MATHS

BOOKS - FULL MARKS MATHS (TAMIL ENGLISH)

SETS, RELATIONS AND FUNCTIONS

Example

1. Find the number of subsets of A if A = { X : X = 4n +1, 2 $\leq n \leq 5, n \in \mathbb{N}$ }

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2. In a survey of 5000 persons in a town, it was found that 45% of the persons know Languages A, 25% know language, B, 10% know language C, 5% know languages A and B, 4% know languages B and C, and 4% know

Language A and C. If 3% of the persons know and the three Languages, find the number of persons who knows only Languages A.

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3. Prove that $((A \cup B' \cap C) \cap (A \cap B' \cap C')) \cup ((A \cup B \cup C') \cap (B' \cap C')) = B' \cap$

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4. If X={1,2,3,.....10} and A={1,2,3,4,5}, find the number of sets $B \subseteq X$ such that A-B={4}

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5. If A and B are two sets so that n(B-A) =2n (A-B) $= 4n(A \cap B)$ and if $n(A \cup B) = 14$, then find n(P(A)).

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6. Two sets have m and k elements. If the total number of subsets of the first set is 112 more than that of the second set, find the values of m and k.

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7. If n(A)=10 and $n(A \cap B) = 3, \quad \text{find } n(A \cap B)' \cap A).$

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8. If A = {1,2,3,4} and B = {3,4,5,6}, find n $((A \cup B) \times (A \cap B) \times (A \Delta B)).$

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9. If P(a) denotes the Power set A and A is void set, then n(P(P(P(a)))) is:

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10. Check the relation R={(1,1),(2,2),(3,3),.....,(n,n)} defined on the set S= {1,2,3,.....n) for the three basic relations.

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11. In the set Z of integers, define m Rn if m-n is a multiple of 12. Prove that R is an equivalence relation.

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12. Check whether the following functions are on-to-one and onto.

$f: N \to N$ defined by $f(n)=n+2$

(ii) $f: N \cup \{-1, 0\} \to N$ defined by $f(n)=n+2$

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13. Check whether the following functions are on-to-oneness ande ontoness.

(i) $f: N \to N$ defined by f(n)=n^2

(ii) $f: R \to R$ defined by f(n) = n^2

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14. Check whether the following for one-to-oneness and ontoness.

(i) $f: R \to R$ defined by f(x)=$\frac{1}{x}$

(ii) $f: R - \{0\}$ defined by f(x) = $\frac{1}{x}$.

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15. If f : R - (-1,1) $\to$ R is defined by f(x) = $\frac{x}{x^2 - 1}$, verify whether f is one to one.

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16. If $f: R \to R$ is defined $f(x) = 2x^2 - 1$, find the pre-images of 17,4 and -2.

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17. If $f: [-2, 2] \to B$ is given by $f(x) = 2x^3$, then find B so that f is onto.

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18. Fnind the domain of f(x) $= \frac{1}{1 - 2\cos x}$.

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19. Find the range of the function $f(x) = \frac{1}{1 - 3\cos x}$

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20. Find the largest possible domain for the real valued function f defined by $f(x) = \frac{\sqrt{9-x^2}}{\sqrt{x^2-1}}$

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21. Let $f = \{(1,2),(3,4),(2,2)\}$ and $g = \{(2,1),(,3,1),(4,2)\}$. Find gof and fog.

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22. Let f={(1,4),(2,5),(3,5)} and g={(4,1),(5,2),(6,4)}. Find gof Can you find fog?

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23. Let f and g be the two functions from R to R defined by f(x)-3x-4 and $g(x) = x^2 + 3$. Find gof and fog.

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24. Show that the statement, "if f and gof are one-to-one, then g is one-to-one", is not true.

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25. If $f : \mathbb{R} \to \mathbb{R}$ is defined by f (x) = 2x -3, then prove that f is a bijection and find its inverse.

