MATHS

BOOKS - RD SHARMA MATHS (HINGLISH)

RELATIONS

Solved Examples And Exercises

1. An integer m is said to be related to another integer n if m is a multiple of n . Check if the relation is symmetric, reflexive and transitive.

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2. If R and S are relations on a set $A,$ then prove the following : R and S are symmetric $R \cap S$ and $R \cup S$ are symmetric R is reflexive and S is any relation $R \cup S$ is reflexive.

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3. If R and S are transitive relations on a set A, then prove that $R \cup S$ may not be a transitive relation on A.

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4. Let L be the set of all lines in $XY = plane$ and R be the relation in L defined as $R = \{(L_1, L_2) : L_1$ is parallel to $L_2\}$. Show that R is an equivalence relation. Find the set of all lines related to the line $y = 2x + 4.$

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5. Show that the relation $\geq$ on the set R of all real numbers is reflexive and transitive but nut symmetric.

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6. Let S be a relation on the set R of all real numbers defined by $S = \{(a, b)RxR : a^2 + b^2 = 1\}$. Prove that S is not an equivalence relation on R.

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7. Given to relation $R = \{(1, 2), (2, 3)\}$ on the set $A = \{1, 2, 3\}$, add a minimum number of ordered pairs so that the enlarged relation is symmetric, transitive and reflexive.

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8. Let O be the origin. We define a relation between two points P and Q in a plane if $OP = OQ$. Show that the relation, so defined is an equivalence relation.

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9. The following relations are defined on the set of real number: aRb if $a - b > 0$ aRb if $1 + ab > 0$ aRb if $|a| \leq b$ Find whether these relations are reflexive, symmetric or transitive.

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10. Let $A = \{1, 2, 3\}$, and let $R_1 = \{(1, 1), (1, 3), (3, 1), (2, 2), (2, 1), (3, 3)\} R_2 = \{(2, 2), 3, 1), (1, 3)\}$, Find whether or not each of the relations R_1, R_2, R_3 on A is (i) reflexive (ii) symmetric (iii) transitive.

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11. Let R be a relation defined on the set of natural numbers N as $R = \{(x, y) : x, y \in N, 2x + y = 41\}$ Find the domain and range of R. Also, verify whether R is (i) reflexive, (ii) symmetric (iii) transitive.

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12. Is it true that every relation which is symmetric and transitive is also reflexive? Give reasons.

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13. Let $A = \{1, 2, 3\}$ and $R = \{(1, 2), (1, 1), (2, 3)\}$ be a relation on A . What minimum number of ordered pairs may be added to R so that it may become a transitive relation on A.

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14. Show that the relation R defined by $R = \{(a, b) : a - b$ is divisible by $3; a, bZ\}$ is an equivalence relation.

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15. Test whether the following relations $R_1, R_2 \text{and} R_3,$ are (i) reflexive (ii) symmetric and (iii) transitive: R_1 on Q_0 defined by $(a, b)R_1 a = \frac{1}{b}$ R_2 on Z defined by $(a, b)R_2|a - b| \leq 5$ R_3 on R defined by $(a, b)R_3 a^2 - 4ab + 3b^2 = 0$

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16. Three relations $R_1, R_2 and R_3$ are defined on set $A = \{a, b, c\}$ as follow: $R_1 = \{(a, a), (a, b), (a, c), (b, b), (b, c), (c, a), (c, b), (c, c)\}$ $R_2 = \{(a, b), (b, a), (a, c), (c, a)\}$ $R_3 = \{(a, b), (b, c), (c, a)\}$ Find whether each of R_1, R_2, R_3 is reflexive, symmetric and transitive.

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17. Show that the relation R on the set $A\{xZ; 0 \leq 12\},$ given by $R = \{(a, b): a = b\},$ is an equivalence relation. Find the set of all elements related to 1.

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18. Let n be a fixed positive integer. Define a relation R on Z as follows: $(a, b)Ra - b$ is divisible by n. Show that R is an equivalence relation on Z.

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19. Let Z be the set of all integers and Z_0 be the set of all non=zero integers. Let a relation R on ZxZ_0 be defined as follows: $(a, b)R(c, d)ad = bc$ for all $(a, b), (c, d)ZxZ_0$ Prove that R is an equivalence relation on ZxZ_0.

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20. Prove that every identity relation on a set is reflexive, but the converse is not necessarily true.

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21. Let Z be the set of integers. Show that the relation $R = \{(a, b) : a, bZ$ and $a + b$ is even} is an equivalence relation on Z.

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22. If R is an equivalence relation on a set A, then R^{-1} is A. reflexive only B. symmetric but not transitive C. equivalence D. None of these

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23. On the set N of all natural numbers, a relation R is defined as follows: $\forall n, m \in N, nRm$ Each of the natural numbers n and m leaves the remainder less than 5.Show that R is an equivalence relation. Also, obtain the pairwise disjoint subsets determined by R.

