

Sets:

A set is a group of non repeating elements, separated by commas inside braces { }.

$$A = \{1, 2, 3\}$$

$$B = \{1, 2, 3, 4, 5\}$$

Empty set (null set):

A set that has no elements, denoted by $\emptyset$ or { }.

$$\emptyset \quad \{\}$$

We can write any set as:

(1) Roster Method:

Listing the elements of a set inside braces { }.

$$A = \{1, 2, 3, 4\}$$

(2) Set-builder notation:

$$A = \{x \mid \text{conditions}\}$$

Example 1:

Write the ^{زوجي} even and ^{فردية} odd numbers as

a) Roster Method

b) Set-builder notation

a) $A = \{2, 4, 6, 8, \dots\} = \text{Roster method}$

b) $A = \{x \mid x \text{ is even number}\}$

a) $B = \{1, 3, 5, 7, 9, \dots\} = \text{Roster}$

$B = \{x \mid x \text{ is odd number}\} =$
set-builder

Subset:

If every element of a set A is also an element of a set B , denoted by $A \subseteq B$

Example: $\{1, 2\} \subseteq \{1, 2, 3\}$

$$\text{ex} = A = \{2, 3, 5\}, B = \{1, 2, 3, 4, 5\}$$
$$A \subseteq B$$

$$\text{ex} = A = \{1, 3\}, B = \{1, 2, 4, 8\} \quad A \not\subseteq B$$

Equal sets:

If 2 sets A and B have the same elements, denoted by $A = B$.

Example: $\{1, 2, 3\} = \{1, 2, 3\}$

Intersection sets: $\cap$

The intersection of 2 sets A and B are those elements that belongs to both sets, denoted by $A \cap B$

Union sets: $\cup$

The union of 2 sets A and B are all the elements from both sets, denoted by $A \cup B$

Example 2:

Let $A = \{1, 3, 5, 8\}$, $B = \{3, 5, 7\}$, $C = \{2, 4, 6, 8\}$

Find

a) $A \cap B$

b) $A \cup B$

c) $B \cap (A \cup C)$

$$\begin{array}{l|l} \text{a) } A \cap B = \{3, 5\} & \text{b) } A \cup B = \{1, 3, 5, 7, 8\} \\ & \text{c) } A \cup C = \{1, 2, 3, 4, 5, 6, 8\} \\ & B \cap (A \cup C) = \{3, 5, 7\} \cap \{1, 2, 3, 4, 5, 6, 8\} \\ & = \{3, 5\} \end{array}$$

Complement set:

تعريف

A complement of a set A contains all elements in universal set U but not in set A , denoted by $\bar{A}$

Example 3:

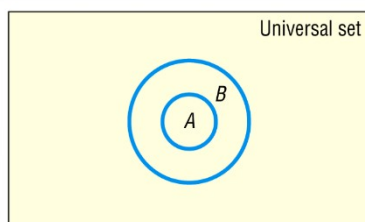
If the universal set $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ and $A = \{1, 3, 5, 7, 9\}$
Find $\bar{A}$.

$\bar{A} = \{2, 4, 6, 8\}$
ex: if A is set then
 $A \cap \bar{A} = \emptyset$
1) $\emptyset$
2) U
3) A

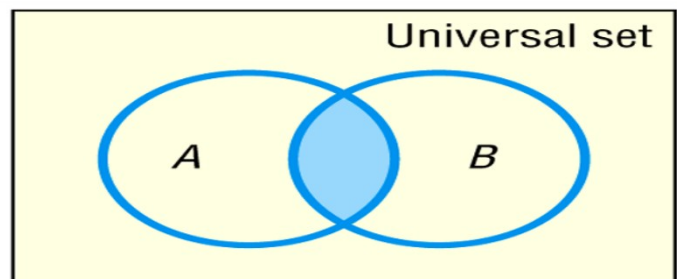
Remark

$$\begin{aligned} A \cup \bar{A} &= U \\ A \cap \bar{A} &= \emptyset \end{aligned}$$

