Relations and Functions Class 12 Important Questions

10 questions · 27 marks · no calculator · step-marked answers

Name _____ Date _____ Score / 27

- Original questions in the board paper's question types, from 1-mark MCQs to a case study. Try every question before you look at the answers.
- No calculator: as in the CBSE board exam, everything works by hand.
- Worked answers with step marks for 5 questions start after the questions. The other 5 open free on the chapter page with a free account (no card): the link is next to each one.
- Online, with more practice: cbsemathrevision.com/class-12/relations-and-functions

Section A · Multiple choice and assertion–reason (1 mark each)

1. **1 mark · Types of relations**

Which statement is true of the relation $R = \{(1,1),(2,2),(3,3),(4,4),(2,3)\}$ on the set $\{1,2,3,4\}$?

(a) It is reflexive and transitive but not symmetric.

(b) It is an equivalence relation.

(c) It is symmetric but not reflexive.

(d) It is neither reflexive nor transitive.

2. **1 mark · One-one and onto functions**

Which describes $f(x) = 7 - 2x$ as a function from $\mathbb{R}$ to $\mathbb{R}$?

(a) It is a bijection (one-one and onto).

(b) It is one-one only.

(c) It is onto only.

(d) It is neither one-one nor onto.

3. 1 mark · One-one and onto functions

In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.

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

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 · Short answer (2 marks each)

4. 2 marks · Equivalence relations

On the set of integers $\mathbb{Z}$, $R = \{(a, b) : a - b \text{ is divisible by } 5\}$. Show that R is reflexive and symmetric.

5. 2 marks · One-one and onto functions

Show that $f : \mathbb{R} \to \mathbb{R}$, $f(x) = x^3 + 2$, is one-one.

Section C · Short answer (3 marks each)

6. 3 marks · Types of relations

On $A = \{1, 2, 3, \ldots, 10\}$, $R = \{(a, b) : a + b = 11\}$. Determine whether R is reflexive, symmetric and transitive.

7. 3 marks · One-one and onto functions

Prove that the function $f(x) = \dfrac{3x - 2}{x + 1}$, from $\mathbb{R} - \{-1\}$ to $\mathbb{R} - \{3\}$, is a bijection.

Section D · Long answer (5 marks each)

8. 5 marks · Equivalence relations

On $A = \{1, 2, 3, \ldots, 14\}$, $R = \{(a, b) : a - b \text{ is divisible by } 3\}$. Show that R is an equivalence relation. Write the equivalence class $[1]$ and state how many equivalence classes there are.

9. 5 marks · One-one and onto functions

(a) Show that $f : \mathbb{R} \to \mathbb{R}$, $f(x) = 4x + 3$, is one-one and onto. (b) Show that $g : \mathbb{R} \to \mathbb{R}$, $g(x) = x^2 + 1$, is neither one-one nor onto.

Section E · Case study (4 marks)

10. 4 marks · One-one and onto functions

Cinema seats. Five friends (Asha, Bina, Chetan, Dev and Esha) form the set A, and the six seats $s_1, s_2, \ldots, s_6$ of a row form the set B. Each friend gets a different seat, so the seating is a one-one function $f : A \to B$.

i. Can f be onto? Give a reason. *[1 mark]*

ii. How many one-one functions from A to B are there? *[1 mark]*

iii. If the row had only five seats, how many one-one functions would there be, and would each be onto? *[2 marks]*

Answers and worked solutions

Question 1

1 mark

All four pairs (a, a) are in R (reflexive); $(2, 3) \in R$ but $(3, 2) \notin R$ (not symmetric); every chain such as $(2, 3), (3, 3)$ gives a pair already in R (transitive) **A1**

Correct option: (a) It is reflexive and transitive but not symmetric.

Question 2

1 mark

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/relations-and-functions#iq-2

Question 3

1 mark

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/relations-and-functions#iq-3

Question 4

2 marks

Answer: Shown

Reflexive: $a - a = 0 = 5 \times 0$, so $(a, a) \in R$ for every integer a **A1**

Symmetric: if $a - b = 5m$, then $b - a = 5(-m)$, so $(a, b) \in R \Rightarrow (b, a) \in R$ **A1**

Question 5

2 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/relations-and-functions#iq-5

Question 6

3 marks

Answer: Symmetric only

Not reflexive: $(a, a) \in R$ needs $2a = 11$, which no $a \in A$ satisfies (e.g. $(1, 1) \notin R$) **A1**

Symmetric: $a + b = 11 \Rightarrow b + a = 11$ **A1**

Not transitive: $(1, 10) \in R$ and $(10, 1) \in R$, but $(1, 1) \notin R$ **A1**

Question 7

3 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/relations-and-functions#iq-7

Question 8

5 marks

Answer: Equivalence relation;

$[1] = \{1, 4, 7, 10, 13\}$; 3 classes

Reflexive: $a - a = 0$ is divisible by 3 **B1**

Symmetric: $a - b = 3m \Rightarrow b - a = 3(-m)$ **B1**

Transitive: $a - b = 3m$ and $b - c = 3n$ **M1**

$\Rightarrow a - c = 3(m + n)$, so $(a, c) \in R$: R is an equivalence relation **A1**

$[1] = \{1, 4, 7, 10, 13\}$; there are 3 classes (remainders 0, 1, 2 on division by 3) **A1**

Question 9

5 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/relations-and-functions#iq-9

Question 10

4 marks

i. No: 5 friends can fill at most 5 of the 6 seats, so one seat has no pre-image **A1**

ii. $6 \times 5 \times 4 \times 3 \times 2 = 720$ **A1**

iii. $5 \times 4 \times 3 \times 2 \times 1 = 120$ one-one functions **M1**
Each fills all five seats, so each is also onto (a bijection) **A1**

More on this chapter, free: revision notes, a Route to 95 and practice with instant feedback at cbsemathrevision.com/class-12/relations-and-functions
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