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24. If R_1 and R_2 are equivalence relations in a set A, show that $R_1 \cap R_2$ is also an equivalence relation.

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25. Let Z be the set of all integers and Z_0 be the set of all non=zero integers. Let a relation R on $Z \times Z_0$ be defined as follows: $(a, b)R(c, d)ad = bc$ for all $(a, b), (c, d)Z \times Z_0$ Prove that R is an equivalence relation on $Z \times Z_0$.

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26. Let R be the equivalence relation in the set $A = \{0, 1, 2, 3, 4, 5\}$ given by $R = \{(a, b) : divides(a - b)\}$. Write the equivalence class [0].

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27. An integer m is said to be related to another integer n if m is a multiple of n. Check if the relation is symmetric, reflexive and transitive.

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28. Show that the relation $\geq$ on the set R of all real numbers is reflexive and transitive but nut symmetric.

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29. m is said to be related to n if m and n are integers and $m - n$ is divisible by 13. Does this define an equivalence relation?

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30. Let O be the origin. We define a relation between two points P and Q in a plane if $OP = OQ$. Show that the relation, so defined is an equivalence relation.

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31. Show that the relation R defined by $R = \{(a, b) : a - b$ is divisible by $3; a, bZ\}$ is an equivalence relation.

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32. Prove that a relation R on a set A is symmetric iff $R = R^{-1}$

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33. Three relations R_1, R_2 and R_3 are defined on set $A = \{a, b, c\}$ as follow:

$R_1 = \{(a, a), (a, b), (a, c), (b, b), (b, c), (c, a), (c, b), (c, c)\}$

$R_2 = \{(a, b), (b, a), (a, c), (c, a)\}$

$R_3 = \{(a, b), (b, c), (c, a)\}$

Find whether each of R_1, R_2, R_3 is reflexive, symmetric and transitive.

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34. Let a relation R_1 on the set R of real numbers be defined as $(a, b) \in R \Leftrightarrow 1 + ab > 0$ for all $a, b \in R$. Show that R_1 is reflexive and symmetric but not transitive.

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35. Let S be the set of all points in a plane and R be a relation on S defines as $R = \{(P, Q):$ distance between P and Q is less than 2 units} Show that R is reflexive and symmetric but not transitive.

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36. The following relations are defined on the set of real number: aRb if $1 + ab > 0$ Find whether these relations are reflexive, symmetric or transitive.

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37. Prove that every identity relation on a set is reflexive, but the converse is not necessarily true.

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38. Let R be a relation defined on the set of natural numbers N as $R = \{(x, y) : x, y \in N, 2x + y = 41\}$ Find the domain and range of R. Also, verify whether R is (i) reflexive, (ii) symmetric (iii) transitive.

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39. Let N denote the set of all natural numbers and R be the relation on $N \times N$ defined by $(a, b)R(c, d) \Leftrightarrow ad(b+c) = bc(a+d)$. Check whether R is an equivalence relation on $N \times N$

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40. Let N be the set of all natural numbers and let R be a relation on $N \times N$, defined by $(a, b)R(c, d) \Leftrightarrow ad = bc$ for all $(a, b), (c, d) \in N \times N$. . Show that R is an equivalence relation on $N \times N$.

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41. Let R be a relation on the set of all line in a plane defined by $(l_1, l_2) \in Ri$ is parallel to line l_2. Show that R is an equivalence relation.

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42. Each of the following defines a relation on N:

$x \rightarrow y, (i)x, y \in Nx + y = 10x, \int e \geq r, (iii)$x , y in Nx+4y=10 ,x , y in N`

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43. Let $A = \{a, b, c)$ and the relation R be defined on A as follows: $R = \{(a, a), (b, c), (a, b)\}$. Then, write minimum number of ordered pairs to be added in R to make it reflexive and transitive.

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44. Given the relation $R = \{(1, 2), (2, 3)$ on the set $A = \{1, 2, 3\}$, add a minimum number of ordered pairs so that the enlarged relation is symmetric, transitive and reflexive.

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45. Let $A = \{1, 2, 3, \ldots. ., 9\}$ and R be the relation in $A \times A$ defined by $(a, b)R(c, d)$ if $a + d = b + c$ for $(a, b), (c, d)$ in $A \times A$. Prove that R is an equivalence relation. Also obtain the equivalence class [(2,5)].

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46. Prove that the relation R on the set $N \times N$ defined by $(a,\ b)R\,(c,\ d)a + d = b + c$ for all $(a,\ b),\ (c,\ d) \in N \times N$ is an equivalence relation. Also, find the equivalence classes [(2, 3)] and [(1, 3)].

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47. Let n be a positive integer. Prove that the relation R on the set Z of all integers numbers defined by $(x, y) \in R \Leftrightarrow x - y$ is divisible by $n,$ is an equivalence relation on Z.

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48. Let T be the set of all triangles in a plane with R as relation in T given by $R = \{(T_1, T_2) : (T)_1 \cong T_2\}$. Show that R is an equivalence relation.

