1. Relations and Functions

one mark - 1, two marks - 1, three marks - 1
Five marks - 1 total marks - 11

I PUC Revision

order pair: If a pair of elements are listed in a specific manner then it is called an order pair. It is denoted by (a,b)

Note: In an order pair (a,b) the element a is called antecedent (or first element) and b is called consequent (or second element) of the order pair (a,b)

cartesian product of two sets: The set of all order pair of elements (a,b), where $a \in A$ and $b \in B$ is called cartesian product of the sets A and B. It is denoted by $A \times B$

i.e. $A \times B = \{(a,b) : a \in A \text{ and } b \in B\}$

Note:

1) if $n(A) = m$ and $n(B) = n$ then the number of elements in $A \times B$ is mn
2) If $A = \phi$ or $B = \phi$ then $A \times B$ does not exist
3) If $A \neq B$ then $A \times B \neq B \times A$
4) If $A = B$ then $A \times B = B \times A$

Relations: Let A and B be two non empty sets, then the subsets of $A \times B$ is called a relation R from set A to set B i.e. $R \subseteq A \times B$

Note: 1) If $n(A) = m$ and $n(B) = n$ then the number of relations from set A to set B is 2^{mn}

2) If $A = \phi$ or $B = \phi$ then the relations from the set A to set B is not possible.

Relation on a set:

Let A be any non empty set, then the relation from set A to itself is called relation on a set A. i.e $R \subseteq A \times A$

Note: If $n(A) = n$ then the number of relations on a set A is 2^{n^2}

Domain and range of relation:

If R is a relation from set A to set B defined by $R = \{(a,b) : a \in A \text{ and } b \in B\}$ then the set of all first elements of the order pair (a, b) are called domain and second elements are called range of a relation R

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Types of Relations:

Empty relation: A relation R in a set A is called empty relation, if no element of A is related to any element of A. i.e. $R = \phi \subset A \times A$

Ex. $A = \{1, 2, 3, 4\}$ the relation R defined on A as $R = \{(x, y) : x + y > 10\}$

ie. $R = \phi$

Universal relation: A relation R on a set A is said to be universal relation if each element of set A is related to every element of set A. i.e. $R = A \times A$

Ex. $A = \{1, 2, 3, 4\}$ the relation R defined on A as $R = \{(a, b) : a + b > 0\}$

Both the empty relation and the universal relation are sometimes called trivial relations.

Reflexive relation: A relation R on a set A is said to be reflexive relation if $(a, a) \in R \ \forall \ a \in A$.

Ex. If $A = \{1, 2, 3\}$ then

$R_1 = \{(1,1), (2,2), (3,3)\}$ is reflexive.

$R_2 = \{(1,1) (1,2) (2,2) (2,3)\}$ is not reflexive

$(\because 3 \in A$ but $(3,3) \notin R_2)$

$R_3 = \{(1,1), (1,2), (1,3), (2,2) (3,3)\}$ is reflexive

Symmetric relation:

A relation R on a set A is said to be symmetric if $(a,b) \in R \Rightarrow (b,a) \in R$ $\forall$ $a,b \in A$

Ex: If $A = \{1,2,3\}$ then

$R_1 = \{(1,1),(2,2),(3,3)\}$ is symmetric

$R_2 = \{(1,2),(2,3),(3,2)\ (1,3)\}$ is not symmetric. $(\because (1,2) \in R$ but $(2,1) \notin R)$

$R_3 = \{(1,1),(1,2),(1,3),(3,2),(2,3),(3,1),(2,1)\}$ is symmetric.

Transitive relation:

A relation R on a set A is said to be transitive if $(a,b) \in R$ and $(b,c) \in R \Rightarrow (a,c) \in R$, $\forall$ $a,b,c \in A$

Ex: $R_1 = \{(1,1),(1,2),(2,1),(2,2)\}$ is transitive.

$R_2 = \{(1,1)\ (2,2)\ (3,3)\}$ is transitive

$R_3 = \{(1,2)\ (2,3)\ (2,1)\ (2,2)\}$ is not transitive $(\because (1,2)$ and $(2,3) \in R$, but $(1,3) \notin R]$

Equivalence relation:

A relation R on a set A is said to be an equivalence if R is reflexive, symmetric and transitive.