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Addtional Question Solved

1. Write the following sets in roster form

(i) $\{x \in N, x^3 < 1000\}$

(ii) The set of postive roots of the equation $\{(x^2 - 4)(x^3 - 27)\} = 0$

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2. By taking suitable sets A,B,C, verify the following result

(i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $(B - A) \cup C = (B \cup C) - (A - C)$

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3. Given n(A)=,7n(B)=8 and $n(A \cup B) = 10$ find $n[P(A \cap B)]$.

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4. Find the range of the function

$f = \{(1, x), (1, y), (2, x), (2, y), (3, z)\}$

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5. Find the domain and range of the function $f(x) = \frac{1}{\sqrt{x - 5}}$

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6. If $f(x) = \frac{x-1}{x+1}, x \neq 1$ show that $f(f(x)) = \frac{-1}{x}$ provided $x \neq 0$.

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7. Find the domain of each of the following functions given by: $f(x) = \frac{x^3 - x + 3}{x^2 - 1}$

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8. Find the range of the following functions given by $f(x) = 1 + 3\cos 2x$

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9. Find the domain and range of the function $f(x) = \frac{x^2 - 9}{x - 3}$

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10. Find the range of the following function given by $f(x) = \frac{1}{2 - \sin 3x}$

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Exercise 1 1

1. Write the following in roster form.

(i) $y = (x + 1)^{\left(\frac{1}{3}\right)}$

(ii) the set of all postive roots of the eqution $(x - 1)(x + 1)\left(x^2 - 1\right) = 0$

(iii) $\{x \in N : 4x + 9 < 52\}$.

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2. Write the set {-1,1} in set builder form.

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3. By taking suitable sets A,B,C, verify the following result :

(i) $A \times (B \cap C) = (A \times B) \cap (A \times C)$.

(ii) $A \times (B \cup C) = (A \times B) \cup (A \times C)$.

(iii) $(A \times B) \cap (B \times A) = (A \cap B) \times (B \cap A)$.

(iv) $C - (B - A) = (C \cap A) \cup (C \cap B')$.

(v) $(B - A) \cap C = (B \cap C) - A = B \cap (C - A)$.

(vi) $(B - A) \cup C = (B \cup C) - (A - C)$.

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4. Justify the trueness of the statement " An element of a set can never be a subset of itself ".

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5. If n (p(A)) = 1024, n (A $\cup$ B) = 15 and n (P (B)) = 32, then find n (A $\cap$ B).

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6. If n(A $\cap$ B) = 3 and n (A $\cup$ B) = 10 then find n (P (A $\triangle$ B))

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7. For a set A, $A \times A$ contains 16 elements and two of its elements are (1,3) and (0,2). Find the elements of A.

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8. Let A and B be two sets such that n (A) = 3 and n(B) =2. If (x,1) (y,2) (z,1) are in $A \times B$, find A and B, where x,y,z are distinct elements.

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9. If $A \times A$ has 16 elements, S = {(a,b) $\in A \times A : a < b$}, (-1,2) and (0,1) are two elements of S, then find the remaining elements of S.

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Exercise 1 2

1. Let X = {a, b,c,d}, and R = { (a,a) (b,b) (a,c)}. Write down the minimum number of ordered pairs to be included to R to make it

(i) reflexive (ii) symmetric

(iii) transitive (iv) equivalence.

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2. Let X = {a, b,c,d}, and R = { (a,a) (b,b) (a,c)}. Write down the minimum number of ordered pairs to be included to R to make it

(i) reflexive (ii) symmetric

(iii) transitive (iv) equivalence.

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3. Let P be the set of all triangles in a plane and R be the relation defined on P as a Rb if a is similar to b. Prove that R is an equivalence relation .

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4. On the set of natural number let R be the relation defined by aRb if 2a +3b=30. Write down the relation by listing all the pair . check whether it is (i) reflexive (ii) symmetric (iii) transitive (iv) equivalence

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5. Prove that the relation " friendship " is not an equivalence relation on the set of all people in Chennai.

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6. Let A = {a,b,c }. What is the equivalence relation of smallest cardinality on A ? What is the equivalence relation of largest cardinality on A?

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7. In the set Z of integers, define mRn if m-n is divisible by 7. Prove that R is an equivalence relation.

