MATHS

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MATHS (BENGALI ENGLISH)

RELATIONS

Iiiustrative Examples

1. Let A ={1,2,3} be a given set. Define a relation on A which is

(i) reflexive and transitive but not symmetric on A

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2. Let A ={1,2,3} be a given set. Define a relation on A which is

reflexive and symmetric but not transitive on A

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3. Let A ={1,2,3} be a given set. Define a relation on A which is

transitive and symmetric but not reflexive on A

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4. Let A ={1,2,3} be a given set. Define a relation on A which is

reflexive but neither symmetric nor transitive on A

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5. Let A ={1,2,3} be a given set. Define a relation on A which is

symmetric but neither reflexive nor transitive on A

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6. Let A ={1,2,3} be a given set. Define a relation on A which is

transitivebut neither reflexive nor symmetric on A

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7. Let A ={1,2,3} be a given set. Define a relation on A which is

neither reflexive nor symmetric and transitive on A

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8. Let A ={1,2,3} be a given set. Define a relation on A which is

an equivalence relation on A

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9. Let A ={1,2,3} be a given set. Define a relation on A which is

neither symmetric nor antismmetric on A

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10. Let A ={1,2,3} be a given set. Define a relation on A which is

symmetric but not antisymmetric on A

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11. Show that the relation is congruent to on the set T of all triangles in a plane is an equivalence relation.

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12. Check the relation is a factor of on the set of natural numbers N for reflexivity symmetry

and transitivity.

13. Let A be a family of sets and let R be the relation on A defined by X is disjoint from Y . State whether or not R is

reflexive on A

14. Let A be a family of sets and let R be the relation on A defined by X is disjoint from Y . State whether or not R is

symmetric on A

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15. Let A be a family of sets and let R be the relation on A defined by X is disjoint from Y . State whether or not R is

transitive on A

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16. Let A be a family of sets and let R be the relation on A defined by X is disjoint from Y . State whether or not R is

antisymmetric on A

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17. A relation R is defined on the set of natural numbers NN as follows

R = {(x,y) : x,y $\in NN$ and x+3y=12}

Show that R is transitive and antisymmetric but neither reflexive nor symmetric on NN.

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18. A relation R on the set of natural number NN is defined as follows :

(x,y) $\in R \rightarrow$ (x-y) is divisible by 5 for all x,y $\in NN$ Prove that R is an equivalence relation on NN.

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19. A relation R_1 is defined on the set of real number RR as follows :

$R_1 = \{(x, y) : 1 + xy > 0$, x $\in RR$ y $\in RR$ }

Show that R_1 is reflexive and symmetric but not transitive on RR.

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20. A relation R is defined on the set of integers ZZ as follows

R= {(x,y) :x,y $\in ZZ$ and (x-y) is even }

show that R is an equivalence relation on ZZ.

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21. Let R be a relation on the set N be defined by $\{(x, y) \mid x, y \varepsilon N, 2x + y = 41\}$. Then prove that the R is neither reflexive nor symmetric and nor transitive.

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22. Let A ={a,b,c } and R ={b,b),(c,c), (a,b)} be a relation on A . Add a minimum and maximum number of ordered pairs to R so that the enlarged relations become equivalence relations on A.

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23. Let NN be the set of natural numbers and R be a relation on $NN \times NN$ defined by,

(a,b) R (c,d) $\rightarrow$ a+d=b+c, for all (a,b) and (c,d)

$iNNN \times NN.$

prove that R is an equivalence relation on

$NN \times NN.$

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24. Let NN be the set of natural numbers and

R be a relation on $NN \times NN$ defined by,

(a,b) R (c,d) $\rightarrow$ ad =bc , for all (a,b) and (c,d)

$iNNN \times NN$.

Show that R is an equivalence relation on

$NN \times NN.$

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25. Let ZZ be the set of all integers and let m be an arbitrary but fixed positive integer. Show that the relation "congruence modulo m" on ZZ defined by :

a $\equiv$ b '(mod m)' $\Rightarrow$ (a-b) is divisible by m, for all a,b $\in ZZ$ is an equivalence relation on ZZ.

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26. Show that the relation R, on the set A={x $\in \mathbb{Z}: 0 \leq x \leq 12\}$ given by R = {(a,b) : |a-b| is a multiple of 4 and a,b $\in$ A } is an equivalance relation on A.

