MATHS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

SETS, RELATIONS AND FUNCTIONS

Exercise 1 Topical Problems Type Of Set Operations And Cartesion Products

1. If $X = \{4^n - 3n - 1 : n \in N\} and Y = \{9(n-1) : n \in N\}$, where N is the set of natural numbers, then $X \cup Y$ is equal to (1) N (2) Y - X (3) X (4) Y

A. N

B. $Y - X$

C. X

D. Y

Answer: D

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2. The total number of subsets of a finite set A has 56 more elements than the total number of subsets of another finite set B. What is the number of elements in the set A?

A. 5

B. 6

C. 7

D. 8

Answer: B

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3. If $A = \{(x, y) : y = e^{-x}\}$ and $B = \{(x, y) : y = -x\}$. Then,

A. $A \cap B = \phi$

B. $A \subset B$

C. $B \subset A$

D. $A \cap B = \{(0, 1), (0, 0)\}$

Answer: A

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4. There are 100 students in a class. In the examination, 50 of them failed in Mathematics, 45 failed in Physics, 40 failed in Biology and 32 failed in exactly two of the three subjects. Only one student passed in all the subjects. Then, the number of students failing in all the three subjects is

A. 12

B. 4

C. 2

D. Cannot be determined

Answer: C

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5. Out of 64 students, the number of students taking Mathematics is 45 and number of students taking both Mathematics and Biology is 10. Then, the number of students taking only Biology is

A. 18

B. 19

C. 20

D. None of these

Answer: B

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6. If A and B are two sets, then $(A \cup B') \cap (A' \cap B)$ is equal to

A. A'

B. A

C. B'

D. None of these

Answer: D

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7. $A = \{1, 2\}, B = \{\{1\}, \{2\}\}, C = \{\{1, 2\}\}$. Then, which of the following relation is correct ?

A. A = B

B. $B \subseteq C$

C. $A \in C$

D. $A \subset C$

Answer: C

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8. Universal set,

$U = \{x \mid x^5 - 6x^4 + 11x^3 - 6x^2 = 0\}$

$A = \{x \mid x^2 - 5x + 6 = 0\}$

$B = \{x \mid x^2 - 3x + 2 = 0\}$

What is $(A \cap B)'$ equal to ?

A. $\{1, 3\}$

B. $\{1, 2, 3\}$

C. $\{0, 1, 3\}$

D. $\{0, 1, 2, 3\}$

Answer: C

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9. If $A = \{1, 2, 3, 4\}$ and $B = \{2, 4, 6\}$. Then, the number of set C such that $A \cap B \subseteq C \subseteq A \cup B$ is

A. 6

B. 9

C. 8

D. 10

Answer: C

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10. In a class of 30 pupils, 12 take Chemistry, 16 take Physics and 18 take History. If all the 30 students take atleast one subject and no one take all three, then the number of pupils taking 2 subjects is

A. 16

B. 6

C. 8

D. 20

Answer: A

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11. If $A \subseteq B$, then $B \cup A$ is equal to

A. $B \cap A$

B. A

C. B

D. None of these

Answer: C

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Exercise 1 Topical Problems Relation And Equivalence Relation

1. Let $R = \{(3, 3), (6, 6), (9, 9), (12, 12), (6, 12), (3, 9(, (3, 12), (3, 6)\}$ be relation on the set $A = \{3, 6, 9, 12\}$. The relation is-

A. an equivalence relation

B. reflexive and symmetric

C. reflexive and transitive

D. only reflexive

Answer: C

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2. Let S be set of all real numbers and let R be relation on s , defined by $aRb \Leftrightarrow |a - b| \leq 1.$ then R is

A. symmetric and transitive but not reflexive

B. reflexive and transitive but not symmetric

C. reflexive and symmetric but not transitive

D. an equivalence relation

Answer: C

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3. If Z is the set of integers. Then, the relation $R = \{(a, b) : 1 + ab > 0\}$ on Z is

A. reflexive and transitive but not symmetric

B. symmetric and transitive but not reflexive

C. reflexive and symmetric but not transitive

D. an equivalence relation

Answer: C

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4. If A and B are two equivalence relations defined on set C, then

A. $A \cap B$ is an equivalence relation

B. $A \cap B$ is not an equivalence relation

C. $A \cup B$ is an equivalence relation

D. $A \cup B$ is not an equivalence relation.

Answer: A

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5. R is a relation on N given by

$R = \{(x, y) : 4x + 3y = 20\}$. Which of the following belongs to R?

