INDIAN SCHOOL AL WADI AL KABIR

Class XII, Mathematics

Worksheet- RELATIONS AND FUNCTIONS

29 - 07 - 2026

Q.1.	A function f: $R_+ \rightarrow R$ (where $R_+$is the set of all non−negative real numbers) defined by f(x) = 4x+3 is			
	A.	one-one but not onto	C	both one-one and onto
	B	onto but not one-one	D	neither one-one nor onto
Q.2	A relation R defined on a set of human beings as R = {(x, y) : x is 5 cm shorter than y} is:			
	A.	reflexive only	C.	symmetric and transitive
	B	reflexive and transitive	D	neither transitive, nor symmetric, nor reflexive

Q.3	A relation R defined on set A ={x/x$\epsilon Z, 0 \leq x \leq 10$} and R = {(x, y)/x=y} is given to be an equivalence relation. The number of equivalence classes is:							
	A.	1	B.	2	C.	10	D.	11
Q.4	Let f: $R_+ \rightarrow [-5, \infty)$ be defined as f(x)=9x^2 +6x -5, where $R_+$is the set of all non−negative real numbers, then f is							
	A.	One-one	B.	onto	C.	*bijection*	D.	Neither one-one nor Onto
Q.5	Which of the following statements is **not true** about equivalence classes A_i (i=1,2,3,……n) formed by an equivalence relation R defined on a set A?							
	A.	$\bigcup_{i=1}^{n} A_i = A$	B.	$A_i \cap A_j \neq \emptyset$, i≠ j	C.	$x\epsilon A_i, A_j \Rightarrow A_i = A_j$	D.	All elements of A_i are related to each other, for all i.
Q6.	Let f: $R_+ \rightarrow R_+$ defined as f(x)=x^2+1 where $R_+$is the set of all non−negative real numbers, ten R is							
	A	one-one but not onto	B	onto but not one-one	C	both one-one and onto	D	neither one-one nor onto
Q7.	Let Z be the set of integers, a function f defined by f(x)=x^3 -1is							
	A	both one-one and onto	B	one-one but not onto	C	onto but not one-one	D	neither one-one nor onto

Q8.	A function f : R → R is defined as $f(x) = x^2 - 4x + 5$ is							
	A	injective but not surjective.	B	surjective but not injective.	C	both injective and surjective.	D	neither injective nor surjective.
Q9.	For the set of real numbers R defined by $R_1 = \{(x, y)/x^2 + y^2 \leq 25\}$ and $R_2 = \{(x, y)/9y \geq 4x^2\}$ then $R_1 \cap R_2$ is							
	A	One-one	B	onto	C	bijection	D	None of these
Q10.	If f: $[0, \infty) \to [0, \infty), f(x) = \frac{x}{1+x}$, then f is							
	A	injective but not surjective.	B	surjective but not injective.	C	both injective and surjective.	D	neither injective nor surjective.
Q11.	If $f(x) + 2f(1-x) = x^2 + 2, \forall x \epsilon R$ then f(x) is given as							
	A	$x^2 - 2$	B	$\frac{(x-2)^2}{3}$	C	$\frac{(x-3)^2}{2}$	D	Not defined
Q12.	If the functions f(x) and g(x) are defined on R → R such that, $f(x)=\begin{cases} 0, & x \text{ is rational} \\ x, & x \text{ is irrational} \end{cases}$ and $g(x)=\begin{cases} 0, & x \text{ is irrational} \\ x, & x \text{ is rational} \end{cases}$ then (f-g)(x) is							
	A	one-one and onto	B	neither one-one nor onto	C	one-one but not onto	D	onto but not one-one
Q13.		Set A has 3 elements and the set B has 4 elements. Then the number of injective mappings that can be defined from A to B is						
	A	144	B	12	C	24	D	64
Q14 (i).	Let f: **R** → **R** be defined by $f(x) = x^2 + 1$. Then, pre-images of 17 and – 3, respectively, are							
	A	∅, {4, – 4}	B	{3, – 3}, ∅	C	{4, –4}, ∅	D	{4, – 4, {2, – 2}
Q14 (ii).	If f is a function such that f(0) = 2, f(1) = 3 and f(x+2) = 2f(x) – f(x+1) for every real x then f(5) is							
	A	12	B	13	C	21	D	22
Q15.	(A) A function f: N⟶ N given by $f(x)=x^3+2, \forall x \epsilon N$ is one-one but not onto function. (R) Since $\forall y \epsilon N$(codomain), there does not exist $x=(y-2)^{1/3}$ in N(Domain) such that $f(x)=x^3+2=y$							
	A	A and (R) are true and R is the correct explanation of (A)	B	A and (R) are true and R is not the correct explanation of (A)	C	A and (R) are true and R is the correct explanation of (A)	D	A and (R) are true and R is not the correct explanation of (A)

