Sections 2.3 - 2.6 Practice Problems

1. Let universe U = {1,2,3,4,5,6,7,8,9,a,b,c,d,e,f}, and sets A = {a, b, c, d, 1, 2, 3, 4}, B = {1,2,3,4,5}, and C = {a,b,1,2,9}. Find

a) $A \cup B \cup C$

b) $A \cap B \cap C$

c) $A - B$

d) $C - A$

e) $\overline{A \cup B}$

f) $\overline{A \cap C}$

g) $A \cup B \cap C$

Practice Problems

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a) A U B U C = {1,2,3,4,5,9,a,b,c,d}

b) A ∩ B ∩ C

c) A – B

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e) $\overline{A \cup B}$

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a) A U B U C = {1,2,3,4,5,9,a,b,c,d}

b) A ∩ B ∩ C = {1,2}

c) A – B

d) C – A

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c) A – B = {a,b,c,d}

d) C – A = {9}

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e) $\overline{A \cup B} = \overline{\{a,b,c,d,1,2,3,4,5\}}$

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1. Let universe $U = \{1,2,3,4,5,6,7,8,9,a,b,c,d,e,f\}$, and sets A = {a, b, c, d, 1, 2, 3, 4}, B = {1,2,3,4,5}, and C = {a,b,1,2,9}. Find

a) $A \cup B \cup C = \{1,2,3,4,5,9,a,b,c,d\}$

b) $A \cap B \cap C = \{1,2\}$

c) $A - B = \{a,b,c,d\}$

d) $C - A = \{9\}$

e) $\overline{A \cup B} = \overline{\{a,b,c,d,1,2,3,4,5\}} = \{6,7,8,9,e,f\}$

f) $\overline{A \cap C}$

g) $A \cup B \cap C$

Practice Problems

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Practice Problems

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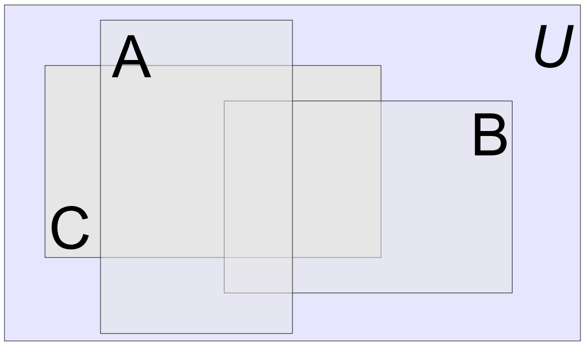
g) A U B ∩ C = A U {1,2} = A = {a, b, c, d, 1, 2, 3, 4}

Practice Problems

2. Draw Venn Diagrams for each of these combinations of the sets A, B, and C.

a) $A \cap (B - C)$



b) $(A \cap \overline{B}) \cup (A \cap \overline{C})$

c) $(A \cap B) \cup (A \cap C)$

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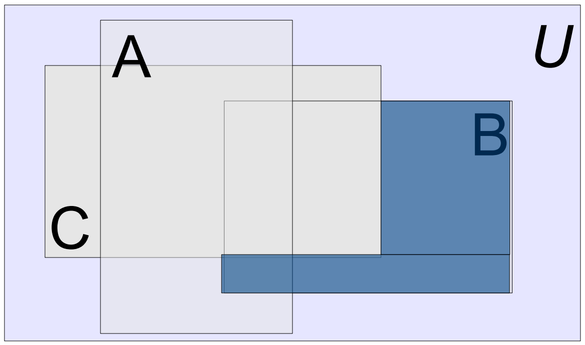

B – C

b) $(A \cap \overline{B}) \cup (A \cap \overline{C})$

c) $(A \cap B) \cup (A \cap C)$

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2. Draw Venn Diagrams for each of these combinations of the sets A, B, and C.

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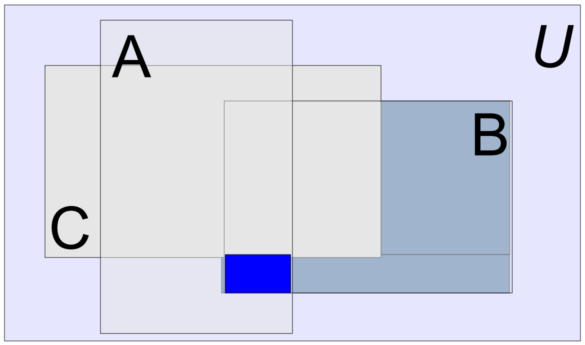

b) $(A \cap \overline{B}) \cup (A \cap \overline{C})$

c) (A ∩ B)U (A ∩ C)