A. (-4, 12)

B. (5, 0)

C. (3, 4)

D. (2, 4)

Answer: D

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6. Let $A = \{1, 2, 3\}, B = \{2, 3, 4)$ be two sets, which one of the following subsets of $A \times B$ defines a funciton from A to B?

A. $\{(1, 2), (2, 3), (3, 4), (2, 2)\}$

B. $\{(1, 2), (2, 3), (1, 3)\}$

C. $\{(1, 3), (2, 3), (3, 3)\}$

D. $\{(1, 1), (2, 3), (3, 4)\}$

Answer: C

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7. R is a relation from {11, 12, 13} to {8, 10, 12} defined by $y = x - 3$. Then, R^{-1} is (a) {(8, 11), (10, 13)} (b) {(11, 8), (13, 10)} (c) {(10, 13), (8, 11), (8, 10)} (d) none of these

A. $\{(8, 11), (10, 13)\}$

B. $\{(11, 18), (13, 10)\}$

C. $\{(10, 13), (8, 11)\}$

D. None of these

Answer: A

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8. Let w denote the words in the english dictionary. Define the relation R by: R = $\{(x, y) \in W \times W \mid$ words x and y have at least one letter in common}. Then R is: (1) reflexive, symmetric and not transitive (2) reflexive, symmetric and transitive (3) reflexive, not symmetric and transitive (4) not reflexive, symmetric and transitive

A. reflexive, symmetric and not transitive

B. reflexive, symmetric and transitive

C. reflexive, not symmetric and transitive

D. not reflexive, symmetric and transitive

Answer: A

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9. Which of the following statements is not correct for the R by aRb if and only if b lives within one kilometer from a (a) R is reflexive (b) R is symmetric (c) R is not anti-symmetric (d) None of the above

A. R is reflexive

B. R is symmetric

C. R is anti-symmetric

D. None of these

Answer: C

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10. Let R be a relation on the set of integers given by $aRb \Leftrightarrow a2^k.\ b$ for some integer k. Then, R is

A. an equivalence relation

B. reflexive but not symmetric

C. reflexive and transitive, but not symmetric

D. reflexive and symmetric, but not transitive

Answer: A

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Exercise 1 Topical Problems Types Of Mapping

1. The function $f(x) = x^2 + bx + c$, where b and c are real constants, describes

A. one-one mapping

B. onto mapping

C. not one-one but onto mapping

D. Neither one-one nor onto mapping

Answer: D

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2. The function $f: [0, 3] \to [1, 29]$, defined by $f(x) = 2x^3 - 15x^2 + 36x + 1$ is

A. one-one and onto

B. onto but not one-one

C. one-one but not onto

D. Neither one-one nor onto

Answer: B

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3. On the set of integers Z, define f : $Z \to Z$ as

$$f(n) = \begin{cases} \frac{n}{2}, & \text{n is even.} \\ 0, & \text{n is odd.} \end{cases}$$

Then, f is

A. injective but not surjective

B. Neither injective nor surjective

C. surjective, but not injective

D. bijective

Answer: C

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4. If $n(A) = 4$ and $n(B) = 6$. Then, the number of one-one function from A to B is

A. 24

B. 60

C. 120

D. 360

Answer: D

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5. Let $f: N \to N$ be defined by $f(x) = x^2 + x + 1, x \in N$. Then is f is

A. one-one and onto

B. many-one and onto

C. one-one but not onto

D. None of the above

Answer: C

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6. Which one of the following functions is one-one?