Q16.	(A): A relation R on the set {1,2,3} defined as R ={(1,1), (1,2), (2, 1), (2,2), (3,3) is an equivalence relation. (R): A relation that is reflexive, symmetric and transitive is an equivalence relation.			
	A	A and (R) are true and R is the correct explanation of (A)	B	A and (R) are true and R is not the correct explanation of (A)
	C	A is true but (R) is false	D	A is false but (R) is true
Q17.	Assertion(A): $R = \{(x, y)/x^2 + y^2 \leq 0\}$ is an empty relation. Reason(R)A relation R in a set A is called *empty relation*, if no element of A is related to any element of A, i.e., $R = \varphi \subset A \times A$.			
	A	A and (R) are true and R is the correct explanation of (A)	B	A and (R) are true and R is not the correct explanation of (A)
	C	A is true but (R) is false	D	A is false but (R) is true
Q18.	Assertion(A): In a class XII students group, a relation R is defined as R = {(*a*, *b*) : the difference between heights of *a* and *b* is less than 3 meters} is the universal relation. Reason(R): A relation R in a set A is called *universal relation*, if each element of A is related to every element of A, i.e., $R = A \times A$.			
	A	A and (R) are true and R is the correct explanation of (A)	B	A and (R) are true and R is not the correct explanation of (A)
	C	A is true but (R) is false	D	A is false but (R) is true
	Section B- Short answer type (2 marks)			
Q19.	A relation R on set A = {1, 2, 3, 4, 5} is defined as $R = \{(x,y)/\lvert x^2 - y^2\rvert < 8\}$, Check whether the relation Ris reflexive, symmetric, and transitive.			
Q20.	A function f is defined from R to R as f(x)=ax+b, such that f(1)=1 and f(2)=3. Find function f(x) and hence check whether f is one-one and bijective or not.			
Q21.	Let A = {0, 1, 2, 3} and define a relation R on A as follows: R = {(0, 0), (0, 1), (0, 3), (1, 0), (1, 1), (2, 2), (3, 0), (3, 3)}. Is R reflexive? symmetric? transitive?			
Q22.	For real numbers x and y, define xRy if and only if $x - y + \sqrt{2}$ is an irrational number. Then check whether it is an equivalence relation or not.			
Q23.	Let **C** be the set of complex numbers. Prove that the mapping f: **C**⟶**R** given by $f(z) = \lvert z\rvert$, $\forall z \in$ **C**, is neither one-one nor onto.			

	Section D- Long answer type (5 marks)
Q24.	Show that a function f : R → R is defined as f(x)=$\frac{2x}{1+x^2}$ is neither one-one nor onto. Further find a set A so that the given function f : R → A becomes an onto function.
Q25.	A relation R is defined on N × N where N is the set of Natural numbers as, $(a, b)R(c, d) \Leftrightarrow a - c = b - d$ show that R is an equivalence relation.
Q26.	A relation R is defined on N × N where N is the set of Natural numbers as, $(a, b)R(c, d) \Leftrightarrow ad = bc$ show that R is an equivalence relation.
Q27.	In the set of natural numbers **N**, define a relation R as follows: $\forall \boldsymbol{n}, \boldsymbol{m} \in$ **N**, nRm if on division by 5 each of the integers n and m leaves the remainder less than 5, i.e. one of the numbers 0, 1, 2, 3 and 4. Show that R is equivalence relation. Also, obtain the pairwise disjoint subsets determined by R.
Q28.	A relation R is defined on Z, the set of integers, as R = {(x, y) : |x – y| is divisible by a prime number 'p', x, y ϵ Z}. check whether R is an equivalence relation or not.
Q29.	Show that a function f : $R_+ \rightarrow A \subset N$, defined as $f(x) = 4x^2 + 12x + 15$ is one-one. Find set A so that f is onto where $R_+ = [0, \infty)$. Also, find if there exists a ϵ R_+ such that f(a) = 7. Justify.
Q30.	A relation R is defined on N × N where N is the set of Natural numbers as, $(a, b)R(c, d) \Leftrightarrow ad(b + c) = bc(a + d)$ show that R is an equivalence relation.
Case Study Based Questions	
Q31.	A school wants the students of class XII to do a project on 'Sustainability' keeping the world environment in mind. They select the student participants on the basis of an essay writing competition. 7 students out of 80 are selected for the project and are categorized into two sets such that: **Girl students belong to Set A** = {G1, G2, G3, G4} **Boy students belong to Set B** = {B1, B2, B3} **Based on the above information, answer the following questions:** 1. **i.** How many relations are possible from Set A to Set B? **(1 mark)** 2. **ii.** Let R be a relation from A to B such that: R = {(G1, B), (G2, B2), (G3, B2), (G4, B3), (G1, B2)} Is R an injective function? Justify your answer. **(1 mark)** 3. **a.** Let the relation R from A A be such that: R = {(x, y) : x, y in A, x and y are students from the same colony in the city} Verify if R is an equivalence relation. **(2 marks) OR** **b.** Verify if any function f: B to A is bijective. Give reason to support your answer. **(2 marks)**

Q32.	An exhibit in the museum depicted many rail lines on the track near the railway station. Let L be the set of all rail lines on the railway track and R be the relation on L defined by $R=\{(l_1, l_2): l_1$ is parallel to $l_2\}$ On the basis of the above information, answer the following questions: (i) Find whether the relation R is symmetric or not. (ii) Find whether the relation R is transitive or not. (iii) If one of the rail lines on the railway track is represented by the equation $y = 3x + 2$, then find the set of rail lines in R related to it. **OR** Let S be the relation defined by $S = \{(l_1, l_2) : l_1$ is perpendicular to $l_2\}$ check whether the relation S is symmetric and transitive.

