

Relations and Functions — CBSE Pattern Test 2

Class 12 Maths · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 2 — CBSE Pattern (90 minutes, 40 marks)

Class 12 Maths · Relations and Functions · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

- A relation R is transitive if
 - $(a, b), (b, c) \in R \implies (a, c) \in R$
 - $(a, b) \in R \implies (b, a) \in R$
 - $(a, a) \in R$
 - R is empty
- A function $f : A \rightarrow B$ is onto (surjective) if
 - every element of B is the image of some element of A
 - distinct inputs give distinct outputs
 - f is constant
 - the range is a proper subset of B
- The function $f : \mathbb{R} \rightarrow \mathbb{R}, f(x) = x^2$, is
 - neither one-one nor onto
 - one-one and onto
 - one-one only
 - onto only
- If f is invertible, then f^{-1} satisfies
 - $f^{-1}(f(x)) = x$
 - $f^{-1}(f(x)) = 0$
 - $f^{-1}(f(x)) = f(x)$
 - $f^{-1} = f$
- For $f(x) = 2x + 3$, the inverse $f^{-1}(x)$ is
 - $(x - 3)/2$
 - $2x - 3$
 - $(x + 3)/2$
 - $x/2 + 3$
- A binary operation $*$ is associative if
 - $a * (b * c) = (a * b) * c$
 - $a * b = b * a$
 - $a * e = a$
 - $a * a = a$
- An element e is the identity for $*$ if
 - $a * e = e * a = a$

- (B) $a * e = e$
 (C) $a * a = e$
 (D) $a * b = b * a$
8. On the set of integers, addition is
 (A) commutative and associative
 (B) only commutative
 (C) only associative
 (D) neither
9. Define an onto function.
10. Define a commutative binary operation.

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. What is a bijective function?
12. Define the composition $f \circ g$.
13. Define an associative binary operation.
14. Define a transitive relation.

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. Check whether $f: \mathbb{R} \rightarrow \mathbb{R}$, $f(x) = |x|$ is one-one.
16. Find the inverse of $f(x) = (x - 1)/2$.
17. Find the identity element for the operation $a * b = a + b - 2$ on integers.
18. Check whether the relation 'is less than' on the set of integers is reflexive, symmetric or transitive.

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. Show that $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = 3x + 2$ is bijective.
20. Prove that the relation 'is parallel to' on the set of lines in a plane is an equivalence relation. Show that the operation $a * b = a + b - ab$ on the set of rationals is commutative and associative.

Answer Key (Marking Scheme)

- Q1 — (A) $(a, b), (b, c) \in R \Rightarrow (a, c) \in R$. Q2 — (A) every element of B is the image of some element of A. Q3 — (A) neither one-one nor onto. Q4 — (A) $f^{-1}(f(x)) = x$.
- Q5 — (A) $(x - 3)/2$. Q6 — (A) $a * (b * c) = (a * b) * c$. Q7 — (A) $a * e = e * a = a$. Q8 — (A) commutative and associative.
- Q9 — Every element of B has a pre-image in A.
- Q10 — $a * b = b * a$.
- Q11 — One-one and onto.
- Q12 — $(f \circ g)(x) = f(g(x))$.
- Q13 — $a * (b * c) = (a * b) * c$.
- Q14 — $(a, b), (b, c) \in R \Rightarrow (a, c) \in R$.
- Q15 — Not one-one.
- Q16 — $2x + 1$.
- Q17 — $e = 2$.

Q18 — Neither reflexive nor symmetric; transitive.

Q19 — One-one and onto (proof as in notes).

Q20 — Parallel: reflexive, symmetric, transitive; $a * b = a + b - ab$ is commutative and associative.