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Exercise 1 3

1. Suppose that 120 students are studying in 4 sections of eleventh standard in a school. Let A denotes the set of students and B denote the set of the sections. Define a relation from A to B as "x related to y if the student x belongs to the section y". Is this relation a function ? What can you say about the inverse relation ? Explain your answer.

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2. Write the values of f at -4,1,-2,7,0 if f(x)=

$$\begin{cases} -x+4 & \text{if} \quad -\infty < x \leq -3 \\ x+4 & \text{if} \quad -3 < x < -2 \\ x^2 - x & \text{if} \quad -2 \leq x < 1 \\ x - x^2 & \text{if} \quad 1 \leq x < 7 \\ 0 & \text{otherwise} \end{cases}$$

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3. Write the values of f at -3,5,2,-1,0 if f(x)=

$$\begin{cases} x^2 + x - 5 & \text{if} \quad x \in (-\infty, 0) \\ x^2 + 3x - 2 & \text{if} \quad x \in (3, \infty) \\ x^2 & \text{if} \quad x \in (0, 2) \\ x^2 - 3 & \text{otherwise} \end{cases}$$

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4. Find the domain of $\frac{1}{1 - 2\sin x}$.

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5. Find the largest possible domain of the real valued function f(x) = $\frac{\sqrt{4-x^2}}{\sqrt{x^2-9}}$.

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6. Find the range of the function $\frac{1}{2\cos x - 1}$.

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7. Show that the relation xy = -2 is a function for a suitable domain. Find the domain and the range of the function.

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8. If f,g,h are real valued function defined on R, then prove that (f+g)oh=foh+goh. what can you say about fo(g+h)? Justify your answer.

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9. If : $\mathbb{R} \to \mathbb{R}$ is defined by f(x) = 3x-5, prove that f is a bijection and find its inverse.

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10. The weight of the muscles of a man is a function of his body weight x and can be expressed as W(x) = 0.35x. Determine the domain of this function.

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11. The distance of an object falling is a function of time t and can be expressed as s(t) = $-16t^2$. Graph the function and determine if it is one-to-one.

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12. The total cost of airfare on a given route is comprised of the base cost C and the fuel surcharge S in rupee. Both C and S are functions of the mileage m, C(m) =0.4 m +50 and S(m) = 0.03 m. Determine a function for the total cost of a ticket in terms of the mileage and find the airfare for flying 1600 miles.

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13. A salesperson whose annual earnings can be represented by the function A (x) = 30,000+0.04x, where x is the rupee value of the merchandise he sells. His son is also in sales and his earnings are represented by the function S(x) = 25,000 +0.05 x. Find (A+S) (x) and determine the total family income if they each sell Rs 1,50,00,000 worth of merchandise.

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14. The function for exchanging American dollars for Singapore Dollar on a given day is f(x) = 1.23 x, where x represents the number of American dollars. On the same day the function for exchanging Singapore Dollar to Indian Rupee is g(y) = 50.50 y , where y represents the number of Singapore dollars. Write a function which will give the exchange rate of American dollars in terms of Indian rupee.

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15. The owner of a small restaurant can prepare a particular meal at a cost of Rupees 100. He extimate that if the menu price of the meal is x rupees, then the number of customers who will order that meal at that price in an evening is given by the function D (x) = 200 - x. Express his day revenue total cost and profit on this meal as a function of x.

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16. The formula for converting from Fahrenheit to Celsius temperatures is $y = \frac{5x}{9} - \frac{160}{9}$. Find the inverse of this function and determine whether the inverse is also a function.

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17. A simple ciphertakes a number and codes it, using the function f(x)=3x-4. Find the inverse of this function, determine whether the inverse is also a function and verify the symmetrical property about the line y-x (by drawing the lines).

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Exercise 1 4

1. Graph the functions f (x) = x^3 and g(x) = $\sqrt[3]{x}$ on the same co-ordinate plane. Find fog and graph it on the plane as well. Explain your results.

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2. Write the steps to obtain graph of steps to obtain the graph of the function y = 3 $(x-1)^2$+5 from the graph y = x^2.