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Multiple Choice Type Questions

1. If A={1,2,3,4,} and I_A be the identity relation on A, then _____

A. (1,2) $\in I_A$

B. (2,2) $\in I_A$

C. (2,1) $\in I_A$

D. (3,4) $\in I_A$

Answer: B

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2. Let A be a non-empty set. Then a relation R on A is said to be an equivalence relation on A. If R is _____

A. reflexive on A

B. symmetric on A

C. transitive on A

D. reflexive, symmetric and transitive on A

Answer: D

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3. Which of the following statement is true ?

A. If A={1,2,3,4,} and R={1,1), (2,2),(2,3), (1,2) } then the relation R on set A is reflexive.

B. Let A ={a,b,c,d) and a relation R on A be defined as follows :

R={a,c), (b,d), (b,c), (c,a), (d,b) }

Then R is a symmetric relation on A.

C. A reflexive relation defined on a non-empty set A is always symmetric.

D. The universal relation defined on a non-empty set A is transitive.

Answer: D

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4. Which of the following statement is false?

A. The identity relation I_A on a non-empty set A is always a reflexive relation on A.

B. A reflexive relation on a non-empty set A is not necessarily the idenitity relation on A.

C. Suppose a relation R is defined on the set A={1,2,3} as follows :

R ={(1,2), (3,2), (2,1), (1,1)}

Then R is a transitive relation on A.

D. If X={a,b,c} and Y={c,a,b} then

$$X \times Y = Y \times X$$

Answer: C

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5. Total number of relations that can be defined on set A={1,2,3,4} is

A. 2^4

B. 2^8

C. 2^{12}

D. 2^{16}

Answer: D

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6. State which of the following is total number of relations from set A={a,b,c} to set B ={d,e} is

A. 2^6

B. 2^8

C. 2^4

D. 2^{15}

Answer: A

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7. Set A ={8,9,10} and B={2,3,4,5} and let R be a relation from A to B defined by xRy $\Rightarrow$ "y divides x " . Then the domain of R is

A. {2,3,4,5,}

B. {8,9,10}

C. {8,9,10,11}

D. {8,9}

Answer: B

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8. If R ={(x,y) :x is an integer and $|x| < 3 \text{and} y = |x-3|\}$ then the range of R is

A. {-2,-1,0,1,2}

B. {-2,-1,0}

C. {5,4,3,2,1}

D. {4,3,2,1,}

Answer: C

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9. A relation ϕ from $\mathbb{C}\text{or}RR$ is defined by $x\phi y \Rightarrow |x|$=y. which one is coR Rect ?

A. (2+3i)ϕ 13

B. 3ϕ (-3)

C. (1+i) ϕ 2

D. $i\phi 1$

Answer: D

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10. Let $A=\{1,2,3\}$. Then the number of relations containing $(1,2)$ and $(1,3)$ which are reflexive and symmetric but not transitive is

A. 1

B. 2

C. 3

D. 4

Answer: A

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Very Short Answer Type Questions

1. Let A={1,3,5} , B ={2,4,6} and R be the relation defined by

xRy $\Rightarrow$ (x+y) is even.

Show that R is a void relation from A to B.

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2. When is a relation R on a set A not reflexive ?

Let A {a,b,c,d} and R be a relation on A given by

R= {(a,a), (a,c), (c,a) , (c,c), (d,d)}. Is R reflexive on A ?

3. When is a relation R on a set A not symmetric ?

Let X= {1,2,3,4} and R be a relation on set X defined by R ={(1,2), (3,4), (2,2), (4,3), (2,3) }. Is R symmetric on X?

4. When is a relation R on a set A not antisymmetric?

Let A={1,2,3,4} and R be a relation on A defined by

R={(1,1), (2,2), (3,4), (3,3),(2,1), (4,3)}. Is R antisymmetric on A?

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5. When is a relation R on a set A not transitive ?

Let A={1,2,3,4} and a relation R on A be given by

$R=\{(2,3),(2,2), (3,1), (3,2), (4,1)\}$ Is R transitive on A?

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6. Can a relation R on a set A be both symmetric and antisymmetric?