Ex: If $A = \{1, 2, 3\}$ then

$R_1 = \{(1,1), (2,2), (3,3)\}$ is an equivalence relation.

$R_2 = \{(1,1), (1,2), (2,1), (2,2), (3,3)\}$ is an equivalence relation.

Ex 1.1:

① Determine whether each of the following relations are reflexive, symmetric and transitive.

(i) Relation R in the set $A = \{1, 2, 3 \ldots 14\}$ defined as $R = \{(x, y) : 3x - y = 0\}$

Ans Given $A = \{1, 2, 3, \ldots 14\}$

$R = \{(x, y) : 3x - y = 0\}$

$R = \{(x, y) : y = 3x\}$

$R = \{(1, 3), (2, 6), (3, 9), (4, 12)\}$

Reflexive:

Since $1 \in A$ but $(1,1) \notin R$

Hence R is not reflexive.

Symmetric :

Since $(1,3) \in R$ but $(3,1) \notin R$

Hence R is not symmetric

transitive :

Since $(1,3) \in R$ and $(3,9) \in R$

but $(1,9) \notin R$

Hence R is not transitive.

(ii) Relation R in the set N of natural numbers defined as

$R = \{ (x,y) : y = x+5 \text{ and } x < 4 \}$

Ans Given $R = \{ (x,y) : y+5 \text{ and } x < 4 \}$

$A = \{ 1, 2, 3 \ldots \}$

$R = \{ (1,6), (2,7), (3,8) \}$ because $x<4$

Reflexive :

Since $1 \in A$ but $(1,1) \notin R$

Hence R is not reflexive

Symmetric :

Since $(1,6) \in R$ but $(6,1) \notin R$

Hence R is not symmetric

transitive :

Clearly R is not transitive.

(iii) Relation R in the set $A = \{1,2,3,4,5,6\}$ as $R = \{(x,y) : y$ is divisible by $x\}$

Ans: Given $A = \{1,2,3,4,5,6\}$

$R = \{(x,y) : y$ is divisible by $x\}$

$R = \{(1,1), (1,2), (1,3), (1,4), (1,5), (1,6), (2,2), (2,4), (2,6), (3,3), (3,6), (4,4), (5,5), (6,6)\}$

Reflexive:

Since $(1,1)$ $(2,2)$ $(3,3)$ $(4,4)$ $(5,5)$ $(6,6)$ $\in R$

$\therefore$ R is reflexive.

Symmetric:

Since $(1,2) \in R$ but $(2,1) \notin R$

Hence R is not symmetric.

transitive:

Since y is divisible by x and z is divisible by y then z is divisible by x

ie. $(1,2) \in R$ and $(2,6) \in R \Rightarrow (1,6) \in R$

$\therefore$ R is transitive.

(iv) Relation R in the set Z of all integers defined as $R = \{ (x,y) : x-y$ is an integer$\}$

Ans. Given $A = \{$ set of integers $\}$

$R = \{ (x,y) : x-y$ is an integer.

Reflexive :

$\forall \; x \in Z \qquad x-x = 0 \in Z$.

Hence R is reflexive.

Symmetric :

Since $x-y$ is an integer, $y-x$ also an integer.

ie. $x-y \in R \Rightarrow y-x \in R$.

Hence R is symmetric.

transitive :

Since $x-y$ is an integer, $y-z$ is an integer $\Rightarrow x-z$ is also an integer

i.e. $x-y \in R$ and $y-z \in R \Rightarrow x-z \in R$

Hence R is transitive.

(V) Relation R in the set A of human beings in a town at a particular time given by.

(a) $R = \{ (x,y) : x$ and y work at the same place $\}$

Ans Given $R = \{(x,y) : x$ and y work at the same place$\}$

Reflexive: Since $x \in A$, x and x work at the same place.

$\Rightarrow (x,x) \in R$

Hence R is reflexive.

Symmetric: Since $(x,y) \in R$

$\Rightarrow$ x and y work at the same place

$\Rightarrow$ y and x work at the same place

$\Rightarrow (y,x) \in R$

$\therefore$ R is symmetric.

transitive:

Since $(x,y) \in R$ and $(y,z) \in R$

ie x and y work at the same place

y and z work at the same place

$\Rightarrow$ x and z work at the same place

$\Rightarrow (x,z) \in R$

Hence R is transitive.