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3. From the curve y= sinx, graph the function

(i) $y = \sin(-x)$

(ii) $y = -\sin(-x)$

(iii) $y = \sin\left(\frac{\pi}{2} + x\right)$ which is cos x

(iv) $y = \sin\left(\frac{\pi}{2} - x\right)$ which is also cos x (refer trigonometry)

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4. From the curve y = sin x draw y = sin |x| (Hint : sin (-x) = -sin x.)

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Exercise 1 5

1. If A= {(x,y) : y = e^x, $x \in R$} and B = { (x,y) : y = e^{-x}, $x \in$ R } then n (A $\cap$ B) is

A. Infinity

B. 0

C. 1

D. 2

Answer: C

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2. If A = { (x,y) : y = sin x, x $\in$ R } and B = { (x,y) : y = cos x, x $\in$ R} then A $\cap$ B contains

A. no element

B. infinitely many element

C. only one element

D. cannot be determined

Answer: B

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3. The relation R defined on a set A = { 0,-1,1,2} by xRy if $|x^2 + y^2| \leq 2$, then which one of the following is true?

A. R={(0,0),(0,-1),(0,1),(-1,0),(-1,1),(1,2),(1,0)}

B. $R^{-1} = \{(0, 0), (0, -1), (0, 1), (-1, 0)1, 0)\}$

C. Domain of R is {0,-1,1,2}

D. Range of R is (0,-1,1}

Answer: D

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4. If f(x) = |x-2|+|x+2|,x $\in$ R, then

A. $f(x) = \begin{cases} -2x & \text{if } x \in (-\infty, 2] \\ 4x & \text{if } x \in (-2, 2] \\ 2x & \text{if } x \in (-\infty, -2] \end{cases}$

B. $f(x) = \begin{cases} 2x & \text{if } x \in (-\infty, 2] \\ 4x & \text{if } x \in (-2, 2] \\ -2x & \text{if } x \in (2, \infty] \end{cases}$

C. $f(x) = \begin{cases} -4x & \text{if } x \in (-2, 2] \\ 2x & \text{if } x \in (2, \infty) \\ 2x & \text{if } x \in (2, \infty) \end{cases}$

D. $f(x) = \begin{cases} -2x & \text{if } x \in (-\infty, -2] \\ 2x & \text{if } x \in (2, \infty] \\ 2x & \text{if } x \in (2, \infty) \end{cases}$

Answer: A

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5. Let $\mathbb{R}$ be the set of all real numbers. Consider the following subsets of the plane $\mathbb{R} \times \mathbb{R}$:S = { (x,y) : y=x+1 and 0 $< x <$ 2} and T = { (x,y) : x-y is an integer }. Then which of the following is true ?

A. T is an equivalence relation but S is not an equivalence relation.

B. Neigher S nor T is an equivalence relation.

C. Both S and T are equivalence relation

D. S is an equivalence relation but T is not an equivalence realtion.

Answer: A

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6. Let A and B be subsets of the universal set $\mathbb{N}$, the set of natural numbers. Then A' $\cup [(A \cap B) \cup B']$ is

A. A

B. A'

C. B

D. N

Answer: D

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7. The number of students who take both the subjects Mathematics and Chemistry is 70. This represent 10 % of the enrollment in Mathematics and 14% of the enrollment in Chemistry. The number of students take at least one of these two subjects, is

A. 1120

B. 1130

C. 1100

D. insufficient data

Answer: B

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8. If $n[(A \times B) \cap (B \times c) = 3,$ and $n(B \cap C) = 2$ then n(A) is ..... .

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9. If n (A) = 2 and n $(B \cup C)$ =3 then n $[(A \times B) \cup (A \times C)]$ is

A. 2^3

B. 3^2

C. 6

D. 5

Answer: C

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10. If two sets A and B have 17 elements in common, then the number of elements common to the set $A \times B$ and $B \times A$ is

A. 2^{17}

B. 17^2

C. 34

D. insufficient date

Answer: C

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11. For non-empty sets A and B, if A $\subset B$then$(A \times B) \cap (B \times A)$ is equal to

A. $A \subset B$

B. $A \times A$

C. $B \times B$

D. None of these

Answer: B

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12. The number of relations on a set containing 3 elements is

A. 9

B. 81

C. 512

D. 1024

Answer: B

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13. Let R be the universal relation on a set X with more than one element.

