbers less than 20	yes: 1, 3, 5, ..., 19
days whose English names begin with S	yes: Sunday, Saturday
two beautiful cities of Nepal	no: "beautiful" is not exact
tall students in Grade 6	no: no fixed height for "tall"
students taller than 150 cm	yes: measure, and it is certain

- vague words → **not** a set
  - tall
  - tasty
  - beautiful
  - big
  - good
- well defined ≠ easy: "students of your school born in 2070 B.S." is a set; the records decide it
- turn a vague word into an exact rule to make a set
- **odd one out**: cross the member without the shared property; the rest is the set: a, b, c, d, e, 6 → cross 6 → {first five letters of the English alphabet}

Three ways to write a set

- **listing**: every member in **curly brackets** { } (middle brackets, braces), commas between: $V = \{a, e, i, o, u\}$
- **describing**: what the members share, in words: $V =$ {vowels of the English alphabet}
- **set builder**: a variable and its rule: $P = \{x : x \text{ is a prime number less than } 10\}$
- ":" is read **such that**; P by listing: {2, 3, 5, 7}
- "set of" inside the brackets, or left out: both accepted

Listing, step by step

1. choose a capital letter for the set
2. find all its members
3. write them inside { }, separated by commas
4. each member **once**, never twice

- factors of 16: $1 \times 16 = 2 \times 8 = 4 \times 4 \rightarrow F_{16} = \{1, 2, 4, 8, 16\}$
- {0, 2, 4, 6, 8, 10} = {even whole numbers up to 10}: 0 is even (2×0)
- $\{1, 2, 3, 4, 5\} = \{x : x \text{ is a natural number less than } 6\}$
- **order doesn't matter**: {1, 2, 3} and {3, 1, 2} are the same set
- **no repeats**: letters of "book" = $\{b, o, k\}$
- a set that never ends: list the start, then "...": {2, 4, 6, 8, ...}
- a rule is shorter than a long list: odd numbers less than 1000 are 500 numbers
- **number of members**: list, then count each once: factors of 20 = {1, 2, 4, 5, 10, 20}, 6 members; counting numbers greater than 2 and less than 7 = {3, 4, 5, 6}, 4 members (2 and 7 left out)
- **members in both** sets: keep each member of one that is also in the other: letters of *kathmandu* and of *mathematics* → $\{a, t, h, m\}$

Membership

- $\in$: belongs to, is a member of: $6 \in \{1, 2, ..., 10\}$
- $\notin$: does not belong to: $5 \notin \{2, 4, 6, 8, 9\}$
- **member first, then the set**: $S =$ {Nepal, India, Bhutan}, Bhutan $\in S$
- $O =$ {odd numbers less than 12} = {1, 3, 5, 7, 9, 11}
  - $7 \in O$
  - $1 \in O$
  - $12 \notin O$

Where it is used

- voters' list (voting age 18), database searches (SQL's `WHERE`): exact rules decide who or what is in

COMMON MISTAKES

✗ "the big rivers of Nepal" called a set
✓ "big" has no exact meaning: not well defined.

✗ $\{b, o, o, k\}$
✓ each member once: $\{b, o, k\}$.

✗ {3, 1, 2} called a different set from {1, 2, 3}
✓ order doesn't matter: the same set.

✗ factors of 9 = {9, 18, 27}
✓ those are multiples; factors {1, 3, 9}.

✗ $B = 1, 3, 5, 7, 9$
✓ no brackets, no set: $B = \{1, 3, 5, 7, 9\}$.

✗ $S \in$ Nepal
✓ member first: Nepal $\in S$.

✗ $\in$ written as the letter e
✓ a symbol of its own; $\notin$ with a line through.