A. $f(x) = \sin x, x \in [-\pi, \pi]$

B. $f(x) = \sin x, x \in \left[-\frac{3\pi}{2}, -\frac{\pi}{4}\right]$

C. $f(x) = \cos x, x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

D. $f(x) = \cos x, x \in \left[\pi, \frac{3\pi}{2}\right]$

Answer: D

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7. A mapping $f: N \to N$ where N is set of natural numbers is destined as

$f(n) = n^2, n = odd$ and $2n + 1, n = even$ for $n \in N$ then f is

A. surjective but not injective

B. injective but not surjective

C. bijective

D. Neither injective nor surjective

Answer: D

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8. The mapping f : $N \to N$ given by $f(n) = 1 + n^2, n \in N$, where N is the set of natural numbers, is

A. one-one and onto

B. onto but not one-one

C. one-one but not onto

D. Neither one-one nor onto

Answer: C

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9. A function f : $A \to B$, where $A = \{x: -1 \leq x \leq 1\}$ and $B = \{y: 1 \leq y \leq 2\}$ is defined by the rule $y = f(x) = 1 + x^2$. Which of the following statement is correct ?

A. f is injective but not surjective

B. f is surjective but not injective

C. f is both injecitve and surjective

D. f is neither injective nor surjective

Answer: B

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10. Let $f(x) = [0$, if x is rational and x if x is irrational and $g(x) = [0$, if x is irrational and x if x is rational then the function $(f - g)x$ is

A. one-one and into

B. Neither one-one nor onto

C. many-one and onto

D. one-one and onto

Answer: D

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Exercise 1 Topical Problems Domain Range Odd Even And Periodic Functions

1. If $f(x)$ is an odd periodic function with period 2, then f(4) equals to-

A. -4

B. 4

C. 2

D. 0

Answer: D

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2. The period of $\sin^2\theta$, is

A. π^2

B. π

C. 2π

D. $\frac{\pi}{2}$

Answer: B

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3. Which one of the following is not correct for the feature of exponential function given by

$f(x) = b^x$, where $b > 1$?

A. For very large negative values of x, the function is very close to 0

B. The domain of the funcation is R. the set of real numbers

C. The point (1,0) is always on the graph of the function

D. The range of the function is the set of all positive real numbers

Answer: C

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4. Let A = {1, 2, 3, 4) and R be the relation on A defined by {(a, b) : a, be A, a Ã— b is an even number}, then the range of R is

A. $\{1, 2, 3, 4\}$

B. $\{2, 4\}$

C. $\{2, 3, 4\}$

D. $\{1, 2, 4\}$

Answer: B

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5. Find the domain of the function

$f(x) = \left(x^2 + 1\right) / \left(x^2 - 3x + 3\right).$

A. $R - \{1, 2\}$

B. $R - \{1, 4\}$

C. R

D. $R - \{1\}$

Answer: C

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6. Find the range of function, f: [0,1] -> R,

$f(x) = x^3 - x^2 + 4x + 2\sin^{-1} x.$

A. $[-(\pi + 2), 0]$

B. $[0, 4 + \pi]$

C. $[2, 3]$

D. $[0, 2 + \pi]$

Answer: B

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7. If $A = \{1, 2, 3, 4, 5\}$, then find the domain in the relation from A to A by $R = \{(x, y) : y = 2x - 1\}$.

A. $\{1, 2, 3\}$

B. $\{1, 2\}$

C. $\{1, 3, 5\}$

D. $\{2, 4\}$

Answer: A

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8. The domain of the function $f(x) = \log_{2x-1}(x-1)$ is

A. $(1, \infty)$

B. $\left(\frac{1}{2}, \infty\right)$

C. $(0, \infty)$

D. None of these

Answer: A

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9. If $f(x) = \frac{1}{2} - \tan\left(\frac{\pi x}{2}\right), \ -1 < x < 1$ and $g(x) = \sqrt{3 + 4x - 4x^2}$, then domain $(f + g)$ is given by

A. $\left[\frac{1}{2}, 1\right]$

B. $\left[\frac{1}{2}, -1\right]$

C. $\left[-\frac{1}{2}, 1\right]$

D. $\left[-\frac{1}{2}, -1\right]$

Answer: C

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10. The range of the function $f(x) = \tan\sqrt{\frac{\pi^2}{9} - x^2}$, is

A. $[0, 3]$

B. $\left[0, \sqrt{3}\right]$

C. $(-\infty, \infty)$

D. None of these

Answer: B

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11. The domain of the real valued function