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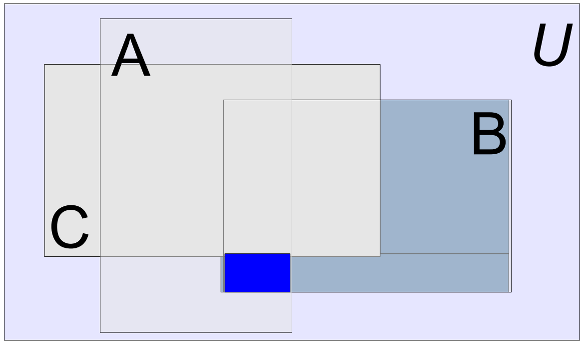
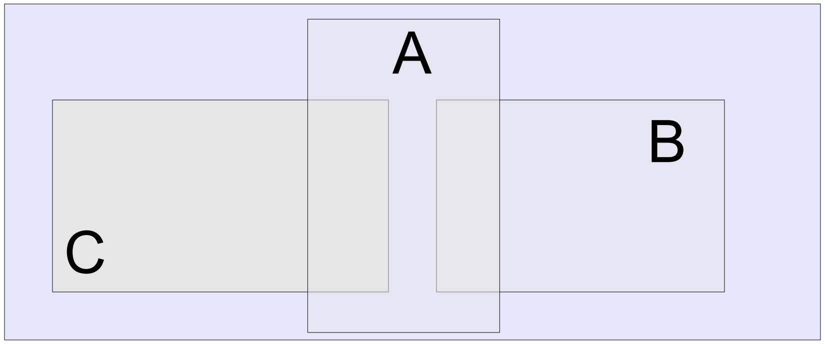


b) $(A \cap \overline{B}) \cup (A \cap \overline{C})$



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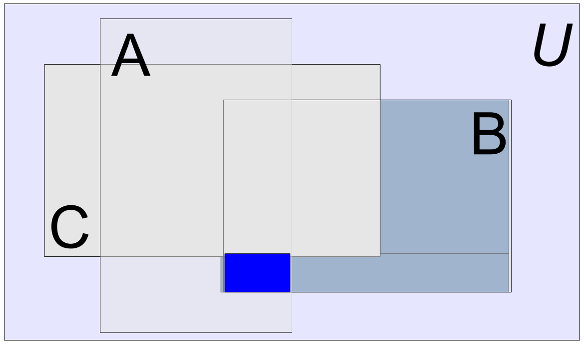

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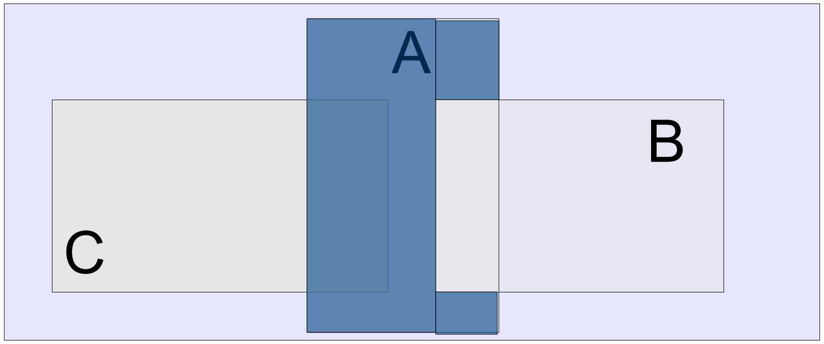

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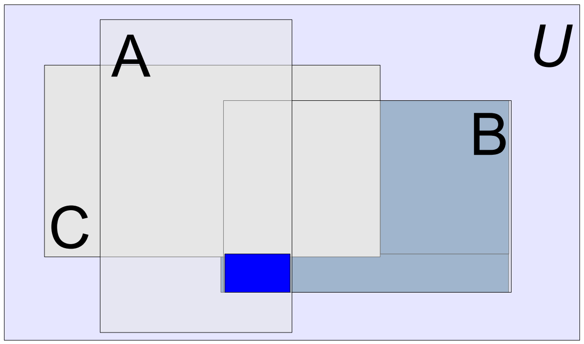