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49. If R and S are relations on a set $A,$ then prove the following : R and S are symmetric $R \cap S$ and $R \cup S$ are symmetric R is reflexive and S is any relation $R \cup S$ is reflexive.

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50. Let S be a relation on the set R of all real numbers defined by $S = \{(a, b) R \times R : a^2 + b^2 = 1\}$. Prove that S is not an equivalence relation on R.

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51. Write the domain of the relation R defined on the set Z of integers as follows $(a, b) \in R \Leftrightarrow a^2 + b^2 = 25$

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52. If R and S are transitive relations on a set A, then prove that $R \cup S$ may not be a transitive relation on A.

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53. Let R be the equivalence relation in the set $A = \{0, 1, 2, 3, 4, 5\}$ given by $R = \{(a, b) : divides(a - b)\}$. Write the equivalence class [0].

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54. If $R = \{(x, y) : x + 2y = 8\}$ is a relation on N, write the range of R.

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55. Let Z be the set of all integers and R be the relation on Z defined as $R = \{(a, b); a,\ b\ \in Z,\ \text{ and } (a - b) \text{ is divisible by } 5.\}$. Prove that R is an equivalence relation.

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56. The union of two equivalence relations on a set is not necessarily an equivalence relation on the set.

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57. Let A be the set of all students of a boys school. Show that the relation R on A given by $R = \{(a,\ b) : a$ is sister of $b\}$ is empty relation and $R' = \{(a,\ b) :$ the difference between the heights of a and b is less than 5 meters} is the universal relation.

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58. Prove that a relation R on a set A is symmetric iff $R = R^{-1}$.

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59. The relation R on the set N of all natural numbers defined by $(x, \ y) \in R \Leftrightarrow x$ divides y, for all $x, \ y \in N$ is transitive.

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60. Three relations $R_1, R_2 and R_3$ are defined on set $A = \{a, b, c\}$ as follow: $R_1 = \{(a, a), (a, b), (a, c), (b, b), (b, c), (c, a), (c, b), (c, c)\}$ $R_2 = \{(a, b), (b, a), (a, c), (c, a)\}$ $R_3 = \{(a, b), (b, c), (c, a)\}$ Find whether each of R_1, R_2, R_3 is reflexive, symmetric and transitive.

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61. Show that the relation R on the set $A = \{1,\ 2,\ 3\}$ given by $R = \{(1,\ 1),\ (2,\ 2),\ (3,\ 3),\ (1,\ 2),\ (2, 3\ )\}$ is reflexive but neither symmetric nor transitive.

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62. Show that the relation R on the set $A = \{1,\ 2,\ 3\}$ given by $R = \{(1,\ 2),\ (2,\ 1)\}$ is symmetric but neither reflexive nor transitive.

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63. Check the following relations R and S for reflexivity, symmetry and transitivity: (i)aRb iff b is divisible by $a,\ a,\ b \in N$ (ii) $l_1\ S\, l_2$ iff $l_1 \perp l_2$, where l_1 and l_2 are straight lines in a plane.

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64. Let a relation R_1 on the set R of real numbers be defined as $(a, b) \in R_1 \Leftrightarrow 1 + ab > 0$ for all $a, b \in R$. Show that R_1 is reflexive and symmetric but not transitive.

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65. Determine whether Relation R on the set $A = \{1, 2, 3, , 13, 14\}$ defined as $R = \{(x, y) : 3x - y = 0\}$ is reflexive, symmetric or transitive.

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66. Determine whether Relation R on the set N of all natural numbers defined as $R = \{(x, y) : y = x + 5 \text{ and } x < 4\}$ is reflexive, symmetric or transitive.

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67. Determine whether Relation R on the set $A = \{1, 2, 3, 4, 5, 6\}$ defined as $R = \{(x, y) : y$ is divisible by $x\}$ is reflexive, symmetric or transitive.

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68. Determine whether Relation R on the set Z of all integer defined as $R = \{(x, y) : (x - y) = integer\}$ is reflexive, symmetric or transitive.

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69. Show that the relation R on R defined as $R = \{(a, b) : a \leq b\}$, is reflexive and transitive but not symmetric.

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70. Let S be the set of all points in a plane and R be a relation on S defines as $R = \{(P, Q):$ distance between P and Q is less than 2 units$\}$ Show that R is reflexive and symmetric but not transitive.

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71. Let $X = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, Let R_1 be a relation on X given by $R_1 = \{(x, y) : x - y$ is divisible by 3$\}$ and R_2 be another relation on X given by $R_2 = \{(x, y) : \{x, y\} \subset \{1, 4, 7\}$ or $\{x, y\} \subset \{2, 5, 8\}$ or $\{x, y\} \subset \{3, 6, 9\}\}$. Show that $R_1 = R_2$.

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72. Show that the relations R on the set R of all real numbers, defined as $R = \{(a, b) : a \leq b^2\}$ is neither reflexive nor symmetric nor transitive.