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b). $R = \{(x,y) : x$ and y live in same locality$\}$

Ans reflexive: Since $x \in A \Rightarrow x$ and x live in the same locality

$\Rightarrow (x,x) \in R$

$\therefore$ R is reflexive

Symmetric: Since $(x, y) \in R$

$\Rightarrow$ x and y live in same locality

$\Rightarrow$ y and z live in same locality

$\Rightarrow$ $(y, z) \in R$

$\therefore$ R is symmetric

transitive:

Since $(x,y) \in R$ and $(y,z) \in R$

$\Rightarrow$ x and y live in the same locality

$\Rightarrow$ y and z live in the same locality

$\Rightarrow$ $(x,z) \in R$

$\therefore$ R is transitive.

(c) $R = \{(x, y) : x$ is exactly 7cm taller than $y\}$

Ans reflexive:

Since x is not exactly 7cm taller than x

i.e. $(x, x) \notin R$

hence R is not reflexive.

Symmetric: Given x is ~~taller~~ ~~7cm~~ exactly 7cm taller than y not imply y is exactly 7cm taller than x.

i.e. $(x, y) \in R$ but $(y, x) \notin R$

Hence R is not symmetric

clearly R is not transitive.

Since $(x, y) \in R$ but $(y, z) \notin R$

$\not\Rightarrow (x, z) \in R$

i.e $(x, z) \notin R$

Hence R is not transitive

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d) $R = \{(x, y) : x \text{ is wife of } y\}$

Ans Reflexive:

Since x can't be the wife of x

$\Rightarrow (x, x) \notin R$

$\therefore$ R is not reflexive.

Symmetric:

Given $(x, y) \in R$

$\Rightarrow x$ is wife of y

but y can't be the wife of x

$\Rightarrow (y, x) \notin R$

hence R is not symmetric

Clearly R is not transitive.

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e) $R = \{(x, y) : x \text{ is father of } y\}$

Reflexive:

Since x can't be father of x

i.e $(x, x) \notin R$

Hence R is not reflexive

Symmetric:

Since x is the father of y

ie. $(x, y) \in R$ but

y can't be father of x

$\Rightarrow (y, x) \notin R$

hence R is not symmetric

transitive: As x is the father of y

and y is the father of z

but x can't be father of z

ie. $(x, y) \in R$ and $(y, z) \in R \Rightarrow (x, z) \notin R$

Hence R is not transitive.

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2) Show that the relation R defined in the set of $\mathbb{R}$ of real numbers as

$R = \{(a, b) : a \leq b^2\}$ is neither reflexive nor symmetric or transitive.

Reflexive: Given $R = \{(a, b) ; a \leq b^2\}$

$\forall a \in A \Rightarrow a \nleq a^2 \quad (\because \frac{1}{2} \nleq \frac{1}{2}^2)$

ie. $\cancel{2 \leq 4}$

ie. $\frac{1}{2} \nleq \frac{1}{4}$

hence $(a, a) \notin R$

Hence R is not reflexive

Symmetric :

$\forall (a,b) \in R \Rightarrow a \le b^2$ ($\because 1 \le 2^2$)

but $b^2 \not\le a$ ($\because 2^2 \not\le 1$ $4 \le 1$ is not true)

Hence $(b,a) \notin R$

$\therefore$ R is not symmetric.

Transitive : $\forall (a,b) \in R$ and $(b,c) \in R$

$\Rightarrow a \le b^2$ and $b \le c^2$

$\Rightarrow a \not\le c^2$ ($\because 2 \le (-3)^2$ and $-3 \le 1^2$ $\Rightarrow 2 \le 1^2$)

$\Rightarrow (a,c) \notin R$

$\therefore$ R is not transitive.

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

Ans Given $A = \{1,2,3,4,5,6\}$

$R = \{(a,b) : b = a+1\}$

$R = \{(1,2), (2,3), (3,4), (4,5), (5,6)\}$

Reflexive : Since $1 \in A$ but $(1,1) \notin R$

Hence R is not reflexive

Symmetric : Since $(1,2) \in R$ but $(2,1) \notin R$

Hence R is not symmetric

Since $(2,3) \in R$ and $(3,4) \in R$

but $(2,4) \notin R$

Hence R is not transitive.