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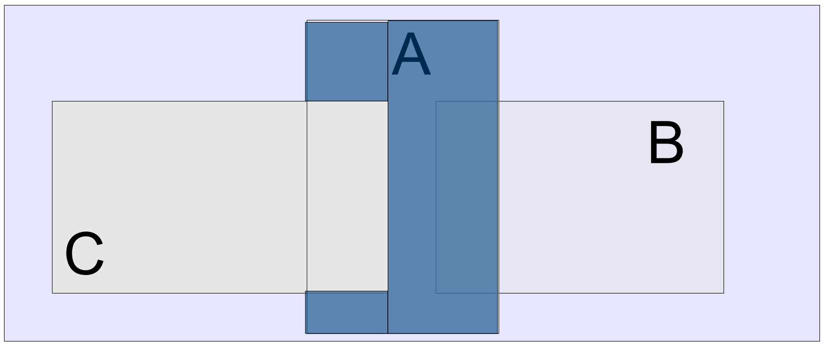

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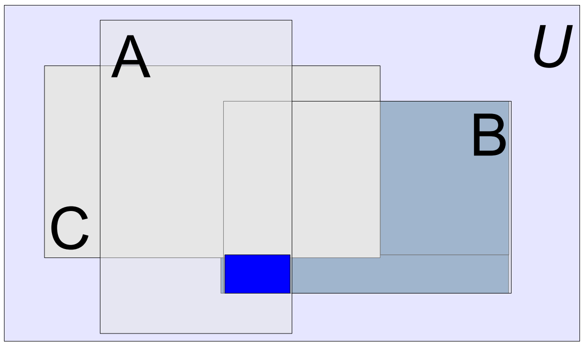

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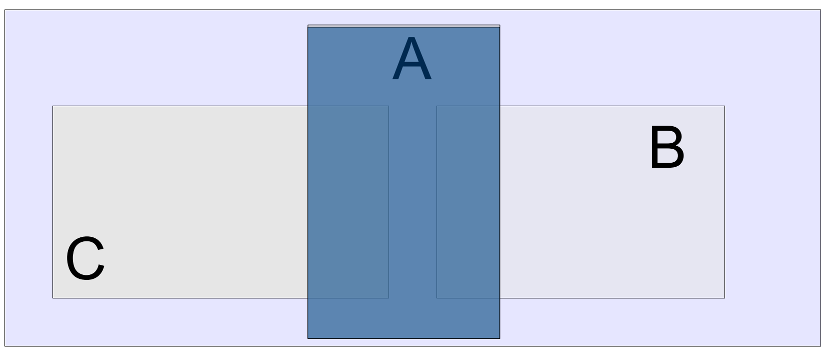

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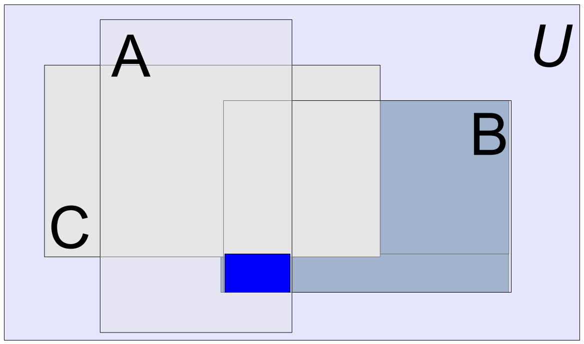

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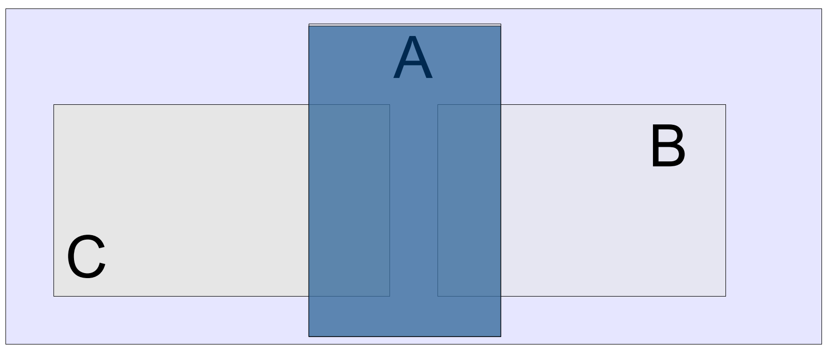

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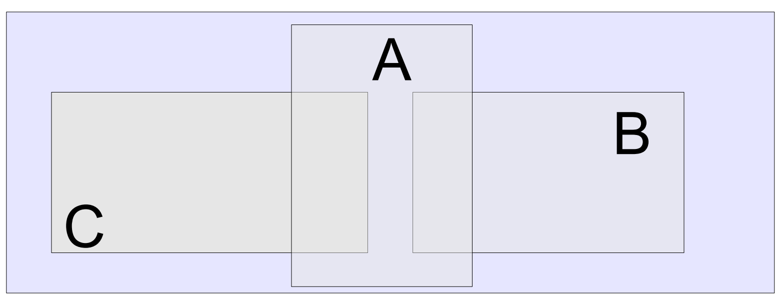