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

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74. Let A be the set of all human beings in a town at a particular time. Determine whether Relation $R = \{(x, y) : x$ and y work at the same place$\}$ is reflexive, symmetric and transitive:

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75. Let A be the set of all human beings in a town at a particular time. Determine whether Relation $R = \{(x, y) : x$ and y live in the same locality$\}$ is reflexive, symmetric and transitive:

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76. Let A be the set of all human beings in a town at a particular time. Determine whether Relation $R = \{(x, y) : x$ is wife of $y\}$ is reflexive, symmetric and transitive:

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77. Let A be the set of all human beings in a town at a particular time. Determine whether Relation $R = \{(x, y) : x$ is father of $y\}$ is reflexive, symmetric and transitive:

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78. $R_1 = \{(a, a), (a, b), (a, c), (b, b), (b, c), (c, a), (c, b), (c, c)\}$ is defined on set $A = \{a, b, c\}$. Find whether or not it is (i) reflexive (ii) symmetric (iii) transitive.

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79. $R_2 = \{(a, \ a)\}$ is defined on set $A = \{a, \ b, \ c\}$. Find whether or not it is (i) reflexive (ii) symmetric (iii) transitive.

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80. $R_3 = \{(b, c)\}$ is defined on set $A = \{a, \ b, \ c\}$. Find whether or not it is (i) reflexive (ii) symmetric (iii) transitive.

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81. Test whether, R_1 on Q_0 defined by $(a, \ b) \in R_1 \Leftrightarrow a = 1/b$ is (i) reflexive (ii) symmetric and (iii) transitive:

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82. Test whether, R_2 on Z defined by $(a, \ b) \in R_2 \Leftrightarrow |a - b| \leq 5$ is (i) reflexive (ii) symmetric and (iii) transitive.

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83. Test whether, R_3 on R defined by $(a, b) \in R_3 \Leftrightarrow a^2 - 4ab + 3b^2 = 0$.

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84. Find whether or not $R_1 = \{(1, 1), (1, 3), (3, 1), (2, 2), (2, 1), (3, 3)\}$, on $A = \{1, 2, 3\}$ is (i) reflexive (ii) symmetric (iii) transitive.

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85. Find whether or not $R_2 = \{(2, 2), (3, 1), (1, 3)\}$, on $A = \{1, 2, 3\}$ is (i) reflexive (ii) symmetric (iii) transitive.

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86. Find whether or not $R_3 = \{(1, 3), (3, 3)\}$, on $A = \{1, 2, 3\}$ is (i) reflexive (ii) symmetric (iii) transitive.

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87. aRb if $a - b > 0$ is defined on the set of real numbers, find whether it is reflexive, symmetric or transitive.

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88. aRb iff $1 + ab > 0$ is defined on the set of real numbers, find whether it is reflexive, symmetric or transitive.

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89. aRb if $|a| \leq b$ is defined on the set of real numbers, find whether it is reflexive, symmetric or transitive.

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90. Check whether the relation R defined on the set $A = \{1, 2, 3, 4, 5, 6\}$ as $R = \{(a, b) : b = a + 1\}$ is reflexive, symmetric or transitive.

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91. Check whether the relation R on R defined by $R = \{(a, b) : a \leq b^3\}$ is reflexive, symmetric or transitive.

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92. Prove that every identity relation on a set is reflexive, but the converse is not necessarily true.

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93. If $A = \{1, 2, 3, 4\}$ define relations on A which have properties of being reflexive, transitive but not symmetric.

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94. If $A = \{1, 2, 3, 4\}$ define relations on A which have properties of being symmetric but neither reflexive nor transitive.

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95. If $A = \{1, 2, 3, 4\}$ define relations on A which have properties of being reflexive, symmetric and transitive.

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96. Let R be a relation defined on the set of natural numbers N as $R = \{(x, y) : x, y \in N, 2x + y = 41\}$ Find the domain and range of R. Also, verify whether R is (i) reflexive, (ii) symmetric (iii) transitive.

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97. Is it true that every relation which is symmetric and transitive is also reflexive? Give reasons.

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98. An integer m is said to be related to another integer n if m is a multiple of n . Check if the relation is symmetric, reflexive and transitive.

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99. Show that the relation " $\geq$ " on the set R of all real numbers is reflexive and transitive but not symmetric.

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100. Give an example of a relation which is reflexive and symmetric but not transitive.

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101. Give an example of a relation which is reflexive and transitive but not symmetric.

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102. Give an example of a relation which is symmetric and transitive but not reflexive.

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103. Give an example of a relation which is symmetric but neither reflexive nor transitive.

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104. Give an example of a relation which is transitive but neither reflexive nor symmetric.

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105. Given the relation $R = \{(1, 2), (2, 3)\}$ on the set $A = \{1, 2, 3\}$, add a minimum number of ordered pairs so that the enlarged relation is symmetric, transitive and reflexive.