ANSWER KEY

1	A	2	D	3	D	4	C
5	B	6	A	7	B	8	D
9	D	10	A	11	B	12	A
13	C	14(1)	C	14(2)	D	15	A
16	A	17	D	18	A		

19	• **Reflexive:** Yes, $\lvert x^2 - x^2 \rvert = 0 < 8$. • **Symmetric:** Yes, $\lvert x^2 - y^2 \rvert = \lvert y^2 - x^2 \rvert < 8$. • **Transitive:** No (e.g., (1, 3) ∈ R since $\lvert 1 - 9 \rvert$= 8 ≮ 8 is false, but (1, 2) ∈ R and (2, 3) ∈ R, while (1, 3) ∉ R.	20	f(1) = a + b = 1 , f(2) = 2a + b = 3 ⟹ a = 2, b = -1. • **Function:** f(x) = 2x - 1. • **One-one & Bijective:** Yes, as linear polynomial on ℝ is a bijection.
21	• Reflexive: **Yes** • Symmetric: **Yes** • Transitive: **Yes**	22	**Not an equivalence relation.** • Not reflexive: x - x + 2 = 2 (rational), so (x, x) ∉ R.
23	• **Not one-one:** f(1) = f(-1) = 1. • **Not onto:** f(z) = $\lvert z \rvert \geq 0$, negative real numbers in codomain ℝ have no pre-images.	24	• **Not one-one:** f(2) = f(1/2) = 4/5. • **Not onto:** Range of f(x) is [-1, 1] ≠ ℝ. • **Set A:** A = [-1, 1].
25	Proof that (a, b) R (c, d) ⟺ a - c = b - d satisfies: 1. **Reflexive:** a - a = b - b = 0. 2. **Symmetric:** a – c = b - d ⟹ c – a = d - b. 3. **Transitive:** Adding equations shows (a,b) R (e,f). Hence, an **Equivalence Relation**.	26	Proof that (a,b) R (c,d) ⟺ ad = bc satisfies Reflexivity, Symmetry, and Transitivity on ℕ × ℕ. Hence, an **Equivalence Relation**.
27	• **Equivalence Relation:** Verified for Reflexivity, Symmetry, Transitivity mod 5. • **Disjoint Subsets:** Partitioned into 5 equivalence classes [0], [1], [2], [3], [4] based on remainder when divided by 5.	28	Verified Reflexive ($\lvert x - x \rvert = 0$ is divisible by p), Symmetric ($\lvert x - y \rvert = \lvert y - x \rvert$), and Transitive. Thus, R **is an equivalence relation**.
29	• **One-one:** $4x_1^2 + 12x_1 + 15 = 4x_2^2 + 12x_2 + 15 \Longrightarrow x_1 = x_2$ for $x \geq 0$. • **Set A:** Range = [15, ∞). • **For f(a)=7 :** $4a^2+12a+15 = 7 \Longrightarrow 4a^2+12a+8=0 \Longrightarrow a = -1, -2 \notin R^+$. No such a exists.	30	Proof that ad(b + c) = bc(a + d) ⟺ $\frac{1}{b} + \frac{1}{c} = \frac{1}{a} + \frac{1}{d}$ satisfies Reflexive, Symmetric, and Transitive properties on ℕ × ℕ. Hence, an **Equivalence Relation**.
31(i)	Total relations from A (n = 4) to B (n = 3) = $2^{4 \times 3} = 2^{12} = 4096$.	31(ii)	**Not an injective function** (nor a function at all because G_1 has two outputs B_1 and B_2).

31(iii) (a)	R is an **Equivalence Relation** (Reflexive: same colony; Symmetric: mutual colony; Transitive: standard chain).	OR (b)	**Not bijective because $\lvert B\rvert$ = 3 and $\lvert A\rvert$ = 4. A bijection requires equal cardinality ($\lvert B\rvert$ = $\lvert A\rvert$).**
32(i)	**Symmetric:** Yes, if $l_1 \parallel l_2$, then $l_2 \parallel l_1$.	32(ii)	**Transitive: Yes, if $l_1 \parallel l_2$ and $l_2 \parallel l_3$, then $l_1 \parallel l_3$.**
32(iii) (a)	**Set of lines related to y = 3x + 2 is {y = 3x + c |c$\in$ $\mathbb{R}$}.**	OR (b)	**For Relation ($\perp$):** **• Symmetric: Yes ($l_1 \perp l_2 \implies l_2 \perp l_1$).** **• Transitive: No ($l_1 \perp l_2$ and $l_2 \perp l_3 \implies l_1 \parallel l_3$).**

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