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Set :- A set is a ~~well~~ collection of well defined objective or things.

Types of set :- (1) **Empty set** :- A set having no element(s) is called empty set.
It is denoted by $\emptyset$ $\{\}$

2) **Singleton set** :- A set having one element only is called singleton set.

Subset :- A set is called subset of the set B if for all $x \in A \Rightarrow x \in B$. It is expressed as $A \subseteq B$

Power set :- The family of all subsets of a set A is called power set of A.
Example $A = \{a, b\}$ $P(A) = \{\emptyset, \{a\}, \{b\}, \{a, b\}\}$

No. of elements in subset of a set $= 2^n$
where n = no. of elements in original set

(Q) $A = \{1,4\}$ $B = \{4,5\}$ $C = \{5,7\}$ then find
$(A \times B) \cap A \times C$

$A \times B = \{(1,4), (1,5), (4,4), (4,5)\}$
$A \times C = \{(1,5), (1,7), (4,5), (4,7)\}$

$\therefore (A \times B) \cap (A \times C) = \{(1,5), (4,5)\}$

(2) Let A, B, C be any three sets then prove that:

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

Sol:- let $(x,y)\in A\times(B\cap C)$

$\therefore x\in A$ & $y\in B\cap C$

or $x\in A$ & $y\in B$ & $y\in C$

or $(x\in A$ & $y\in B)$ & $(x\in A$ & $y\in C)$

~~$x\in A\times B$ &~~

$x,y\in A\times B$ & $x,y\in A\times C$

$\therefore (x,y)\in(A\times B)\cap(A\times C)$

or $A\times(B\cap C)\subseteq(A\times B)\cap(A\times C)$

let $(x,y)\in(A\times B)\cap(A\times C)$

~~$\therefore x\in A\times B$ & $y\in A\times C$~~

~~or $x\in A$ & $x\in B$ & $y\in A$ & $y\in C$~~

$(x,y)\in A\times B$ & $(x,y)\in A\times C$

$x\in A$ & $y\in B$ & $x\in A$ & $y\in C$

$x\in A$ & $y\in B$ & $y\in C$

$x\in A$ & $y\in B\cap C$

or $(x,y)\in A\times(B\cap C)$

$(A\times B)\cap(A\times C)\subseteq A\times(B\cap C)$

(3) If A, B, C, D are any four sets then prove that
$(A \cap B) \times (C \cap D) = (A \times C) \cap (B \times D)$

Sol:: let $(x, y) \in (A \cap B) \times (C \cap D)$
$\therefore$
$x \in A \cap B$ & $y \in C \cap D$
$x \in A$ & $x \in B$ & $y \in C$ & $y \in D$
or $(x, y) \in A \times C$ & $(x, y) \in C \times D$

$\therefore (x, y) \in (A \times C) \cap (C \times D)$

$\therefore (A \cap B) \times (C \cap D) \subseteq (A \times C) \cap (B \times D)$ — (1)

let $(x, y) \in (A \times C) \cap (B \times D)$
$\therefore (x, y) \in A \times C$ & $(x, y) \in B \times D$
or $x \in A$ & $y \in C$ & $x \in B$ & $y \in D$
$(x \in A \cap B)$ & $y \in C \cap D$
or $(x, y) \in (A \cap B) \times (C \cap D)$

$\therefore$ ~~$(A \cap B) \times (C \cap D) \subseteq A \cap$~~

$(A \times C) \cap (B \times D) \subseteq (A \cap B) \times (C \cap D)$ — (2)

From (1) & (2)
$(A \cap B) \times (C \cap D) = (A \times C) \cap (B \times D)$

(4)

(4) If A & B are any two sets then prove that

$(A \cap (B - A)) = \emptyset$

Sol^n: ~~let $(x,y) \in A \cap (B-A)$~~

~~$\therefore (x,y) \in A \;\&\; (x,y) \in B - A$~~

Let $x \in A \cap (B-A)$

$x \in A \;\&\; (x \in B - A)$

$x \in A \;\&\; (x \in B \;\&\; x \notin A)$

$(x \in A \;\&\; x \notin A) \;\&\; (x \in B)$

$(x \in \emptyset) \;\&\; x \in B$

$x \in B \cap \emptyset$

$x \in \emptyset$

Hence $A \cap (B - A) = \emptyset$