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106. Let $A = \{1, 2, 3\}$ and $R = \{(1, 2), (1, 1), (2, 3)\}$ be a relation on A. What minimum number of ordered pairs may be added to R so that it may become a transitive relation on A.

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107. Let $A = \{a, b, c)$ and the relation R be defined on A as follows: $R = \{(a, a), (b, c), (a, b)\}$. Then, write minimum number of ordered pairs to be added in R to make it reflexive and transitive.

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108. Each of the following defines a relation on N: (i)$x > y,\ x,\ y \in N$

(ii) $x + y = 10,\ x,\ y \in N$

(iii) xy is square of an integer, $x,\ y \in N$

(iv) $x + 4y = 10,\ x,\ y \in N$

Determine which of the above relations are reflexive, symmetric and transitive.

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109. Let R be a relation on the set of all lines in a plane defined by $(l_1,\ l_2) \in R$ <=> line l_1 is parallel to line l_2 . Show that R is an equivalence relation.

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

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111. Show that the relation R defined on the set A of all triangles in a plane as $R = \{(T_1, T_2) : T_1$ is similar to $T_2)$ is an equivalence relation. Consider three right angle triangle T_1 with sides $3, 4, 5$; T_2 with sides $5, 12, 13$ and T_3 with sides 6, 8, 10. Which triangles among T_1, T_2 and T_3 are related?

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112. Let n be a positive integer. Prove that the relation R on the set Z of all integers numbers defined by $(x, y) \in R \Leftrightarrow x - y$ is divisible by $n,$ is an equivalence relation on Z.

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113. Show that the relation R on the set A of all the books in a library of a college given by $R = \{(x, y) : x$ and y have the same number of pages$\}$, is an equivalence relation.

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114. Show that the relation R on the set $A = \{1, 2, 3, 4, 5\}$, given by $R = \{(a, b) : |a - b|$ is even $\}$, is an equivalence relation. Show that all the elements of {1, 3, 5} are related to each other and all the elements of {2, 4} are related to each other. But, no element of {1, 3, 5} is related to any element of {2, 4}.

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115. Show that the relation R on the set $A = \{x \in Z : 0 \leq x \leq 12\}$, given by $R = \{(a, b) : |a - b|$ is a multiple of 4$\}$ is an equivalence relation. Find the set of all elements related to 1 i.e. equivalence class [1].

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116. Show that the relation R on the set A of points in a plane, given by $R = \{(P, Q):$ Distance of the point P from the origin is same as the distance of the point Q from the origin}, is an equivalence relation. Further show that the set of all points related to a point $P \neq (0, 0)$ is the circle passing through P with origin as centre.

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117. Prove that the relation R on the set $N \times N$ defined by $(a, b)R \Leftrightarrow (c, d)a + d = b + c$ for all $(a, b), (c, d) \in N \times N$ is an equivalence relation. Also, find the equivalence classes [(2, 3)] and [(1, 3)].

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118. Let $A = \{1, 2, 3, , 9\}$ and R be the relation on $A \times A$ defined by $(a, b)R(c, d)$ if $a + d = b + c$ for all $(a, b), (c, d) \in A \times A$. Prove that R is an equivalence relation and also obtain the equivalence class [(2, 5)].

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119. Let N be the set of all natural numbers and let R be a relation on $N \times N$, defined by $(a, b)R(c, d) \Leftrightarrow ad = bc$ for all $(a, b), (c, d) \in N \times N$. Show that R is an equivalence relation on $N \times N$. Also, find the equivalence class [(2,6)].

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120. Let N denote the set of all natural numbers and R be the relation on NxN defined by $(a, b)R(c, d) \Leftrightarrow ad(b + c) = bc(a + d)$. Check whether R is an equivalence relation on NxN.

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121. Prove that the relation congruence modulo m on the set Z of all integers is an equivalence relation.

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122. Show that the number of equivalence relations on the set {1, 2, 3} containing (1, 2) and (2, 1) is two.

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123. Given a non-empty set X, consider $P(X)$ which is the set of all subsets of X. Define a relation in $P(X)$ as follows: For subsets A, B in $P(X)$, $A\,R\,B$ if $A \subset B$. Is R an equivalence relation on $P(X)$? Justify your answer.

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124. Let R be the equivalence relation in the set $A = \{0,\ 1,\ 2,\ 3,\ 4,\ 5\}$ given by $R = \{(a,\ b) : 2 \text{ divides } (a - b)\}$. Write the equivalence class [0].

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125. On the set N of all natural numbers, a relation R is defined as follows: nRm <=> Each of the natural numbers n and m leaves the same remainder less than 5 when divided by 5. Show that R is an equivalence relation. Also, obtain the pairwise disjoint subsets determined by R.

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126. Show that the relation R defined by $R = \{(a, b) : a - b$ is divisible by $3; a, bZ\}$ is an equivalence relation.

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127. Show that the relation R on the set Z of integers, given by $R = \{(a,\ b) : 2 \text{ divides } a - b\}$, is an equivalence relation.

