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Relations and Functions — CBSE Class 12 Mathematics Chapter Test

FREE CHAPTER TEST · CLASS XII · MATHEMATICS (041) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	40	19 (A 10 · B 3 · C 2 · D 2 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 19 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. In Section A, Questions 1 to 8 are multiple choice questions (MCQs) and Questions 9 and 10 are assertion-reason based questions of 1 mark each.
4. In Section B, Q11–13 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section C, Q14–15 are short answer (SA) type questions, carrying 3 marks each.
6. In Section D, Q16–17 are long answer (LA) type questions, carrying 5 marks each.
7. In Section E, Q18–19 are case study based questions, carrying 4 marks each, with sub-parts of the values of 1, 1 and 2 marks.
8. There is no overall choice. However, an internal choice has been provided in 1 question of Section B, 1 question of Section C, 1 question of Section D and in the 2-mark sub-part of each question of Section E.
9. Use of calculators is not allowed. log x denotes the natural logarithm of x.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Mathematics (041) Sample Question Paper 2026-27, released on 21 September 2026 at cbseacademic.nic.in, at half the length of the 80-mark board paper: 40 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Relations and Functions · **Topics:** Relations: reflexive, symmetric, transitive · Equivalence relations and equivalence classes · Counting relations and functions · One-one, onto and bijective functions

SECTION A

This section comprises 10 questions of 1 mark each: 8 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. The number of relations on the set $\{1, 2, 3\}$ is 1

(A) 512 (B) 9

(C) 64 (D) 256

2. The number of equivalence relations on the set $\{1, 2, 3\}$ is 1

(A) 3 (B) 5

(C) 6 (D) 8

3. The relation R on $\mathbb{Z}$ given by $R = \{(a, b) : a - b \text{ is divisible by } 3\}$ is an equivalence relation. The number of its equivalence classes is 1

(A) 1 (B) 2

(C) 3 (D) infinitely many

4. The number of onto functions from $\{1, 2, 3, 4\}$ to $\{a, b\}$ is 1

(A) 16 (B) 8

(C) 12 (D) 14

5. The function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = x^3$ is 1

(A) one-one but not onto (B) onto but not one-one

(C) neither one-one nor onto (D) one-one and onto (bijective)

6. On the set $\{1, 2, 3\}$, the relation $R = \{(1, 1), (2, 2), (3, 3), (1, 2)\}$ is 1

(A) reflexive and symmetric but not transitive (B) symmetric and transitive but not reflexive

(C) reflexive and transitive but not symmetric (D) an equivalence relation

7. The function $f : \mathbb{N} \to \mathbb{N}$, $f(x) = 2x$ is 1

(A) onto but not one-one (B) one-one but not onto

(C) one-one and onto (D) neither one-one nor onto

8. The least number of ordered pairs that must be added to $R = \{(1, 3)\}$ on $\{1, 2, 3\}$ to make it an equivalence relation is 1

(A) 4 (B) 5

(C) 3 (D) 6

9. **Assertion (A):** The relation R = {(a, b) : $a \le b^3$} on $\mathbb{R}$ is not reflexive. 1

Reason (R): A relation R on a set A is reflexive if (a, a) $\in$ R for every a $\in$ A.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

10. **Assertion (A):** The function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = x^2$ is one-one. 1

Reason (R): The function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = x^2$ is not onto.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

SECTION B

This section comprises 3 very short answer (VSA) type questions of 2 marks each.

11. Show that the relation R = {(a, b) : a + b is even} on A = {1, 2, 3, 4, 5, 6, 7} is an equivalence relation, and write the equivalence class [2]. 2

12. (a) Show that $f : \mathbb{R} \to \mathbb{R}$, $f(x) = 3 - 4x$ is one-one and onto. 2

OR

(b) Show that $f : \mathbb{Z} \to \mathbb{Z}$ given by $f(n) = n + 2$ if n is even and $f(n) = n - 2$ if n is odd is one-one and onto.

13. Find the number of one-one functions from A = {1, 2, 3} to B = {a, b, c, d}. How many of them are onto? 2

SECTION C

This section comprises 2 short answer (SA) type questions of 3 marks each.

14. (a) Let A = {0, 1, 2, …, 10} and R = {(a, b) : |a − b| is a multiple of 3} on A. Show that R is an equivalence relation, and find the equivalence classes [1] and [2]. 3

OR

(b) Let $A = \mathbb{R} - \{-1\}$ and $B = \mathbb{R} - \{2\}$. Show that $f : A \to B$, $f(x) = \dfrac{2x}{x + 1}$ is one-one and onto.

15. Determine whether the relation R = {(a, b) : a divides b} on A = {1, 2, 3, 4, 5, 6} is reflexive, symmetric and transitive. 3

SECTION D

This section comprises 2 long answer (LA) type questions of 5 marks each.