Then R is

A. Not reflexive

B. Not symmetric

C. Transitive

D. None of the above

Answer: C

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14. Let X = { 1,2,3,4 } and R = { (1,1), (1,2),(1,3),(2,2), (3,3),(2,1),(3,1),(1,4),(4,1)}.

Then R is

A. Reflexive

B. Symmetric

C. Transitive

D. equivalence

Answer: B

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15. The range of the function $\frac{1}{1-2\sin x}$ is

A. $(-\infty, -1) \cup \left(\frac{1}{3}, \infty\right)$

B. $\left(-1, \frac{1}{3}\right)$

C. $\left[-1, \frac{1}{3}\right]$

D. $(-\infty, -1] \cup \left[\frac{1}{3}, \infty\right)$

Answer: D

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16. The range of the function f(x) = $|\lfloor x \rfloor - x|$, $x \in \mathbb{R}$ is

A. [0,1]

B. $[0, \infty)$

C. [0,1]

D. [0,1]

Answer: D

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17. The rule f(x) = x^2 is a bijection if the domain and the co-domain are given by

A. R,R

B. $R, (0, \infty)$

C. $(0, \infty), R$

D. $[0, \infty), [0, \infty)$

Answer: D

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18. The number of relations form a set containing melements to a set containing n elements is

A. mm

B. m

C. n

D. m+n

Answer: C

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19. The function f : $[0,2\pi] \to 1$ [-1,1] defined by f(x) = sin x is

A. One to one

B. onto

C. Bijiection

D. Cannot to befined

Answer: B

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20. If the function f : [-3,3] $\rightarrow$ S defined by f(x) = x^2 is onto, then S is

A. [-9,9]

B. R

C. [-3,3]

D. [0,9]

Answer: D

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21. Let X = { 1,2,3,4}, Y = {a,b,c,d} and f={(1,a), (4,b), (2,c),(3,d),(2,d)}. Then f is

A. An one-to-one function

B. An onto function

C. An function which is not one-to one

D. Not a function

Answer: D

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22. The inverse of f(x) = $\begin{cases} x & \text{if} \quad x < 1 \\ x^2 & \text{if} \quad 1 \leq x \leq 4 \\ 8\sqrt{x} & \text{if} \quad x > 4 \end{cases}$ is

A. $f^{-1}(x) = \begin{cases} x: & x < 1 \\ \sqrt{x} & 1 \leq x \leq 16 \\ \frac{x^2}{64}: & x > 16 \end{cases}$

B. $f^{-1}(x) = \begin{cases} -x: & x < 1 \\ \sqrt{x} & 1 \leq x \leq 16 \\ \frac{x^2}{64}: & x > 16 \end{cases}$

C. $f^{-1}(x) = \begin{cases} x^2: & x < 1 \\ \sqrt{x} & 1 \leq x \leq 16 \\ \frac{x^2}{64}: & x > 16 \end{cases}$

D. $f^{-1}(x) = \begin{cases} 2x: & x < 1 \\ \sqrt{x} & 1 \leq x \leq 16 \\ \frac{x^2}{8}: & x > 16 \end{cases}$

Answer: A

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23. Lett f: $R \to R$ be defined by f(x)=1-|x|. Then the range of f is

A. R

B. $(1, \infty)$

C. $(-1, \infty)$

D. $(-\infty, 1]$

Answer: D

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24. The function f:$R \to R$ is defined by f(x)= sin x+ cos x is .....

A. An odd function

B. Neither an odd function nor an even function

C. An even function

D. Both odd function and even function

Answer: B

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25. The function $R \to R$ is defined by $f(x) = \cos x$ is .....

A. An odd function

B. Neither an odd function nor an even function

C. An even function

D. Both odd function and even function

Answer: C

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