$f(x) = \sqrt{1-2x} + 2\sin^{-1}\left(\frac{3x-1}{2}\right)$ is

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

B. $\left[\frac{1}{2}, 1\right]$

C. $\left[-\frac{1}{2}, \frac{1}{3}\right]$

D. $\left[-\frac{1}{3}, \frac{1}{2}\right]$

Answer: D

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Exercise 1 Topical Problems Inverse Composition And Different Types Of Functions

1. Let $f_k(x) = \frac{1}{k}\left(\sin^k x + \cos^k x\right)$ where $x \in \mathbb{R}$ and $k \geq 1$. Then $f_4(x) - f_6(x)$ equals

A. $1/6$

B. $1/3$

C. $1/4$

D. $1/12$

Answer: D

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2. Suppose $f(x) = (x+1)^2 f$ or $x \geq -1$. If $g(x)$ is the function whose graph is the reflection of the graph of $f(x)$ with respect to the line $y = x$, then $g(x)$ equal. $a - \sqrt{x} - 1, x \geq 0$ (b) $\frac{1}{(x+1)^2}, x \succ 1$ $\sqrt{x+1}, x \geq -1$ (d) $\sqrt{x} - 1, x \geq 0$

A. $\frac{1}{(x+1)^2} x > -1$

B. $-\sqrt{x} - 1$

C. $\sqrt{x} + 1$

D. $\sqrt{x} - 1$

Answer: D

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3. If $f(x) = \sqrt{x}$ and $g(x) = 2x - 3$, then domain of (fog) (x) is

A. $(-\infty, -3)$

B. $\left(-\infty, -\frac{3}{2}\right)$

C. $\left[-\frac{3}{2}, 0\right]$

D. $\left[\frac{3}{2}, \infty\right]$

Answer: D

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4. If $f(x) = 4x^3 + 3x^2 + 3x + 4$, then $x^3 f\left(\frac{1}{x}\right)$ isequal to

A. $f(-x)$

B. $\frac{1}{f(x)}$

C. $\left[f\left(\frac{1}{x}\right)\right]^2$

D. $f(x)$

Answer: D

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5. If the function $f:[1,\infty) \to [1,\infty)$ is defined by $f(x) = 2^{x(x-1)}$ then f^{-1} is

A. $\left(\frac{1}{2}\right)^{x(x-1)}$

B. $\frac{1}{2}\left(1-\sqrt{1+4\log_2 x}\right)$

C. $\frac{1}{2}\sqrt{1+4\log_2 x}$

D. $\frac{1}{2}\left(1+\sqrt{1+4\log_2 x}\right)$

Answer: D

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6. If $f = \{(0, -1), (-1, -3), (2, 3), (3, 5)\}$ is a function from z to z defined by $f(x) = ax + b$. Then,

A. $a = 1, b = -2$

B. $a = 2, b = 1$

C. $a = 2, b = -1$

D. $a = 1, b = 2$

Answer: C

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7. If f(x) is a polynomial function of the second degree such that, $f(-3) = 6, f(0) = 6$ and $f(2) = 11$, then the graph of the function, f(x) cuts the ordinate x = 1 at the point

A. $(1, 8)$

B. $(1, 4)$

C. $(1, -2)$

D. None of these

Answer: A

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8. If g(x) is the inverse of f(x) and f'(x) = cos x, then g'(x) is equal to

A. sec x

B. $\sec[g(x)]$

C. $\cos[g(x)]$

D. $-\sin[g(x)]$

Answer: B

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Exercise 2 Miscellaneous Problems

1. Let X and Y be the sets of all positive divisions of400 and 1000 respectively (including 1 and the number). Then $n(X \cap Y)$ is T, then $\frac{T}{4}$ is-

A. 4

B. 6

C. 8

D. 12

Answer: D

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2. If A={x,y} then power set of A is

A. $\{x^y, y^x\}$

B. $\{\phi, x, y\}$

C. $\{\phi, \{x\}, \{2y\}\}$

D. $\{\phi, \{x\}, \{y\}, \{x, y\}\}$

Answer: D

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3. If $A = \{x : x \text{ is a multiple of } 3\}$ and

$B = \{x : x \text{ is a multiple of } 5\}$. Then, $A \cap B$ is given by

A. $\{3, 6, 9 \ldots\}$

B. $\{5, 10, 15, 20 \ldots\}$

C. $\{15, 30, 45, \ldots\}$

D. None of these

Answer: C

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4. If $n(A) = 4, n(B) = 3$ and $n(A \times B \times C) = 24$, then n(C) is equal to

