



Attempt all questions before checking the answer key. Real domains are intended unless stated. For sketches, label axes, key points, domain and range.

A. Very short answers - 1 mark each

- For $A = \{1, 2\}$, $B = \{a, b, c\}$, find the number of elements in $A \times B$.
- If $(x + 2, 3) = (5, y - 1)$, find x and y .
- Define the domain and range of a relation.
- State the domain of $f(x) = 1/(x - 4)$.
- State the range of $f(x) = |x|$ for $x \in \mathbb{R}$.

B. Short answers / practice - 2 marks each

- Write $A \times B$ and $B \times A$ for $A = \{0, 1\}$, $B = \{2, 3\}$. Explain why order matters.
- Let $R = \{(1, 2), (2, 4), (3, 4)\}$ from $A = \{1, 2, 3\}$ to $B = \{2, 4, 6\}$. Find domain, codomain and range, and decide whether R is a function.
- Find domain and range of $f(x) = \sqrt{16 - x^2}$.
- Find the domain of $f(x) = \sqrt{(x - 1)/(x - 3)}$.
- If $f(x) = x^2 + 1$ and $g(x) = 2x - 3$, find $f + g$, fg and f/g with their domains.
- Find domain of $1/\sqrt{x-2}$.
- Find range of $x^2 + 3$ on $\mathbb{R}$.
- Is $\{(1, 2), (1, 3)\}$ a function on $\{1\}$?
- Evaluate $\text{floor}(-2.3)$.
- Find zeros of $|x| - 4$.
- If $f(x) = 3x - 1$, find $f(2) + f(-2)$.
- How many relations exist from a two-element set to itself?
- Find domain of $\log_2(x + 3)$.
- Find range of $1/(x^2 + 1)$ on $\mathbb{R}$.
- Sketch the constant function $y = -2$ and state its range.

C. Short answers - 3 marks each

- A set A has 3 elements and B has 4. Find the numbers of ordered pairs in $A \times B$, relations from A to B and functions from A to B . Explain the counting.
- Sketch $f(x) = |x - 2|$ and state its domain, range and zeros.

23. For $f(x) = 2x + 1$ when $x < 0$ and $f(x) = x^2$ when $x \geq 0$, find $f(-2)$, $f(0)$, $f(3)$, domain and range.

24. Sketch the greatest-integer function on $[-2, 3]$, marking open and closed endpoints correctly.

25. Find domain and range of $f(x) = (x - 1)/(x + 2)$. Explain the excluded values.

D. Long answers - 5 marks each

26. Let $A = \{-2, -1, 0, 1, 2\}$ and $R = \{(x, y) \in A \times A : y = x^2\}$. List R , draw its arrow diagram and find its domain/range. Explain why it is not a function from all of A to A .

27. Sketch $y = x^2$, $y = |x|$ and $y = \text{signum}(x)$. Compare their domains, ranges and symmetry.

28. For $f(x) = \sqrt{x + 1}$ and $g(x) = \sqrt{5 - x}$, find domains of f , g , $f + g$, fg and f/g , giving reasons for endpoint inclusion.

29. Sketch $y = 2^x$ and $y = \log_2 x$. State their domains, ranges, intercepts and asymptotes, and explain how their graphs are related geometrically.

30. A parking charge is ₹30 for the first hour and ₹20 for every additional hour or part thereof, up to 5 hours. Define the charge function for $0 < t \leq 5$, find charges at 1, 1.5 and 3 hours, and sketch it.

ANSWER KEY - Numerical / short answers

- 1)** 6. **2)** $x = 3, y = 4$. **4)** $\mathbb{R} - \{4\}$. **5)** $[0, \infty)$. **6)** $A \times B = \{(0, 2), (0, 3), (1, 2), (1, 3)\}$; reverse each pair for $B \times A$. **7)** Domain $\{1, 2, 3\}$; codomain $\{2, 4, 6\}$; range $\{2, 4\}$; yes. **8)** Domain $[-4, 4]$; range $[0, 4]$. **9)** $[1, \infty) - \{3\}$. **10)** Sum $x^2 + 2x - 2$, product $(x^2 + 1)(2x - 3)$, both on $\mathbb{R}$; quotient $(x^2 + 1)/(2x - 3)$, $x \neq 3/2$. **11)** $(2, \infty)$. **12)** $[3, \infty)$. **13)** No. **14)** -3 . **15)** $x = \pm 4$. **16)** -2 . **17)** 16. **18)** $(-3, \infty)$. **19)** $(0, 1]$. **20)** $\{-2\}$. **21)** 12 pairs; 4096 relations; 64 functions. **22)** Domain $\mathbb{R}$; range $[0, \infty)$; zero 2. **23)** $-3, 0, 9$; domain $\mathbb{R}$; range $(-\infty, 1) \cup [0, \infty) = \mathbb{R}$. **25)** Domain $\mathbb{R} - \{-2\}$; range $\mathbb{R} - \{1\}$. **26)** $\{(-1, 1), (0, 0), (1, 1)\}$; domain $\{-1, 0, 1\}$; range $\{0, 1\}$; ± 2 have no image in A . **27)** All domains $\mathbb{R}$; ranges $[0, \infty)$, $[0, \infty)$, $\{-1, 0, 1\}$; first two even, signum odd. **28)** $f: [-1, \infty)$; $g: (-\infty, 5]$; sum/product: $[-1, 5]$; quotient: $[-1, 5]$. **29)** 2^x : domain $\mathbb{R}$, range $(0, \infty)$, $(0, 1)$, $y = 0$ asymptote; $\log_2 x$: domain $(0, \infty)$, range $\mathbb{R}$, $(1, 0)$, $x = 0$ asymptote. **30)** $C(t) = 30 + 20(\text{ceil}(t) - 1)$; ₹30, ₹50, ₹70.