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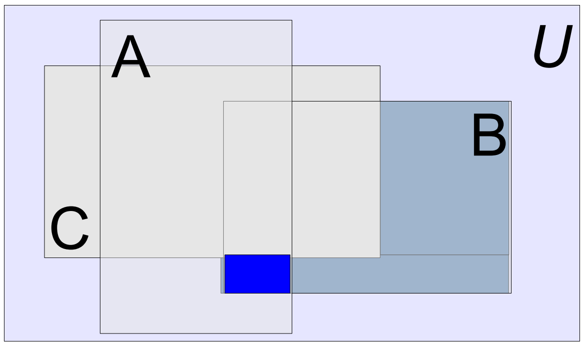

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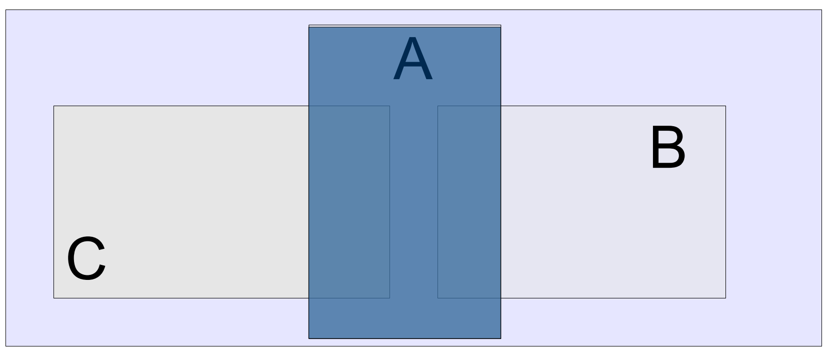
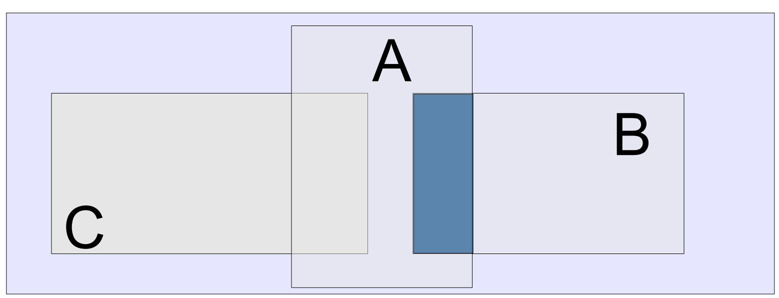


c) $(A \cap B) \cup (A \cap C)$



$A \cap B$

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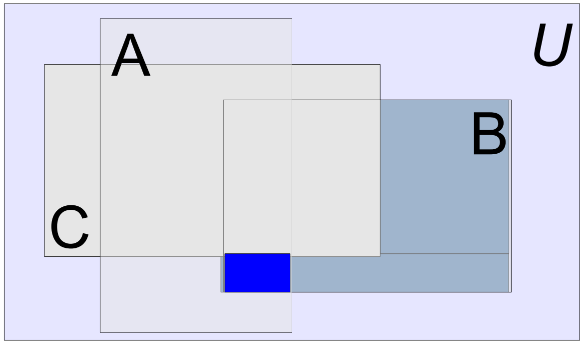

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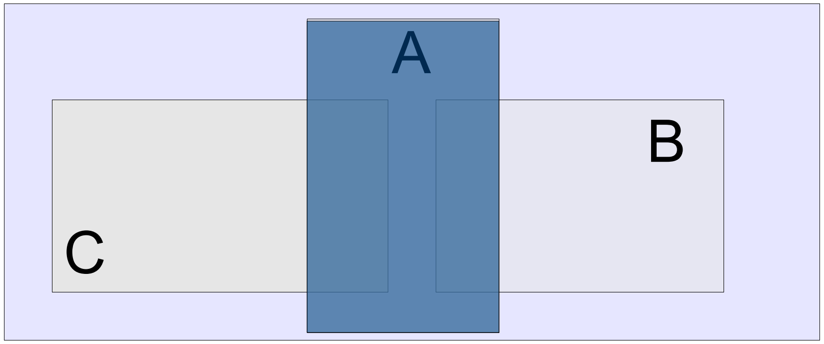