A. 288

B. 1

C. 12

D. 2

Answer: D

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5. The number of elements in the set $\{(a, b) : 2a^2 + 3b^2 = 35. a. b \in Z\}$,where Z is the set of all integers, is

A. 2

B. 4

C. 8

D. 12

Answer: C

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6. $\{n(n+1)(2n+1) : n \in Z\}$ is a subset of

A. $\{6k : k \in Z\}$

B. $\{12k : k \in Z\}$

C. $\{18k : k \in Z\}$

D. $\{24k : k \in Z\}$

Answer: A

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7. Consider the following relations: R = {(x, y) | x, y are real numbers and x = wy for some rational number w}; $S = \left\{ \left(\frac{m}{n}, \frac{p}{q} \right) \mathrm{m}, \mathrm{n}, \mathrm{pandqa\,r\,ei\,n\,t\,e\,g\,e\,r\,ss\,u\,c\,ht\,h\,a\,tn}, \mathrm{q} \neq 0 \mathrm{andq\,m} =$. Then (1) neither R nor S is an equivalence relation (2) S is an equivalence relation but R is not an equivalence relation (3) R and S both are equivalence relations (4) R is an equivalence relation but S is not an equivalence relation

A. R is an equivalence relation, but S is not an equvalence relation, but S is not an equivalence relation

B. Neither R nor S is an equivalence relation

C. S is an equivalence relation, but R is not an equivalence relation

D. R and S both are equivalence relations

Answer: C

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8. If $A = \{x, y, z\}$ and $B = \{a, b, c, d\}$. Then, which one of the following is not a relation from A to B ?

A. $\{(x, a), (x, c)\}$

B. $\{(y, c), (y, d)\}$

C. $\{(z, a), (z, d)\}$

D. $\{(z, b), (y, b), (a, d)\}$

Answer: D

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9. Let r be relation from R (set of real numbers) to R defined by $r = \{(a, b) \mid a, b \in R \text{ and } a - b + \sqrt{3} \text{ isan irrational number}\}$. The relation r is

A. an equivalence relation

B. only reflexive

C. only symmetric

D. only transitive

Answer: B

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10. Let $R = \{(x, y) : x, y \in N \text{ and } x^2 - 4xy + 3y^2 = 0\}$, where N is the set of all natural numbers. Then the relation R is

A. reflexive

B. symmetric

C. transitive

D. an equivalence relation

Answer: A

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11. Let R be the real line. Consider the following subsets of the plane $R \times R$. $S = \{(x, y) : y = x + 1 and 0 < x < 2\}, T = \{(x, y) : x - y$ is an integer $\}$. Which one of the following is true? (1) neither S nor T is an equivalence relation on R (2) both S and T are equivalence relations on R (3) S is an equivalence relation on R but T is not (4) T is an equivalence relation on R but S is not

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12. If R is a relation defined as aRb, $\text{iff} |a - b| > 0$, then the relation is

A. reflexive

B. symmetric

C. transitive

D. symmetric and transitive

Answer: D

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13. The total number of injections (one-one and into mappings) form $\{a_1, a_2, a_3, a_4\}$ to $\{b_1, b_2, b_3, b_4, b_5, b_6, b_7\}$ is

A. 400

B. 420

C. 800

D. 840

Answer: D

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14. The function f : $[0, \infty) \to [0, \infty)$ defined by $f(x) = \frac{2x}{1+2x}$ is

A. one-one and onto

B. one-one but not onto

C. not one-one but onto

D. Neither one-one nor onto

Answer: B

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15. If $A = \{1, 2, 3, 4\}$ and $B = \{1, 2, 3, 4, 5, 6\}$ are two sets and function $f: A \to B$ is defined by $f(x) = x + 2, \forall x \in A$, then the function f is

A. bijective

B. onto

C. one-one

D. many-one

Answer: C

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16. The period of $f(x) = \sin\left(\frac{\sin(x)}{5}\right)$, is