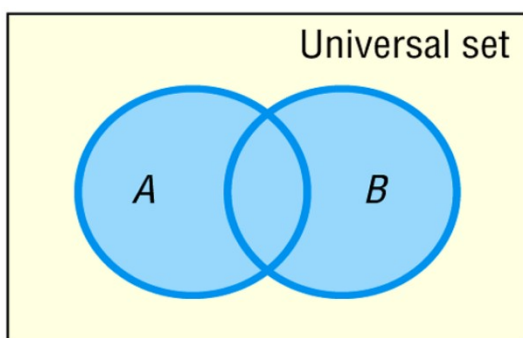
FIGURE



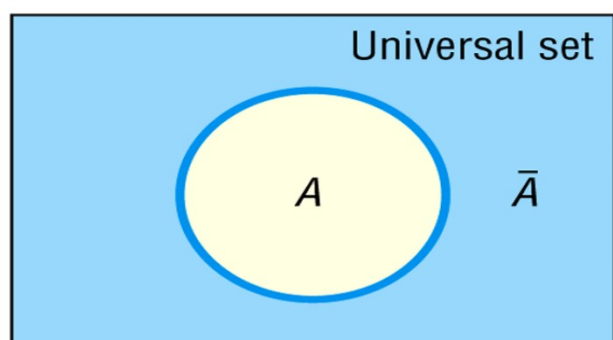
(a) $A \subseteq B$
subset



(a) $A \cap B$
intersection



(b) $A \cup B$
union



(c) $\bar{A}$
complement

$$\text{ex 1: } U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$

$$A = \{1, 4, 5, 7, 9\}$$

$$B = \{1, 3, 6, 7, 9\}$$

$$C = \{2, 8\}$$

Find ① $A \cap B$, ② $A \cup B$ ③ $\bar{A} \cap \bar{B}$

$$1) A \cap B = \{1, 7, 9\}$$

$$2) A \cup B = \{1, 3, 4, 5, 6, 7, 9\}$$

$$*) A \cap C = \emptyset = \{\}$$

$$3) \bar{A} = \{2, 3, 6, 8\}$$

$$\bar{B} = \{2, 4, 5, 8\}$$

$$\bar{A} \cap \bar{B} = \{2, 8\}$$

$$\text{ex: } U = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$$

$$A = \{1, 3, 5, 7, 8\}$$

$$B = \{0, 1, 2, 5, 8\}$$

$$C = \{1, 4, 6, 7\}$$

Find ① $(A \cap C) \cup B$ ② $\bar{A} \cap C$

$$A \cap C = \{1, 7\}$$

$$(A \cap C) \cup B = \{1, 7\} \cup \{0, 1, 2, 5, 8\} \\ = \{0, 1, 2, 5, 7, 8\}$$

$$② \bar{A} = \{0, 2, 4, 6\}$$

$$\bar{A} \cap C = \{0, 2, 4, 6\} \cap \{1, 4, 6, 7\} = \{4, 6\}$$

Common Number Sets

الطبيعية

Natural numbers

$$\mathbb{N} = \{1, 2, 3, \dots\}$$

الكلية

Whole numbers

$$\mathbb{W} = \{0, 1, 2, 3, \dots\}$$

المسوية

Integers

$$\mathbb{Z} = \{\dots, -2, -1, 0, 1, 2, \dots\}$$

النسبية

Rational numbers $\mathbb{Q}$

Quotient

$$\frac{a}{b}, b \neq 0$$

Decimal fractions

(repeating + non-terminating)

e.g. $\frac{1}{2}, \frac{3}{5}, -\frac{2}{3}, 7$

e.g. $0.666666\dots$
 $2.131313\dots$

غير نسبية

Irrational numbers $\mathbb{I}$

(non-repeating + non-terminating)

e.g. $\pi = 3.1415\dots$

$$\sqrt{2} \cong 1.414213\dots$$

$$\sqrt{3} \cong 1.73205\dots$$

Real numbers $\mathbb{R}$

All rational and irrational numbers

$$\text{Rational} = \left\{ \frac{a}{b} ; b \neq 0 \right\}$$

الطبيعية
الكلية
المسوية
النسبية

$$\frac{7}{2} = 3.5$$

$$\frac{8}{2} = 4$$

$$\frac{7}{3}$$

$$\frac{1}{3} = 0.333\dots$$

irrational

الكلية
المسوية
النسبية

$$\pi = 3.14\dots$$

$$e = 2.71\dots$$

$$\sqrt{3}, \sqrt{7}$$

$$\sqrt[3]{5}, \sqrt[4]{7}$$

$$3.215\dots$$

$$61, 3416\dots$$

ex: The number $\sqrt{2}$ is

- 1) Natural
- 2) integer
- 3) rational
- ④ irrational

ex: The number $3,6$ is

- ① Natural
- ② integer
- ③ rational
- ④ irrational

Real Numbers

Distributive Property

$$a \cdot (b + c) = ab + ac$$

Example:

