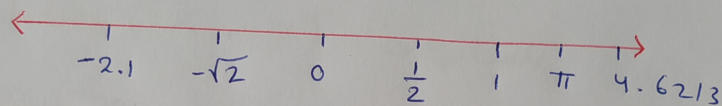


0.2 The real numbers الأعداد الحقيقية

- 1) The set of the real numbers $\mathbb{R}$ can be represented by the real number line where each point on the line represents a real number



Subsets of the set of real numbers : الأعداد الطبيعية

- 2) The Natural numbers $\mathbb{N} = \{1, 2, 3, 4, \dots\}$

note that: the Natural numbers $\subseteq$ Real numbers.

- 3) The set of the integer numbers $\mathbb{Z}$

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

note that

$$\mathbb{N} \subseteq \mathbb{Z} \subseteq \mathbb{R}$$

- 4) The set of the Rational numbers $\mathbb{Q}$: all real numbers that can be written as the ratio of two integers $\frac{a}{b}$ where $b \neq 0$.

Examples: 3, -5, 0.5, 3.465

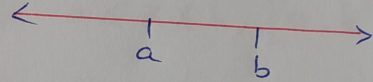
$2.\overline{3}$, 4.153

5) **Irrational numbers**: any real number that is not rational (can not be written as $\frac{a}{b}$, where a and b are integers)

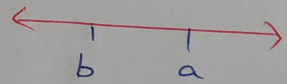
Example:- $\sqrt{2}$, π (کسری نہیں ہے), $-\sqrt{2}$, $\pi \times 10$, e

* **Inequalities** ($<$, $>$) اُلٹیابايات

1) a is less than b ($a < b$) if a is to the left of b on the number line



2) a is greater than b ($a > b$) if a is to the right of b on the number line



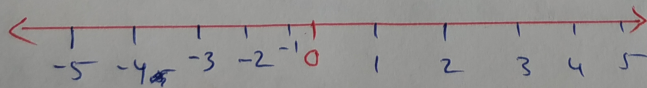
Examples:

$$3 < 5, \quad 3 > -5, \quad -2 < 0$$

$$-2 > -4.5, \quad 2.3 > 2.222$$

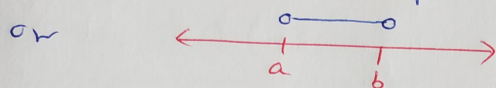
$$\frac{9}{5} > \frac{11}{8}$$

$\downarrow$ $\downarrow$
 1.8 1.375

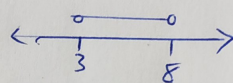


* Intervals الفترات

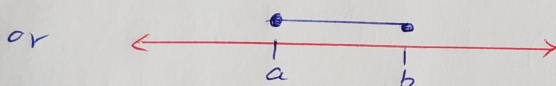
1) The subset $\{x: a < x < b\}$ is an open interval which can be expressed as $a < x < b$ or (a, b)



Example: $-3 < x < 8 \rightarrow (3, 8)$

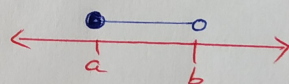


2) The subset $\{x: a \leq x \leq b\}$ is a closed interval which can be expressed as $a \leq x \leq b$, $[a, b]$



Example: $-5 \leq x \leq 2 \rightarrow [-5, 2]$

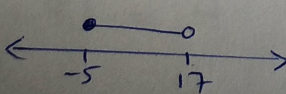
3) The subset $\{x: a \leq x < b\}$ is a half-open interval can be expressed as $a \leq x < b$



Question: write the types of the following intervals and express them in a second and third way:-

① $x \geq 5 \rightarrow [5, \infty) \rightarrow$

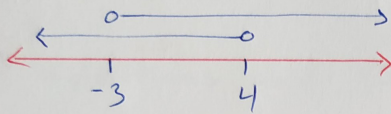
② $(-\infty, 7) \rightarrow x \leq 7 \rightarrow$

③  $\rightarrow [-5, 17) \rightarrow -5 \leq x < 17$

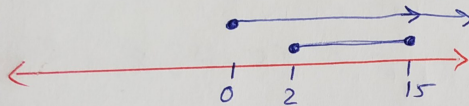
$$4) \begin{array}{c} \text{---} \circ \text{---} \rightarrow \\ | \\ 7 \end{array} \rightarrow x > 7 \rightarrow (7, \infty)$$

Question:- Perform the following operations and write your answer in interval notations:-

$$1) (-\infty, 4) \cap (-3, \infty) = (-3, 4)$$



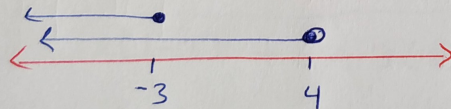
$$2) 2 \leq x \leq 15 \cup x \geq 0 = [0, \infty)$$



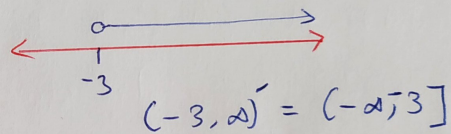
$$3) (-\infty, 4) - (-3, \infty)$$

$$= (-\infty, 4) \cap (-3, \infty)'$$

$$= (-\infty, 4) \cap (-\infty, -3]$$



$$= (-\infty, -3]$$



* Absolute Value: القيمة المطلقة

Evaluate the following:

$$a) |-4| = 4$$

$$c) |2| = 2$$

$$b) |0| = 0$$

$$d) |-5 - (-3)| = |-5 + 3| = |-2| = 2$$

$$= |-8| = 8$$

Order of operations :

- 1) Parentheses () الأقواس
- 2) powers القوى
- 3) multiplications ^{الضرب} and divisions ^{القسمة} (from left to right)
- 4) additions ^{الجمع} and subtractions ^{الطرح} (from left to right)

Example:- Evaluate the expressions:

$$1) 3 + 8(4-2) \div 2$$

$$3 + 8(2) \div 2$$

$$3 + 16 \div 2$$

$$3 + 8 = 11$$

$$2) \frac{(-3)^2 + |2-5|}{2(1-3) + 6 \div 3(2)}$$

$$= \frac{9 + |-3|}{2(-2) + 2(2)}$$

$$= \frac{9 + 3}{-4 + 4} = \frac{12}{0} \text{ meaningless.}$$