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7. Find the domain and range of each of the following relations :

(i). $R_1 = \left\{ \left(a, \frac{1}{a} \right) : 0 < a < 5 \right.$ and a is an integer $\}$

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8. Find the domain and range of each of the following relations :

R_2={(x,y) : x $\in NN$,y are integers and xy =4 }

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9. Find the domain and range of each of the following relations :

R_3={ (x,y) :x,y $\in NN$, and 2x+y=41 }

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10. Find the domain and range of each of the following relations :

R_4 ={(x,y) :x and y are integers and $x^2 + y^2$= 25 }

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11. Find the domain and range of each of the following relations :

R_5 ={(x-5,2x-7) : x is an odd natural number less than 10 }

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12. Find the domain and range of each of the following relations :

$R_6 = \{(x, x^2 - 31)$:x is a prime number less than 12 }

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13. Find the domain and range of each of the following relations :

R={ (x,y) :x is an integer and $|x| < 3$ and $y = |3|$}

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14. Find the domain and range of each of the following relations :

$S=\{(x,y) : x,y \in \mathbb{N} \text{ and } x+3y=12\}$.

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15. Define an equivalence relation. Show that the relation similarity on the set of all triangles in a plene is an equivalence relation.

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16. Define a relation R on the set A ={a,b,c} which is neither reflexive nor symmetric and

transitive.

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17. R is a relation is defined on the set {1,2,3,4} as follow

R={(1,2), (2,2), (1,1), (4,4), (1,3), (3,3), (3,2)}

Then choose the coR Rect option of the following

A. R is reflexive symmetric but not transitive

B. R is reflexive transitive but not symmetric

C. R is symmetric transitive but not reflexive

D. R is an equivalence

Answer:

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18. Let A= {1,2,3} and R={(1,2), (2,3), (3,3), }be a relation on A. Add a (i) minimum (ii) maximum number of ordered pairs to R so that enlarged relation becomes an equivalence relation on A.

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19. consider three right angle triangles T_1 with sides 3,4,5 T_2 with sides 2,12,13 and T_3 with sides 6,8,10. Which triangles among $T_1, T_2, \text{and} T_3$ are related ?

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Short Answer Type Questions

1. Show that the relation is greater than on the set of real numbers $\mathbb{R}$ is transitive but neither reflexive nor symmetric on $\mathbb{R}$.

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2. Prove that the relation is perpendicular to on the set L of all straight lines in a plane is

symmetric but neither reflexive nor transitive on L.

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3. A relation R is defined on the set $\mathbb{N}$ of natural number follows : (x,y) $\in R \Rightarrow$ x divides y for all x,y $\in \mathbb{N}$

show that R is reflexive and transitive but not symmetric on $\mathbb{N}$.

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4. A relation R is defined on the set of natural numbers $\mathbb{N}$ follows :

(x,y) $\in R \Rightarrow$ x+y =12 for all x,y $\in \mathbb{N}$

Prove that R is symmetric but neither reflexive nor transitive on $\mathbb{N}$.

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5. A relation R is defined on the set NN of natural number follows :

(x,y) $\in \mathrm{R} \Rightarrow$ x+2y=10, for all x,y $\in NN$

Show that R is antisymmetric on NN

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6. Show that the relation is a subset of on the set of all sets is reflexive and transitive but not symmetric on S.

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7. A relation R is defined on the set of integers ZZ as follows

R= {(x,y) :x,y $\in ZZ$ and (x-y) is even }

show that R is an equivalence relation on ZZ.

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8. A relation R is defined on the set of all integers ZZ follows :

(x,y) $\in \mathrm{R} \Rightarrow$ (x,y) is divisible by n

Prove that R is an equivalence relation on ZZ.

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9. Show that the relation R defined in the set A of all polygons as $R = \{(P_1, P_2) : P_1 \text{ and } P_2$ have same number of sides}, is an equivalence relation. What is the set of all elements in A related to the right angle triangle T with sides 3,4 and 5 ?

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10. Let O be the origin. We define a relation S between two points P and Q in a plane such

that OP=OQ. Show that the relation S is an equivalence relation.

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11. A relation S is defined on the set of real numbers RR a follows:

S={(x,y) : s,y $\in$ RR and and x= +-y}

Show that S is an equivalence relation on RR.

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12. On a given set $\forall$ define the smalest and the large equivalence relation.

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13. A relation S is defined on the set of real numbers RR a follows :

S{(x,y) : $x^2 + y^2 = 1$ for all x,y $\in RR$ }

Check the relation S for (i) reflexivity (ii) symmetry an (iii) transitivity.