A. 2π

B. $2\pi / 5$

C. 10π

D. 5π

Answer: C

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17. Domain of the function $f(x) = \log\left(\sqrt{x-4} + \sqrt{6-x}\right)$

A. $[4, 6]$

B. $(-\infty, 6)$

C. $[2, 3]$

D. None of these

Answer: A

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18. The domain of the function $f(x) = \sin^{-1}\left\{(\log)_2 \frac{x^2}{2}\right\}$ is given by__

A. $[-1, 2] - \{0\}$

B. $(-1, 2)$

C. $[-2, 2] - \{0\}$

D. $[1, 2]$

Answer: B

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19. The range of $f(x) = \cos x - \sin x$ is

A. $[-1, 1]$

B. $(-1, 2)$

C. $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

D. $[-\sqrt{2}, \sqrt{2}]$

Answer: D

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20. If $f: R \to S$, defined by $f(x) = \sin x - \sqrt{3}\cos x + 1$, is onto then the interval of S, is

A. $[0, 3]$

B. $[-1, 1]$

C. $[0, 1]$

D. $[-1, 3]$

Answer: D

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21. The domain of the function $f(x) = \frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$, is

A. $[2, 3]$

B. $[2, 3)$

C. $[1, 2]$

D. $[1, 2)$

Answer: B

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22. If $f(0) = 1, f(1) = 5$ and $f(2) = 11$, then the equation of polynomial of degree two is

A. $x^2 + 1 = 0$

B. $x^2 + 3x + 1 = 0$

C. $x^2 - 2x + 1 = 0$

D. None of these

Answer: B

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23. If $f(x) = (a - x^n)^{1/n}$, where a > 0 and $n \in N$, then fof (x) is equal to

A. a

B. x

C. x^n

D. a^n

Answer: B

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24. If [x] denotes the greatest integer $\leq x$, then $\left[\frac{2}{3}\right]+\left[\frac{2}{3}+\frac{1}{99}\right]+\left[\frac{2}{3}+\frac{2}{99}\right]+\ldots+\left[\frac{2}{3}+\frac{98}{99}\right]$ is equal to

A. 99

B. 98

C. 66

D. 65

Answer: C

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25. If $f(x)=\cos(\ln x)$ then $f(x)f(y)-\frac{1}{2}\left(f\left(\frac{x}{y}\right)+f(xy)\right)$ has the value

A. -1

B. $1/2$

C. -2

D. 0

Answer: D

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26. If $f(x) = \frac{2x-1}{x+5}, x \neq -5$, then $f^{-1}(x)$ is equal to

A. $\frac{x+5}{2x-1}, x \neq \frac{1}{2}$

B. $\frac{5x+1}{2-x}, x \neq 2$

C. $\frac{x-5}{2x+1}, x \neq \frac{1}{2}$

D. $\frac{5x-1}{2-x}, x \neq 2$

Answer: B

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27. If $f(x) = \frac{x}{x-1}, x \neq 1$, then $\underbrace{(\text{fofo}\ldots\text{of})(x)}_{19 \text{ times}}$ is equal to

A. $\frac{x}{x-1}$

B. $\left(\frac{x}{x-1}\right)^{19}$

C. $\frac{19x}{x-1}$

D. x

Answer: A

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28. The function $f: C \to C$ defined by $f(x) = \frac{ax+b}{cx+d}$ for $x \in C$ where $bd \neq 0$ reduces to a constant function if

A. a = c

B. b = d

C. ad = bc

D. ab = cd

Answer: C

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29. The values of $bandc$ for which the identity of $f(x+1)-f(x)=8x+3$ is satisfied, where $f(x)=bx^2+cx+d, are$ $b=2, c=1$ (b) $b=4, c=-1 b=-1, c=4$ (d) $b=-1, c=1$

A. $b=2, c=1$

B. $b=4, c=-1$

C. $b=-1, c=4$

D. $b=-1, c=1$

Answer: B

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30. If $f(2x+3)=\sin x+2^x$, then $f(4m-2n+3)$ is equal to

A. $\sin(m-2n)+2^{2m-n}$

B. $\sin(2m-n)+2^{(m-n)^2}$

C. $\sin(m-2n)+2^{(m+n)^2}$

D. $\sin(2m-n)+2^{2m-n}$

Answer: D

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