$$2(x + 3) = 2x + 6$$

$$\text{ex: } 7(y - 5) = 7y - 35$$

Zero-Product Property

$$\text{ex: } 5(0) = 0, \text{ ex: } (0)(9) = 0$$

If $ab = 0$, then either $a = 0$ or $b = 0$ or both equal 0.

Definition:

The **absolute value** of a real number a , denoted by the symbol $|a|$, is defined by the rules

$$|a| = a \quad \text{if } a \geq 0 \quad \text{and} \quad |a| = -a \quad \text{if } a < 0$$

$$|a| = \begin{cases} a; & a \geq 0 \\ -a; & a < 0 \end{cases}$$

Example:

Computing Absolute Value

(a) $|8| = 8$ (b) $|0| = 0$ (c) $|-15| = -(-15) = 15$

$$|-3| = 3, \quad |7| = 7$$

Example:

Evaluate each expression if $x = 3$ and $y = -1$.

عوض القيم

(a) $x + 3y$

$$\begin{aligned} & 3 + 3(-1) \\ & 3 - 3 = 0 \end{aligned}$$

(b) $5xy$

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$$5(3)(-1) = -15$$

(c) $\frac{3y}{2 - 2x}$

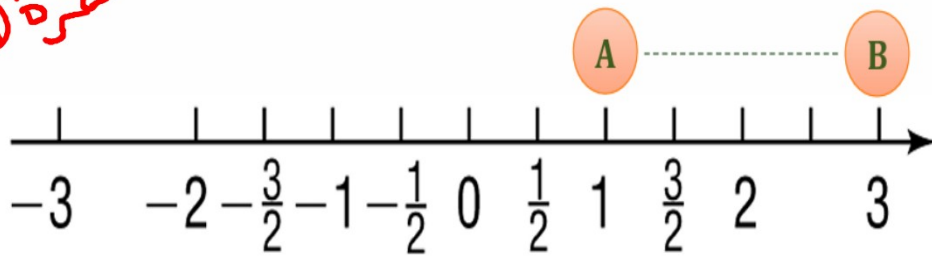
$$\begin{aligned} & \frac{3(-1)}{2 - 2(3)} = \\ & \frac{-3}{2 - 6} = \frac{-3}{-4} \\ & = \frac{3}{4} \end{aligned}$$

(d) $|-4x + y|$

$$\begin{aligned} & |-4(3) + (-1)| \\ & = |-12 - 1| \\ & = |-13| \\ & = 13 \end{aligned}$$

Distance between 2 points on a number line:

فكره



The distance between A and B, denoted by $d(A, B)$, is $d(A, B) = |B - A|$

$$d(A, B) = |A - B|$$

So,

$$d(1, 3) = |3 - 1| = |2| = 2$$

$$d(A, B) = |1 - 3| = |-2| = 2$$

Example:

Let P , Q , and R be points on a real number line with coordinates -5 , 7 , and -3 , respectively. Find the distance

- (a) between P and Q (b) between Q and R

$$d(P, Q) = |P - Q| = |-5 - 7| = |-12| = +12$$

$$\begin{aligned} d(Q, R) &= |Q - R| = |7 - (-3)| \\ &= |7 + 3| = |10| \\ &= 10 \end{aligned}$$

Integer exponent

For any real number **a** and **n** is a positive integer then

$$a^n = \underbrace{a \cdot a \cdot a \cdot a \cdots a}_{n\text{-times}}$$

Example: Find the following

(a) $2^3 = (2)(2)(2) = 8$

(b) $3^4 = (3)(3)(3)(3) = 81$

(c) $4 \cdot 3^2 = (4) \cdot (3)(3) = 36$

(d) $2^2 + 3^2 = (2)(2) + (3)(3) = 4 + 9 = 13$