16. (a) Let A = {1, 2, 3, 4, 5} and let R be the relation on A × A given by (a, b) R (c, d) if a + b = c + d. Show that R is an equivalence relation, and find the equivalence class [(2, 4)]. 5

OR

(b) On A = {1, 2, 3, 4, 5, 6}, determine whether each of the following relations is reflexive, symmetric and transitive; for any equivalence relation, write its equivalence classes.
$R_1 = \{(a, b) : b = a + 2\}$, $R_2 = \{(a, b) : a - b \text{ is a multiple of } 4\}$, $R_3 = \{(a, b) : a + b \text{ is odd}\}$.

17. Show that the function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = \dfrac{x}{2 + |x|}$ is one-one but not onto. 5

SECTION E

This section comprises 2 case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.

18. In a class of 30 students, the class teacher considers the relation R on the set S of the students: R = {(x, y) : x and y were born in the same month}. It turns out that the students were born in only 9 of the 12 months.

(i) Show that R is reflexive. [1]

(ii) Is R an equivalence relation? Justify briefly. [1]

(iii) How many equivalence classes does R have? Describe the equivalence class of a student born in March. [2]

OR

(iii) Show that the relation T = {(x, y) : x was born in an earlier month of the year than y} on S is transitive, but neither reflexive nor symmetric. [2]

19. Five students A, B, C, D and E are to be given seats, one student per seat, for an examination. An assignment of seats is a function from the set of students to the set of seats.

(i) If there are exactly 5 seats and each seat gets one student, is the assignment function one-one and onto? [1]

(ii) In how many ways can the five students be seated in the 5 seats, one in each? [1]

(iii) If there are 6 seats instead, find the number of one-one functions from the set of students to the set of seats. How many functions are onto? [2]

OR

(iii) If there are only 4 seats and several students may share a seat, how many functions from the 5 students to the 4 seats are onto (every seat used)? [2]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
(A)	(B)	(C)	(D)	(D)	(C)	(B)	(A)	(A)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (A). $A \times A$ has 9 ordered pairs, and every subset of $A \times A$ is a relation: $2^9 = 512$.

Q2. Answer (B). Equivalence relations correspond to partitions of {1, 2, 3}: {123}, {1|23}, {2|13}, {3|12}, {1|2|3} — five.

Q3. Answer (C). The classes are the integers leaving remainders 0, 1 and 2 on division by 3.

Q4. Answer (D). All $2^4 = 16$ functions, except the 2 constant ones: 14.

Q5. Answer (D). x^3 is strictly increasing (one-one), and every real y equals $(\sqrt[3]{y})^3$ (onto).

Q6. Answer (C). All (a, a) are present; $(1, 2) \in R$ but $(2, 1) \notin R$; every chain (a, b), (b, c) gives $(a, c) \in R$.

Q7. Answer (B). $2x_1 = 2x_2$ gives $x_1 = x_2$; odd natural numbers have no pre-image.

Q8. Answer (A). Reflexivity needs (1, 1), (2, 2), (3, 3) and symmetry needs (3, 1); the result {(1, 1), (2, 2), (3, 3), (1, 3), (3, 1)} is already transitive: 4 pairs.

Q9. Answer (A). For $a = ½$, $½ \le ⅛$ is false, so $(½, ½) \notin R$ and R is not reflexive: A is true, and R is the definition that shows it. Answer (A).

Q10. Answer (D). $f(-1) = f(1)$, so f is not one-one: A is false. Negative numbers have no pre-image, so f is not onto: R is true. Answer (D).

Q11. (2 marks) Answer: equivalence; [2] = {2, 4, 6}.
$a + a = 2a$ is even (reflexive); $a + b = b + a$ (symmetric); if $a + b$ and $b + c$ are even, $a + c = (a + b) + (b + c) - 2b$ is even (transitive). [1]
[2] = {2, 4, 6}. [1]

Q12. (2 marks) Answer: bijective.
(a) $f(x_1) = f(x_2) \Rightarrow 3 - 4x_1 = 3 - 4x_2 \Rightarrow x_1 = x_2$: one-one. [1] For any $y \in \mathbb{R}$, $x = (3 - y)/4 \in \mathbb{R}$ gives $f(x) = y$: onto. [1]
OR (b) f keeps the parity of n (an even number goes to an even one, an odd number to an odd one), so if $f(m) = f(n)$ then m and n have the same parity, and $m + 2 = n + 2$ or $m - 2 = n - 2$ gives $m = n$: one-one. [1] For any k: if k is even, $f(k - 2) = k$; if k is odd, $f(k + 2) = k$: onto. [1]

Q13. (2 marks) Answer: 24; 0.
1 has 4 choices, 2 then has 3 and 3 has 2: $4 \times 3 \times 2 = 24$ one-one functions. [1]
None is onto: three elements cannot have four different images. [1]