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14. Let A={ a,b,c} be a given set. Define a relation on A which is :

(i) reflexive and transitive but not symmetric on A

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15. Let A={ a,b,c} be a given set. Define a relation on A which is :

reflexive and symmetric but not transitive on A

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16. Let A={ a,b,c} be a given set. Define a relation on A which is :

transitive and symmetric but not reflexive on A

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17. Let A={ a,b,c} be a given set. Define a relation on A which is :

reflexive but neither symmetric nor transitive on A

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18. Let A={ a,b,c} be a given set. Define a relation on A which is :

symmetric but neither reflexive nor transitive on A

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19. Let A={ a,b,c} be a given set. Define a relation on A which is :

transitive but neither reflexive nor symmetric on A

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20. Let A={ a,b,c} be a given set. Define a relation on A which is :

neither reflexive nor symmetric and transitive on A

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21. Let A={ a,b,c} be a given set. Define a relation on A which is :

an equivalence relation on A.

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22. A relation R is defined on the set of natural numbers $\mathbb{N}$ as follows :

R {(x,y) : x $\in \mathbb{N}$ and x is a multiple of y }.

Prove that R is reflexive, antisymmetric and transitive but not symmetric on $\mathbb{N}$.

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23. Let R and S be two relations on a set A. If

(i) R and S are both symmetric on A prove that

$R \cap S$ and $R \cup S$ are also symmetric on A

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24. Let R and S be two relations on a set A. If

(ii) R is reflexive and S is any relation prove that $R \cup S$ is reflexive

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25. Let R and S be two relations on a set A. If (iii). R and S are both transitive on A prove that R $\cap$ S is transitive but R $\cup$ S is not necessarily transitive on A.

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26. A relation R is defined on the set NN of natural as follows :

(x,y) $\in \mathrm{R} \Rightarrow$ x-y+ $\sqrt{3}$ is an iR Rational

number for all x,y $\in NN$.

Show that R is reflexive on NN.

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Sample Question For Competitive Examination Multiple Cor Recy Answers Type

1. If R and R' are symmetric relations (not disjoint) on a set A then the relation R $\cap$ R' is not

A. reflexive

B. symmetric

C. transitive

D. equivalence

Answer: A::C::D

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2. Let A= {1,2,3}, we define $R_1 = \{(1, 2), (3, 2), (1, 3)\}$ and R_(2)= {(1,3), (3,6), (2,1), (1,2) }. Then which of the relation on A is not coR Rect ?

A. R_1 is a relation and R_2 is not

B. R_1 and R_2 are relation

C. R_1 and R_2 are both non-relation

D. R_2 is a relation and R_1 is not

Answer: B::C::D

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3. Let A= {1,2,3}, we define R ={ (1,1), (2,2), (3,3) }

then it is

A. reflexive

B. symmetric

C. equivalence

D. ordered relation on A

Answer: A::B::C::D

4. Let A={ (a,b,c} we define

R = { (a,b), (b,a), (b,b), (a,a)} then

A. R is not symmetric

B. R is not reflexive

C. R is not anti symmetric

D. R is not transitive

Answer: B::C

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5. The relation R defined on the set NN of natural numbers by xRy $\Leftrightarrow 2x^2 - 3xy + y^2$ =0 is

A. symmetric

B. reflexive

C. not symmetric

D. not reflexive

Answer: B::C

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Sample Question For Competitive Examination Integer Answer Type

1. If R be a relation $<$ from A ={ 1,2,3,4 } to B = { 1,3,5} i.e (a,b) $\in$ R iff a $<$ b then R^{-1} is { (3,1), (k,1), (3,2), (k,2), (k,3), (k,4) } what will be the value of k ?

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2. Let R be a relation on NN defined by R = {(x,y) :x+2y=8}. The range of R is { 1,λ 3} find the value of λ .

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3. If R ={ (x,y) : x,y $\in z, x^2 + y^2 \leq 4$ } is a relation on ZZ then domain of R is { 0,-1,k,-2,2} find the value of k.

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4. Let A and B have 3 and 6 elements respectively. What will be the minimum number of elements in A $\cup$ B?

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5. If the number of elements in sets A and B are 3 and 1 respectively then the number of relations from A to B is

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Sample Question For Competitive Examination Matrix Match Type

1. Let R and S be two non - void relations on a set A.

	Column I		Column II
(A)	If R and S transitive then $R \cup S$ will be	(p)	symmetric
(B)	If R and S transitive then $R \cap S$ will be	(q)	reflexive
(C)	If R and S symmetric then $R \cup S$ will be	(r)	transitive
(D)	If R and S reflexive then $R \cap S$ will be	(s)	not transitive

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2. The relation R : A $\rightarrow$ B where A = {2,3,4,5,6,7,} and B={1,4,} is defined by R ={ (x,y) :