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

Ans. Given $R = \{(a,b) : a \leq b\}$

reflexive: $\forall\, a \in R \Rightarrow a \leq a \quad (\because 1 \leq 1)$

$\therefore (a,a) \in R$

Hence R is reflexive.

Symmetric: $\forall\, (a,b) \in R \Rightarrow a \leq b \quad (\because 2 \leq 3)$

but $b \nleq a \quad (\because 3 \leq 2$ is not true$)$

Hence $(b,a) \notin R$

Hence R is not symmetric.

transitive:

Since $(a,b) \in R \Rightarrow a \leq b \quad (\because 2 \leq 3$

and $(b,c) \in R \Rightarrow b \leq c \quad (3 \leq 5)$

$\Rightarrow a \leq c \quad (2 \leq 5$

$\therefore (a,c) \in R$

hence R is transitive

5) Check whether the relation R in $\mathbb{R}$ defined by $R = \{(a,b) : a \le b^3\}$ is reflexive, symmetric, or transitive.

Ans. Reflexive:

$\forall a \in \mathbb{R} \Rightarrow a \nleq a^3 \quad \left(\because \frac{1}{3} \nleq \frac{1}{3^3}\right)$

$\Rightarrow (a,a) \notin R$

$\therefore$ R is not reflexive.

Symmetric:

$\forall (a,b) \in R \Rightarrow a \le b^3 \quad (\because 1 \le 2^3)$

but $b^3 \nleq a \quad (2^3 \nleq 1$ ie. $8 \le 1$ is not true$)$

Hence $(b,a) \notin R$

Hence R is not symmetric.

Transitive:

$\forall (a,b) \in R$ and $(b,c) \in R$

$\Rightarrow a \le b^3$ and $b \le c^3$

$(\because 9 \le 3^3$ and $3 \le 2^3$

but $9 \nleq 2^3$ ie. $9 \le 8$ is not true$)$

Hence $(a,c) \notin R$

$\therefore$ R is not transitive.

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

$R = \{(1,2),(2,1)\}$

Ans: Reflexive: Since $1 \in R$ but

$(1,1) \notin R$

Hence R is not reflexive.

Symmetric:

Since $(1,2) \in R$ and $(2,1) \in R$

i.e. $(a,b) \in R \Rightarrow (b,a) \in R$

Hence R is symmetric.

Transitive: Since $(1,2) \in R$ and $(2,1) \in R$

but $(1,1) \notin R$

Hence R is not transitive.

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

Ans: Reflexive: $\forall x \in A$, $\because x$ and x have same number of pages.

$\Rightarrow (x,x) \in R$

$\therefore R$ is reflexive.

Symmetric:

$\forall (x,y) \in R \Rightarrow x$ and y have same number of pages

$\Rightarrow$ y and x have same number of pages

$\Rightarrow (y, x) \in R$

$\therefore$ R is symmetric.

Transitive: $\forall (x, y) \in R$ and $(y, z) \in R$

$\Rightarrow$ x and y have same number of pages

$\Rightarrow$ y and z have same number of pages

$\Rightarrow$ x and z have same number of pages

$\Rightarrow (x, z) \in R$

$\therefore$ R is transitive

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8) Show that the relation R in the set $A = \{1, 2, 3, 4, 5\}$ given by $R = \{(a, b) : |a-b| \text{ is even}\}$ 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 $\{2, 4\}$.

Ans $A = \{1, 2, 3, 4, 5\}$

$R = \{(a, b) : |a-b| \text{ is even}\}$

$R = \{(1,1), (1,3), (2,2) (1,5), (2,4), (3,1) (3,3)$
$(3,5) (4,2) (4,4) (5,1), (5,3), (5,5)\}$

Reflexive:

Since $(1,1) (2,2), (3,3), (4\,4), (5,5) \in R$

$\therefore$ R is reflexive

Symmetric:

Since $|a-b|$ is even $\Rightarrow$ $|b-a|$ is even

ie. $|a-b| \in R \Rightarrow |b-a| \in R$

Hence R is symmetric

Transitive:

Since $|a-b|$ is even and $|b-c|$ is even $\Rightarrow$ $|a-c|$ is even

ie. $|a-b| \in R$ and $|b-c| \in R \Rightarrow |a-c| \in R$

Hence R is transitive.

