Name:_____

NetID:_____   **Lecture:**   **A**   **B**

Discussion: **Thursday**   **Friday**   **9**   **10**   **11**   **12**   **1**   **2**   **3**   **4**   **5**   **6**

1. (4 points) $A = \{\text{oak}, \text{apple}, \text{maple}, \text{elm}\}$ $B = \{\text{tree}, \text{oak}, \emptyset\}$

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

   $\{\frac{p}{q} \; : \; p \in \mathbb{Z}^+, q \in \mathbb{Z}^+, \text{ and } pq = 6\} =$

2. (4 points) Check the (single) box that best characterizes each item.

   For all positive integers n,
   if $n! < -10$, then $n > 8$.   true $\Box$ false $\Box$ undefined $\Box$

   Let A and B be disjoint.   true for all sets A and B $\Box$ true for some sets A and B $\Box$
   $|A - B| = |A| - |B|$ false for all sets A and B $\Box$

3. (7 points) In $\mathbb{Z}_7$, find the value of $[3]^{41}$. You must show your work, keeping all numbers in your calculations small. **You may not use a calculator.** You must express your final answer as $[n]$, where $0 \leq n \leq 6$.

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1. (4 points) Is this claim true? Give a concrete counter-example or briefly explain why it's true.

   For any sets A and B, $(A - B) \cup (B - A) \subseteq (A \cup B) - (A \cap B)$

2. (4 points) Check the (single) box that best characterizes each item.

   $A \times A = A$ true for all sets A   □   false for all sets A   □
   (Assume $A \neq \emptyset$)   true for some sets A   □

   $\{1,2\} \times \emptyset =$ $\emptyset$ □ $\{(1,\emptyset),(2,\emptyset)\}$ □ $\{1,2,\emptyset\}$ □
                                $\{\emptyset\}$ □ $\{1,2\}$ □   undefined   □

3. (7 points) In $\mathbb{Z}_9$, find the value of $[5]^{38}$. You must show your work, keeping all numbers in your calculations small. **You may not use a calculator.** You must express your final answer as $[n]$, where $0 \leq n \leq 8$.

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1. (4 points) Is this claim true? Give a concrete counter-example or briefly explain why it's true.

    For any sets A, B, and C, $(A - B) - C \subseteq A - C$

2. (4 points) Check the (single) box that best characterizes each item.

    $|A - B| = |A| - |B|$ true for all sets A and B ☐   true for some sets A and B ☐

    false for all sets A and B ☐

    For all reals n, if $n^2 = 101$,
    then $n > 11$.   true ☐   false ☐   undefined ☐

3. (7 points) In $\mathbb{Z}_{13}$, find the value of $[7]^{21}$. You must show your work, keeping all numbers in your calculations small. **You may not use a calculator.** You must express your final answer as $[n]$, where $0 \leq n \leq 12$.

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1. (4 points) $A = \{\text{earth}, \text{air}, \text{fire}\}$ $B = \{\ (\text{fire}, 3),\ (\text{water}, 2)\ \}$ $C = \{\ 1, 2, 3\ \}$
   $(A \times C) \cap B =$

   $\{p + q \ | \ p \in \mathbb{Z},\ q \in \mathbb{Z},\ pq = 6\} =$

2. (4 points) Check the (single) box that best characterizes each item.

   $A = \overline{A}$
   (Assume the universe
   is not empty.)
       true for all sets A ☐   true for some sets A ☐
       false for all sets A ☐

   $\{1, 2\} \times \{\emptyset\} =$ $\emptyset$ ☐ $\{(1, \emptyset), (2, \emptyset)\}$ ☐ $\{1, 2, \emptyset\}$ ☐
       $\{\emptyset\}$ ☐ $\{1, 2\}$ ☐   undefined ☐

3. (7 points) In $\mathbb{Z}_9$, find the value of $[5]^{41}$. You must show your work, keeping all numbers in your calculations small. **You may not use a calculator.** You must express your final answer as $[n]$, where $0 \le n \le 8$.

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1. (4 points) Is this claim true? Give a concrete counter-example or briefly explain why it's true.

    For any sets A, B, and C, if $A \times C \subseteq B \times C$, then $A \subseteq B$.

2. (4 points) Check the (single) box that best characterizes each item.

    $\forall x \in \mathbb{N}$, if $x^2 < -3$, then $x > 1000$.   true ☐   false ☐   undefined ☐

    $A \cap B \subseteq A$ true for all sets A and B ☐   true for some sets A and B ☐
    false for all sets A and B ☐

3. (7 points) In $\mathbb{Z}_{17}$, find the value of $[5]^{42}$. You must show your work, keeping all numbers in your calculations small. **You may not use a calculator.** You must express your final answer as $[n]$, where $0 \leq n \leq 16$.

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1. (4 points) State the Inclusion Exclusion Principle/Formula for two sets.

2. (4 points) Check the (single) box that best characterizes each item.

   $\emptyset \times A = A \times \emptyset$ true for all sets A   ☐   false for all sets A   ☐
                                      true for some sets A   ☐

                                      true for all sets A and B   ☐   true for some sets A and B   ☐
   $A \cap B = A \cup B$
                                      false for all sets A and B   ☐

3. (7 points) In $\mathbb{Z}_{13}$, find the value of $[7]^{19}$. You must show your work, keeping all numbers in your calculations small. **You may not use a calculator.** You must express your final answer as $[n]$, where $0 \leq n \leq 12$.