$x > y, x \in A, y \in B\}$

	Column I		Column II
(A)	Domain of R	(p)	$\{1, 4\}$
(B)	Range of R	(q)	$\{2, 3, 4, 5, 6, 7\}$
(C)	Domain of R^{-1}	(r)	$\{2, 3, 4, 5, 6, 7\}$
(D)	Range of R^{-1}	(s)	$\{1, 4\}$

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Sample Question For Competitive Examination Comprehension Type

1. Let X = {1,2,3,4,5} and Y = { 1,3,5,7,9}.

(i) If R_1 = { (x,y) : y =x+2, x $\in$ X ,y $\in$ Y} then

R_1 is a relation from X to Y because

A. $R_1 \supseteq (X \times Y)$

B. $R_1 \subseteq (X \times Y)$

C. $R_1 \not\subseteq (X \times Y)$

D. None of these

Answer: B

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2. Let X = {1,2,3,4,5} and Y = { 1,3,5,7,9}.

If R_2 ={ (1,1), (1,3), (3,5), (3,7), (5,7) } then R_2 is a relation from X to Y because

A. $R_2 \subseteq (X \times Y)$

B. $R_2 \subset (X \times Y)$

C. $R_2 \not\subseteq (X \times Y)$

D. None of these

Answer: A

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3. Let X = {1,2,3,4,5} and Y = { 1,3,5,7,9}.

If R_3 = { (1,3) ,(2,5), (2,4), (7,9) } then R_3 is not a relation from X to Y because

A. (2,5) $\notin (X \times Y)$

B. (1,3) $\notin (X \times Y)$

C. (2,4), (7,9) $\notin (X \times Y)$

D. (1,3), (2,5) $\notin (X \times Y)$

Answer: C

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4. Each question in this section has four choices A , B, C , and D out of which only one is coR Rect. Mark your choices as follows .

Let R be a relation on the set NN of the natural numbers defined by nRm $<$ $\Rightarrow$ n is a factor of m. Let R be the relation over the set of integers such that mRn if and only if m is a multiple of n

Then R is reflexive because

A. mRn as m is multiple of n

B. mRn as m is multiple of m

C. mRn $\not\Rightarrow$ nRm

D. None of these

Answer: B

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5. Each question in this section has four choices A , B, C , and D out of which only one is coR Rect. Mark your choices as follows .

Let R be a relation on the set NN of the

natural numbers defined by nRm $<$ $\Rightarrow$ n is a factor of m. Then R is not symmetric because

A. mRn nRp $\not\Rightarrow$ nRm

B. mRn and nRp $\Rightarrow$ mRp

C. mRn $\not\Rightarrow$ nRm

D. None of these

Answer: C

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6. Each question in this section has four choices A , B, C , and D out of which only one is coR Rect. Mark your choices as follows .

Let R be a relation on the set NN of the natural numbers defined by nRm $<$ $\Rightarrow$ n is a factor of m. Then R is transitive because

A. mRn, nRp $\Rightarrow$ mRp

B. mRn $\not\Rightarrow$ nRm

C. mRm as m is multiple of m

D. None of these

Answer: A

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Sample Question For Competitive Examination Assertion Reason Type

1. Each question in this section has four choices A , B, C , and D out of which only one is coR Rect. Mark your choices as follows .

Let R be a relation on the set NN of the natural numbers defined by nRm $<$ $\Rightarrow$ n is a

factor of m.

Statement -1 : R is not oan equivalence relation.

Statement -II: R is not symmetric

A. Statement -I is True Statemint- II is True, Statement -II is a caR Rect explanation for Statement -I

B. Statement -I is True Statemint- II is True, Statement -II is a caR Rect explanation for Statement -I

C. Statement -I is True Statement -II is False.

D. Statement -I is False Statement-II is True.

Answer: A

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2. Each question in this section has four choices A , B, C , and D out of which only one is coR Rect. Mark your choices as follows .

Let RR be a real line, Consider the following subsets of the plane $RR \times RR$:

S= {(x,y) : y =x+1 and 0 $< x < 2$ }

T ={ (x,y) : (x-y) is an integer }.

Statement - I : T is an equivalence relation on RR nut S is not an equivalence relation on RR.

Statement -II : S is neither reflexive nor symmetric but T is reflexive symmetric and transitive.

A. Statement -I is True Statemint- II is True, Statement -II is a caR Rect explanation for Statement -I

B. Statement -I is True Statemint- II is True, Statement -II is a caR Rect explanation for Statement -I

C. Statement -I is True Statement -II is False.

D. Statement -I is False Statement-II is True.

Answer: A

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