Hence R is equivalence relation.

Given $A = \{1, 3, 5\}$.

$|1-3| = 2$ is even, $|1-5| = 4$ even.

$|3-5| = 2$ even.

Hence all the elements of $\{1, 3, 5\}$ are related to each other.

$|2-4| = 2$ even, hence all the elements $\{2, 4\}$ are related to each other.

$|1-2| = 1$, $|3-2| = 1$, $|5-2| = 3$, $|1-4| = 3$

$|3-4| = 1$ $|5-4| = 1$ are odd.

Therefore no elements of $\{1, 3, 5\}$ are related to $\{2, 4\}$

9) Show that each of the relation R in the set $A = \{x \in Z : 0 \le x \le 12\}$ given by

i) $R = \{(a,b) : |a-b|$ is multiple of 4 $\}$

(ii) $R = \{(a,b) : a = b\}$

is an equivalence relation. Find the set of all elements related to 1 in each case.

Ans. $A = \{0, 1, 2, 3 \ldots 12\}$

$R = \{(a,b) : |a-b|$ is multiple of 4 $\}$

(i) Since $a \in A$, $|a-a| = 0$

0 is a multiple of 4

$\Rightarrow (a,a) \in R$

$\therefore$ R is reflexive.

Since $(a,b) \in R \Rightarrow |a-b|$ is a multiple of 4

$\Rightarrow |-(b-a)|$ is a multiple of 4

$\Rightarrow |b-a|$ is a multiple of 4

$\Rightarrow (b,a) \in R$

Hence R is symmetric.

Since $(a,b) \in R$ and $(b,c) \in R$

ie. $|a-b|$ is multiple of 4

$|b-c|$ is multiple of 4

$\Rightarrow |a-b+b-c|$ is multiple of 4

$\Rightarrow |a-c|$ is multiple of 4

$\Rightarrow (a,c) \in R$

Hence R is transitive.

Hence R is equivalence relation

Since $|1-1|=0$ $|5-1|=4$ $|9-1|=8$

are multiple of 4

Hence the set of all elements related to 1 are $\{1, 5, 9\}$

(ii) $\forall a \in A \Rightarrow a=a$

$\therefore (a,a) \in R$

Hence R is reflexive.

Since $(a,b) \in R \Rightarrow a=b$

$\Rightarrow b=a$

$\Rightarrow (b,a) \in R$

Hence R is symmetric.

Since $(a,b) \in R$ and $(b,c) \in R$

$\Rightarrow a=b$ and

$\Rightarrow b=c$

$\Rightarrow a=c$

$\Rightarrow (a,c) \in R$

Hence R is transitive.

Therefore R is an equivalence relation

10) Give an example of a relation which is

i) Symmetric but neither reflexive nor transitive

Ex. $A = \{1, 2, 3\}$ $R = \{(1,2), (2,1)\}$

(ii) Transitive but neither reflexive nor symmetric

Ex $A = \{1, 2, 3\}$ $R = \{(1,2), (2,3), (1,3)\}$

(iii) Reflexive symmetric but not transitive

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

(iv) Reflexive and transitive but not symmetric.

Ex $R = \{(1,1), (2,2), (3,3), (1,2)\}$

(v) Symmetric and transitive but not reflexive.

Ex $R = \{(1,2)\ (2,1), (1,1), (2,2)\}$

$A = \{1, 2, 3\}$ $(3,3) \notin R$ hence not reflexive.

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11) Show that the relation R in 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.

$R = \{(P,Q) ; OP = OQ\}$

Ans. $\forall P \in A \Rightarrow OP = OQ$

$\Rightarrow OP = OP$

$\Rightarrow (P,P) \in R$

$\therefore$ R is reflexive.

Symmetric: $\forall (P,Q) \in R \Rightarrow OP = OQ$

$\Rightarrow OQ = OP$

$\Rightarrow (Q,P) \in R$

$\therefore$ R is Symmetric

Transitive:

$\forall (P,Q) \in R$ and $(Q,S) \in R$

$\Rightarrow OP = OQ$ and $OQ = OS$

$\Rightarrow OP = OS$

$\Rightarrow (P,S) \in R$

$\therefore$ R is transitive

Hence R is an equivalence relation.