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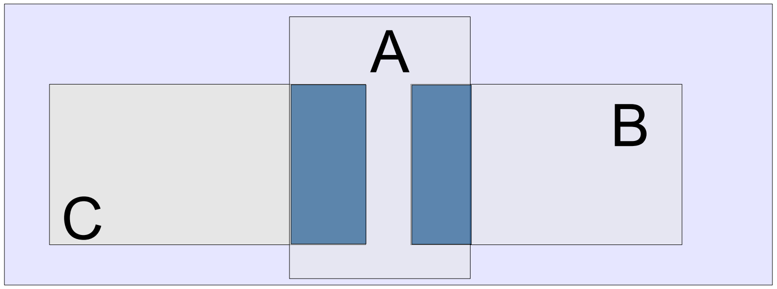

Practice Problems

3. Prove the first absorption law from the Table 1 by showing that if A and B are sets, then $A \cup (A \cap B) = A$

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<u>Proof</u>:
In order to prove that $A \cup (A \cap B) = A$ it is enough to prove that $A \cup (A \cap B) \subseteq A$ and $A \cup (A \cap B) \supseteq A$.

1) Let's prove $A \cup (A \cap B) \subseteq A$:
Let's assume $x \in A \cup (A \cap B)$, then there are three options:
$x \in A$,
$x \in (A \cap B)$,
$x \in A$ and $x \in (A \cap B)$.

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$x \in A$ and $x \in (A \cap B)$.
In the case of the first option, $x \in A$, we immediately get that $A \cup (A \cap B) \subseteq A$,
In the case of the third option, we also get $A \cup (A \cap B) \subseteq A$ immediately, and in the case of the second option, $x \in (A \cap B)$, by definition of intersection of two sets, we get that $x \in A$ and $x \in B$, which again confirms that $A \cup (A \cap B) \subseteq A$.

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2) Let's prove $A \cup (A \cap B) \supseteq A$:
Let's assume that $x \in A$. then, $x \in A \cup (A \cap B)$ by definition of the union.
This proves that $A \cup (A \cap B) \supseteq A$

qed

Practice Problems

4. Prove the second absorption law from the Table 1 by showing that if A and B are sets, then $A \cap (A \cup B) = A$

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1) Let's prove $A \cap (A \cup B) \subseteq A$:
Let's assume $x \in A \cap (A \cup B)$, then by definition of intersection,
$x \in A$ and $x \in (A \cup B)$. Which proves that $A \cap (A \cup B) \subseteq A$

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In order to prove that $A \cap (A \cup B) = A$ it is enough to prove that $A \cap (A \cup B) \subseteq A$ and $A \cap (A \cup B) \supseteq A$.

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2) Let's prove $A \cap (A \cup B) \supseteq A$:
Let's assume that $x \in A$. then, $x \in A \cup B$ by definition of the union, therefore $x \in A \cap (A \cup B)$. This proves that $A \cap (A \cup B) \supseteq A$

qed

Practice Problems

5. What can you say about the sets A and B if we know that

a) $A \cup B = A$?

b) $A \cap B = A$?

c) $A - B = A$?

d) $A \cap B = B \cap A$?

e) $A - B = B - A$?

Practice Problems

5. What can you say about the sets A and B if we know that

a) A U B = A ?
B is a subset of A (might be an empty set, or even equal to A)

b) A ∩ B = A ?

c) A – B = A ?

d) A ∩ B = B ∩ A ?

e) A – B = B – A ?

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b) $A \cap B = A$?
A is a subset of B

c) A – B = A ?

d) $A \cap B = B \cap A$?

e) A – B = B – A ?

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b) A ∩ B = A ?
A is a subset of B

c) A – B = A ?
A and B are disjoint sets (their intersection is empty set, ∅)

d) A ∩ B = B ∩ A ?

e) A – B = B – A ?

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d) A ∩ B = B ∩ A ?
nothing can be said about the sets A and B
(please, notice that A ∩ B = B ∩ A is always true, it is a law,
therefore it is no surprise that we cannot say anything about these sets,
since they might be any sets – the law works for any sets)

e) A – B = B – A ?

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e) A – B = B – A ?
A = B (sets are equal)

6. Find the Cartesian Product of three sets: P = A x B x C, if A = {a,1}, B = {1,2,3}, C = {a,d}

Solution:
A x B x C

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check: P(A) should have 2^4 = 16 elements

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we have exactly 16 sets in P(a).