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128. Prove that the relation R on Z defined by $(a,\ b) \in R \Leftrightarrow\ a - b$ is divisible by 5 is an equivalence relation on Z.

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129. Let n be a fixed positive integer. Define a relation R on Z as follows: $(a,\ b) \in R \Leftrightarrow a - b$ is divisible by $n\cdot$ Show that R is an equivalence relation on $Z\cdot$

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130. Let Z be the set of integers. Show that the relation $R = \{(a,\ b) : a,\ b \in Z$ and $a + b$ is even$\}$ is an equivalence relation on Z.

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131. m is said to be related to n if m and n are integers and $m - n$ is divisible by 13. Does this define an equivalence relation?

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132. Let R be a relation on the set A of ordered pairs of integers defined by $(x,\ y)\ R\ (u,\ v)$ iff $xv = yu$. Show that R is an equivalence relation.

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133. Show that the relation R on the set $A = \{x \in Z; 0 \leq x \leq 12\}$, given by $R = \{(a,\ b) : a = b\}$, is an equivalence relation. Find the set of all elements related to 1.

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134. Let L be the set of all lines in XY -plane and R be the relation in L defined as $R = \{(L_1, L_2) : L_1$ is parallel to $L_2\}$. Show that R is an equivalence relation. Find the set of all lines related to the line $y = 2x + 4$.

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135. Show that the relation R , defined on the set A of all polygons as $R = \{(P_1,\ P_2) : P_1$ 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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136. Let O be the origin. We define a relation between two points P and Q in a plane if $OP = OQ$. Show that the relation, so defined is an equivalence relation.

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137. Let R be the relation defined on the set $A = \{1, 2, 3, 4, 5, 6, 7\}$ by $R = \{(a, b):$ both a and b are either odd or even}. Show that R is an equivalence relation. Further, show that all the elements of the subset {1, 3, 5, 7} are related to each other and all the elements of the subset {2, 4, 6} are related to each other, but no element of the subset {1, 3, 5, 7} is related to any element of the subset {2, 4, 6}.

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138. Let S be a relation on the set R of all real numbers defined by $S = \left\{(a, b) \in R \times R : a^2 + b^2 = 1\right\}$. Prove that S is not an equivalence relation on R .

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139. Let Z be the set of all integers and Z_0 be the set of all non-zero integers. Let a relation R on $Z \times Z_0$ be defined as follows: $(a,\ b)\ R\ (c,\ d) \Leftrightarrow ad = bc$ for all $(a,\ b),\ (c,\ d) \in Z \times Z_0$ Prove that R is an equivalence relation on $Z \times Z_0$

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140. If R and S are relations on a set A , then prove the following: R and S are symmetric $\Rightarrow R \cap S$ and $R \cup S$ are symmetric (ii) R is reflexive and S is any relation $\Rightarrow R \cup S$ is reflexive.

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141. If R and S are transitive relations on a set A , then prove that $R \cup S$ may not be a transitive relation on A .

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142. Write the domain of the relation R defined on the set Z of integers as follows: $(a, b) \in R \Leftrightarrow a^2 + b^2 = 25$

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143. If $R = \{(x, y) : x^2 + y^2 \leq 4; x, y \in Z\}$ is a relation on Z, write the domain of R.

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144. Write the identity relation on set $A = \{a, b, c\}$.

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145. Write the smallest reflexive relation on set $A = \{1, 2, 3, 4\}$.

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146. If $R = \{(x, y) : x + 2y = 8\}$ is a relation on N, then write the range of R.

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147. If R is a symmetric relation on a set A, then write a relation between R and R^{-1}.

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148. Let $R = \{(x, y) : |x^2 - y^2| < 1\}$ be a relation on set $A = \{1, 2, 3, 4, 5\}$. Write R as a set of ordered pairs.

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149. If $A = \{2,\ 3,\ 4\}$, $B = \{1,\ 3,\ 7\}$ and `R={(x ,\ y): x in A ,\ y in B\ a n d\

x

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150. Let $A = \{3,\ 5,\ 7\}$, $B = \{2,\ 6,\ 10\}$ and R be a relation from A to B defined by $R = \{(x,\ y) : x$ and y are relatively prime.} Then, write R and R^{-1}.

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151. Define a reflexive relation.

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152. Define a symmetric relation.

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153. Define a transitive relation.

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154. Define an equivalence relation.

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155. If $A = \{3, 5, 7\}$ and $B = \{2, 4, 9\}$ and R is a relation given by is less than, write R as a set ordered pairs.

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156. $A = \{1, 2, 3, 4, 5, 6, 7\}$ and if $R = \{(x, y) : y$ is one half of $x; x, y \in A\}$ is a relation on A , then write R as a set of ordered pairs.

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157. Let $A = \{2,\ 3,\ 4,\ 5\}$ and $B = \{1, 3,\ 4\}$. If R is the relation from A to B given by $a\,R\,b$ iff a is a divisor of b. Write R as a set of ordered pairs.