Q14. (3 marks) Answer: (a) [1] = {1, 4, 7, 10}, [2] = {2, 5, 8}; (b) bijective.
(a) $|a - a| = 0$ is a multiple of 3; $|a - b| = |b - a|$; if $a - b = 3m$ and $b - c = 3n$ then $a - c = 3(m + n)$. So R is reflexive, symmetric and transitive. [1½]
[1] = {1, 4, 7, 10}; [2] = {2, 5, 8}. [1½]
OR (b) $f(x_1) = f(x_2) \Rightarrow 2x_1(x_2 + 1) = 2x_2(x_1 + 1) \Rightarrow 2x_1 = 2x_2 \Rightarrow x_1 = x_2$: one-one. [1½] For $y \neq 2$, $x = y/(2 - y)$ is defined, $x \neq -1$ (else $y = y - 2$), and $f(x) = (2y/(2 - y)) \div (2/(2 - y)) = y$: onto. [1½]

Q15. (3 marks) Answer: reflexive, transitive, not symmetric.
Reflexive: a divides a for every a. [1]
Not symmetric: 2 divides 4, but 4 does not divide 2. [1]
Transitive: if a | b and b | c, then b = ka, c = lb = (kl)a, so a | c. [1]

Q16. (5 marks) Answer: (a) [(2, 4)] = {(1, 5), (2, 4), (3, 3), (4, 2), (5, 1)}; (b) R_2 only is an equivalence relation.
(a) Reflexive: a + b = a + b, so (a, b) R (a, b). [1] Symmetric: a + b = c + d ⇒ c + d = a + b, so (c, d) R (a, b). [1] Transitive: a + b = c + d and c + d = e + f give a + b = e + f, i.e. (a, b) R (e, f). [1½] (a, b) R (2, 4) means a + b = 6: [(2, 4)] = {(1, 5), (2, 4), (3, 3), (4, 2), (5, 1)}. [1½]
OR (b) R_1: not reflexive ((1, 1) ∉ R_1), not symmetric ((1, 3) ∈ R_1, (3, 1) ∉ R_1), not transitive ((1, 3), (3, 5) ∈ R_1 but (1, 5) ∉ R_1). [2] R_2: reflexive, symmetric (a − b and b − a are both multiples of 4 or neither), transitive (sum of multiples of 4): an equivalence relation, with classes {1, 5}, {2, 6}, {3}, {4}. [2] R_3: not reflexive (1 + 1 is even), symmetric (a + b = b + a), not transitive ((1, 2), (2, 3) ∈ R_3 but (1, 3) ∉ R_3). [1]

Q17. (5 marks) Answer: one-one; range (−1, 1), so not onto.
For x ≥ 0, f(x) = x/(2 + x) ∈ [0, 1); for x < 0, f(x) = x/(2 − x) ∈ (−1, 0). So f(x) has the same sign as x. [1]
One-one: if $f(x_1) = f(x_2)$, x_1 and x_2 have the same sign. If both ≥ 0, $x_1(2 + x_2) = x_2(2 + x_1)$ ⇒ $2x_1 = 2x_2$ ⇒ $x_1 = x_2$; if both < 0, $x_1(2 − x_2) = x_2(2 − x_1)$ ⇒ $x_1 = x_2$. [2]
Not onto: |f(x)| = |x|/(2 + |x|) < 1 for every x, so, e.g., y = 1 (or any |y| ≥ 1) has no pre-image. [2]

Q18. (4 marks) Answer: (i) reflexive; (ii) yes; (iii) 9 classes.
(i) Every student was born in the same month as himself or herself, so (x, x) ∈ R. [1]
(ii) Yes: if x and y share a birth month, so do y and x (symmetric); if x, y share a month and y, z share a month, then x and z share it (transitive). [1]
(iii)(a) One class for each month in which some student was born: 9 classes. [1] The class of a student born in March is the set of all students of the class born in March. [1]
OR (iii)(b) If x is born in an earlier month than y and y in an earlier month than z, then x is born in an earlier month than z: transitive. [1] No student is born in an earlier month than himself or herself (not reflexive), and if x is earlier than y, y is not earlier than x (not symmetric). [1]

Q19. (4 marks) Answer: (i) bijection; (ii) 120; (iii) 720, 0; or 240.
(i) Yes: different students get different seats (one-one) and every seat is used (onto); it is a bijection. [1]
(ii) 5! = 120. [1]
(iii)(a) One-one functions: 6 × 5 × 4 × 3 × 2 = 720. [1] Onto: none, since 5 students cannot fill 6 seats. [1]
OR (iii)(b) Exactly one seat gets two students: choose the pair in C(5, 2) = 10 ways, then seat the 4 'groups' in 4! = 24 ways. [1] Total 10 × 24 = 240. [1]

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Every answer in this paper was checked independently by computer: relations and functions on the finite sets were listed in full and tested pair by pair, and every count was made by enumeration.