181 May 14th 2024

MTH 230 - Linear Algebra

Cartesian Product of Set is an ordered pair obtained by the product of two non-empty set. An ordered pair means that two elements are taken from each set.

$A \times B = \{(a,b) \mid a \in A, b \in B\}$

Two ordered pairs (a,b) and (c,d) are equal if and only if $a = c$ and $b = d$

If $A = (x^2 - 4, y+1) = (0, 2)$

find x and y

$x^2 - 4 = 0 \Rightarrow x^2 = 4 \Rightarrow x = \pm 2$

$y + 1 = 2 \Rightarrow y = 2 - 1 \Rightarrow y = 1$

$A \times B \neq B \times A$ unless $A = B$

Properties of Cartesian Set

1. $A \times B \neq B \times A$ unless $A = B$.
2. $A \times B = \emptyset$ if $A = \emptyset$ or $B = \emptyset$

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182 May 14th 2024

3. $(A \times B) \times C \neq A \times (B \times C)$
4. $A \cap (B \times C) = (A \cap B) \times (A \cap C)$
5. $A \cup (B \times C) = (A \cup B) \times (A \cup C)$
6. $A \times (B - C) = (A \times B) - (A \times C)$

Given set $A = (a, b, c)$ and $B = (b, c)$
find the following set
(i) $(A \times B) \cap (B \times A)$
(ii) $(A \times B) \cup (B \times A$

$A \times B = \{(a, b), (a, c), (b, b), (b, c), (c, b), (c, c)\}$
$B \times A = \{(b, a), (b, b), (b, c), (c, a), (c, b), (c, c)\}$

Suppose $A = (x, y)$ $B = (1, 2)$ and $C = (2, 3)$
Find the set:
(i) $A \times (B \cup C)$ (ii) $(A \times B) \cup (A \times C)$

$(A \times B) \cap (B \times A) = \{(b, b), (b, c), (c, b), (c, c)\}$
$(A \times B) \cup (B \times A) = \{(a, b), (a, c), (b, a), (b, b), (b, c), (c, a), (c, b), (c, c)\}$

Suppose $A = (x, y)$ $B = (1, 2)$ and $C = (2, 3)$
find the set
(i) $A \times (B \cup C)$ (ii) $(A \times B) \cup (A \times C)$

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183 May 14th 2024

(i) $A \times B \cup C = (x, y) \times (1, 2, 3)$

$= \{(x, 1), (x, 2), (x, 3), (y, 1), (y, 2), (y, 3)\}$

(ii) $(A \times B) \cup (A \times C) = \{(x, 1), (x, 2), (y, 1), (y, 2)\}$

$\cup \{(x, 2), (x, 3), (y, 2), (y, 3)\}$

$= \{(x, 1), (x, 2), (y, 1), (y, 2), (x, 3), (y, 3)\}$

Find the Cartesian product of:

$(1, 2, 3)$ and $P(\{a\})$

$(1, 2, 3) \times P(\{a\}) = (1, 2, 3) \times (\emptyset, a)$

$= \{(1, \emptyset), (2, \emptyset), (3, \emptyset), (1, a), (2, a), (3, a)\}$

Osalobioman