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12) Show that the relation R defined in the set A of all triangles as $R = \{(T_1, T_2) : T_1$ is similar to $T_2\}$ is an equivalence relation.

Reflexive:

$\forall T_1 \in A$

$\Rightarrow T_1$ is similar to T_2

$\Rightarrow T_1$ is similar to T_1

$\Rightarrow (T_1, T_1) \in R$

$\therefore$ R is reflexive.

Symmetric: $\forall (T_1, T_2) \in R$

$\Rightarrow$ T_1 is similar to T_2

$\Rightarrow$ T_2 is similar to T_1

$\Rightarrow (T_2, T_1) \in R$

$\therefore$ R is symmetric

Transitive:

$\forall (T_1\ T_2) \in R$ and $(T_2, T_3) \in R$

$\Rightarrow$ T_1 is similar to T_2 and

T_2 is similar to T_3

$\Rightarrow$ T_1 is similar to T_3

$\Rightarrow (T_1\ T_3) \in R$

$\therefore$ R is transitive.

Hence R is an equivalence relation.

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13) Show that the relation R defined in 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.

Ans Given

$R = \{(P_1 \cdot P_2) :$ P_1 and P_2 have same number of sides$\}$

Reflexive: $\forall P_1 \in A$

$\Rightarrow$ P_1 and P_2 have same number of sides

$\Rightarrow P_1$ and P_1 have same number of sides
$\Rightarrow (P_1, P_1) \in R$
$\therefore$ R is reflexive

Symmetric:
$\forall (P_1, P_2) \in R$
$\Rightarrow P_1$ and P_2 have same number of sides
$\Rightarrow P_2$ and P_1 have same number of sides
$\Rightarrow (P_2, P_1) \in R$
$\therefore$ R is symmetric

Transitive:
$\forall (P_1, P_2)$ and $(P_2, P_3) \in R \Rightarrow$
$\Rightarrow P_1$ and P_2 have same number of sides
$\Rightarrow P_2$ and P_3 have same number of sides
$\Rightarrow P_1$ and P_3 have same number of sides
$\Rightarrow (P_1, P_3) \in R$
$\therefore$ R is transitive.

Hence R is an equivalence relation.

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

Ans: Reflexive:
$\forall L_1 \in L \Rightarrow L_1$ is parallel to L_2
$\Rightarrow L_1$ is parallel to L_1
$\Rightarrow (L_1, L_1) \in R$

$\therefore$ R is reflexive

Symmetric:

$\forall (L_1, L_2) \in R \Rightarrow L_1$ is parallel to L_2

$\Rightarrow L_2$ is parallel to L_1

$\Rightarrow (L_2, L_1) \in R$

$\therefore$ R is symmetric

Transitive:

$\forall (L_1, L_2)$ and $(L_2, L_3) \in R$

$\Rightarrow L_1$ is parallel to L_2 and L_2 is parallel to L_3

$\Rightarrow L_1$ is parallel to L_3.

$\Rightarrow (L_1, L_3) \in R$ $\therefore$ R is transitive

$\therefore$ R is an equivalence relation.

Let L be the required line

$= \{L : L$ is parallel to $y = 2x + 4\}$

$= \{L : L$ is a line whose relation is $y = 2x + k$ where k is any real$\}$

15) Let R be the relation in the set $\{1, 2, 3, 4\}$ given by $R = \{(1,2), (2,2), (1,1), (4,4), (1,3), (3,3), (3,2)\}$ choose the correct answer.

A) 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.

Ans. R is reflexive and transitive

since $(1,2) \in R$ but $(2,1) \notin R$

hence R is not symmetric.

$\therefore$ B is the correct answer

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16) Let R be the relation in the set N given by $R = \{(a,b) : a = b-2, b > 6\}$ Choose the correct answer.

A) $(2,4) \in R$ B) $3,8 \in R$ C) $(6,8) \in R$ D) $(8,7) \in R$

Ans. $(6,8) \in R \Rightarrow 6 = 8-2$ and $8 > 6$

C is the correct answer.