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158. State the reason for the relation R on the set {1, 2, 3} given by $R = \{(1,\ 2),\ (2,\ 1)\}$ not to be transitive.

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159. Let $R = \{(a,\ a^3) : a$ is a prime number less than 5} be a relation. Find the range of R.

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160. Let R be the relation in the set Z of integers given by R={(a,b):2 divides a-b}. Show that the relation R transitive ? Write the equivalence class [0].

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161. For the set $A = \{1, 2, 3\}$, define a relation R on the set A as follows: $R = \{(1, 1), (2, 2), (3, 3), (1, 3)\}$ Write the ordered pairs to be added to R to make the smallest equivalence relation.

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162. Let $A = \{0, 1, 2, 3\}$ and R be a relation on A defined as $R = \{(0, 0), (0, 1), (0, 3), (1, 0), (1, 1), (2, 2), (3, 0), (3, 3)\}$, is R reflexive? symmetric transitive?

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163. If the relation R be defined on the set $A = \{1, 2, 3, 4, 5\}$ by $R = \{(a, b) : |a^2 - b^2| < 8\}$. Then, R is given by ....

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164. Let the relation R be defined in N by aRb, if 2a + 3b = 30. Then R = ...

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165. Write the smallest equivalence relation on the set $A = \{1,\ 2,\ 3\}$.

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166. Let R be a relation on the set N given by $R = \{(a,\ b) : a = b - 2,\ b > 6\}$. Then, $(2,\ 4) \in R$ (b) $(3,\ 8) \in R$ (c) $(6,\ 8) \in R$ (d) $(8,\ 7) \in R$

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167. Which of the following is not an equivalence relation on Z ?

$a\,R\,b \Leftrightarrow a+b$ is an even integer (b) $a\,R\,b \Leftrightarrow a-b$ is an even integer (c) $a\,R\,b \Leftrightarrow a=b$

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168. R is a relation on the set Z of integers and it is given by $(x,\ y) \in R \Leftrightarrow |x-y| \leq 1.$ Then, R is (a) reflexive and transitive (b) reflexive and symmetric (c) symmetric and transitive (d) an equivalence relation

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169. Let R = {(1, 3), (4, 2), (2, 4), (2, 3), (3, 1)} be a relation on the set A = {1, 2, 3, 4}. The relation R is

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170. Let R be the relation over the set of all straight lines in a plane such that $l_1 \, R \, l_2 \Leftrightarrow l_1 \perp l_2$. Then, R is (a) symmetric (b) reflexive (c) transitive (d) an equivalence relation

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171. Let$A = \{1, 2, 3\}$Then 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

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172. The relation $'R'$ in $N \times N$ such that $(a, \ b) \, R \, (c, \ d) \Leftrightarrow a + d = b + c$ is reflexive but not symmetric reflexive and transitive but not symmetric an equivalence relation (d) none of these

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173. If $A = \{1, \ 2, \ 3\}, \ \ B = \{1, \ 4, \ 6, \ 9\}$ and R is a relation from A to B defined by $'x$ is greater than y'. The range of R is (a) $\{1, 4, 6, 9\}$ (b) $\{4, 6, 9\}$ (c) $\{1\}$ (d) none of these

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174. A relation R is defined from {2, 3, 4, 5} to {3, 6, 7, 10} by : $x \ R \ y \Leftrightarrow x$ is relatively prime to y. Then, domain of R is (a) {2, 3, 5} (b) {3, 5} (c) {2, 3, 4} (d) {2, 3, 4, 5}

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175. A relation φ from C to R is defined by $x \ \varphi \ y \Leftrightarrow |x| = y$. Which one is correct?

(a) $(2 + 3i)\varphi 13$ (b) $3\varphi(- 3)$ (c) $(1 + i)\varphi 2$ (d) $i\varphi 1$

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176. Let R be a relation on N defined by $x + 2y = 8$. The domain of R is

A. {2,4,8}

B. {2,4,6,8}

C. {2,4,6}

D. {1,2,3,4}

Answer: C) $\{2, 4, 6\}$

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177. 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

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178. Let $R = \{(a,\ a),\ (b,\ b),\ (c,\ c),\ (a,\ b)\}$ be a relation on set $A = \{a,\ b,\ c\}$. Then, R is (a) identity relation (b) reflexive (c) symmetric (d) equivalence

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179. Let $A = \{1,\ 2,\ 3\}$ and $R = \{(1,\ 2),\ (2,\ 3),\ (1,\ 3)\}$ be a relation on A. Then, R is (a)neither reflexive nor transitive (b)neither symmetric nor transitive (c) transitive (d) none of these

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180. If R is the largest equivalence relation on a set A and S is any relation on A, then $R \subset S$ (b) $S \subset R$ (c) $R = S$ (d) none of these

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181. If R is a relation on the set $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ given by $x\,R\,y \Leftrightarrow y = 3x$, then $R =$ (a) {(3, 1), (6, 2), (8, 2), (9, 3)} (b) {(3, 1), (6, 2), (9, 3)} (b) {(3, 1), (2, 6), (3, 9) (d) none of these

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182. If R is a relation on the set $A = \{1, 2, 3\}$ given by $R = (1, 1), (2, 2), (3, 3)$, then R is (a) reflexive (b) symmetric (c) transitive (d) all the three options

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183. If $A = \{a, b, c, d\}$, then a relation $R = \{(a, b), (b, a), (a, a)\}$ on A is (a)symmetric and transitive only (b)reflexive and transitive only (c) symmetric only (d) transitive only

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184. If $A = \{1, 2, 3\}$, then a relation $R = \{(2, 3)\}$ on A is (a) symmetric and transitive only (b) symmetric only (c) transitive only (d) none of these

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185. Let R be the relation on the set $A = \{1,\ 2,\ 3,\ 4\}$ given by $R = \{(1,\ 2),\ (2,\ 2),\ (1,\ 1),\ (4,\ 4),\ (1,\ 3),\ (3,\ 3),\ (3,\ 2)\}$. Then, R is reflexive and symmetric but not transitive (b) R is reflexive and transitive but not symmetric (c) R is symmetric and transitive but not reflexive (d) R is an equivalence relation

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186. Let $A = \{1, 2, 3\}$. Then number of equivalence relations containing (1, 2) is (A) 1 (B) 2 (C) 3 (D) 4

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187. The relation $R = \{(1,\ 1),\ (2,\ 2),\ (3,\ 3)\}$ on the set {1, 2, 3} is (a) symmetric only (b) reflexive only (c) an equivalence relation (d) transitive only

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188. S is a relation over the set R of all real numbers and it is given by $(a,\ b) \in S \Leftrightarrow ab \geq 0$. Then, S is symmetric and transitive only reflexive and symmetric only (c) antisymmetric relation (d) an equivalence relation

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189. In the set Z of all integers, which of the following relation R is not an equivalence relation? $x\ R\ y$: if $x \leq y$ (b) $x\ R\ y$: if $x = y$ (c) $x\ R\ y$: if $x - y$ is an even integer (d) $x\ R\ y$: if $x = y$ (mod 3)

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190. Let $A = \{1,\ 2,\ 3\}$ and consider the relation $R = \{(1,\ 1),\ (2,\ 2),\ (3,\ 3),\ (1,\ 2),\ (2,\ 3),\ (1,\ 3)\}$. Then, R is (a) reflexive but not symmetric (b) reflexive but not transitive (c) symmetric and transitive (d) neither symmetric nor transitive

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191. The relation S defined on the set R of all real number by the rule $a\ Sb$ iff $a \geq b$ is (a) equivalence relation (b)reflexive, transitive but not symmetric (c)symmetric, transitive but not reflexive (d) neither transitive nor reflexive but symmetric

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192. The maximum number of equivalence relations on the set A = {1, 2, 3} are

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193. Let R be a relation on the set N of natural numbers defined by $n\ R\ m$ if n divides m. Then, R is

A. Reflexive and Symmetric

B. Symmetric and Transitive

C. Equivalence

D. Reflexive and Transitive but not Symmetric

Answer: D

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194. Let L denote the set of all straight lines in a plane. Let a relation R be defined by $l\ R\ m$ if and only if l is perpendicular to $m\ f\ \text{or}\ all$, $l,\ m \in L$. Then, R is (a) reflexive (b) symmetric (c) transitive (d) none of these

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195. Let T be the set of all triangles in the Euclidean plane, and let a relation R on T be defined as $a\ R\ b$ if a is congruent to b for all $a,\ b \in T$. Then, R is (a) reflexive but not symmetric (b) transitive but not symmetric (c) equivalence (d) none of these

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196. Let R be a relation defined by $R = \{(a, b) : a \geq b, a, b \in R\}$. The relation R is (a) reflexive, symmetric and transitive (b) reflexive, transitive but not symmetric (c) symmetric, transitive but not reflexive (d) neither transitive nor reflexive but symmetric

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197. For real numbers x and y, we write $x \cdot y$, if $x - y + \sqrt{2}$ is an irrational number. Then, the relation $\cdot$ is an equivalence relation.

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Others

1. If $A = \{a,\ b,\ c\}$, then the relation $R = \{(b,\ c)\}$ on A is (a) reflexive only (b) symmetric only (c) transitive only (d) reflexive and transitive only

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2. Let $A = \{2,\ 3,\ 4,\ 5,\ ,\ 17,\ 18\}$. Let $''$ be the equivalence relation on $A \times A$, cartesian product of A with itself, defined by $(a,\ b)(c,\ d)$ iff $ad = bc$. Then, the number of ordered pairs of the equivalence class of (3, 2) is (a) 4 (b) 5 (c) 6 (d) 7

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