

MATH 201: CLASS DISCUSSION (16 JANUARY 2019)

(A) MATH 201

1. Suppose $A = \{1, 2, 3, 4\}$ and $B = \{a, c\}$.
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|------------------|------------------|-----------------------------|-----------------------------|
| (a) $A \times B$ | (c) $A \times A$ | (e) $\emptyset \times B$ | (g) $A \times (B \times B)$ |
| (b) $B \times A$ | (d) $B \times B$ | (f) $(A \times B) \times B$ | (h) B^3 |

2. Suppose $A = \{\pi, e, 0\}$ and $B = \{0, 1\}$.
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|------------------|------------------|-----------------------------|-----------------------------|
| (a) $A \times B$ | (c) $A \times A$ | (e) $A \times \emptyset$ | (g) $A \times (B \times B)$ |
| (b) $B \times A$ | (d) $B \times B$ | (f) $(A \times B) \times B$ | (h) $A \times B \times B$ |

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|---|---|
| 3. $\{x \in \mathbb{R} : x^2 = 2\} \times \{a, c, e\}$ | 6. $\{x \in \mathbb{R} : x^2 = x\} \times \{x \in \mathbb{N} : x^2 = x\}$ |
| 4. $\{n \in \mathbb{Z} : 2 < n < 5\} \times \{n \in \mathbb{Z} : n = 5\}$ | 7. $\{\emptyset\} \times \{0, \emptyset\} \times \{0, 1\}$ |
| 5. $\{x \in \mathbb{R} : x^2 = 2\} \times \{x \in \mathbb{R} : x = 2\}$ | 8. $\{0, 1\}^4$ |

Sketch these Cartesian products on the x - y plane \mathbb{R}^2 (or \mathbb{R}^3 for the last two).

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|---------------------------------------|--|
| 9. $\{1, 2, 3\} \times \{-1, 0, 1\}$ | 15. $\{1\} \times [0, 1]$ |
| 10. $\{-1, 0, 1\} \times \{1, 2, 3\}$ | 16. $[0, 1] \times \{1\}$ |
| 11. $[0, 1] \times [0, 1]$ | 17. $\mathbb{N} \times \mathbb{Z}$ |
| 12. $[-1, 1] \times [1, 2]$ | 18. $\mathbb{Z} \times \mathbb{Z}$ |
| 13. $\{1, 1.5, 2\} \times [1, 2]$ | 19. $[0, 1] \times [0, 1] \times [0, 1]$ |
| 14. $[1, 2] \times \{1, 1.5, 2\}$ | 20. $\{(x, y) \in \mathbb{R}^2 : x^2 + y^2 \leq 1\} \times [0, 1]$ |

(B) Find the power set of each of the following sets:

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|--------------------------|---|
| 1. $\{1, 2, 3, 4\}$ | 5. $\{\emptyset\}$ |
| 2. $\{1, 2, \emptyset\}$ | 6. $\{\mathbb{R}, \mathbb{Q}, \mathbb{N}\}$ |
| 3. $\{\{\mathbb{R}\}\}$ | 7. $\{\mathbb{R}, \{\mathbb{Q}, \mathbb{N}\}\}$ |
| 4. \emptyset | 8. $\{\{0, 1\}, \{0, 1, \{2\}\}, \{0\}\}$ |

(C)

Write out the following sets by listing their elements between braces.

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|---|--|
| 9. $\{X : X \subseteq \{3, 2, a\} \text{ and } X = 2\}$ | 11. $\{X : X \subseteq \{3, 2, a\} \text{ and } X = 4\}$ |
| 10. $\{X \subseteq \mathbb{N} : X \leq 1\}$ | 12. $\{X : X \subseteq \{3, 2, a\} \text{ and } X = 1\}$ |

Decide if the following statements are true or false. Explain.

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|---|---|
| 13. $\mathbb{R}^3 \subseteq \mathbb{R}^3$ | 15. $\{(x, y) : x - 1 = 0\} \subseteq \{(x, y) : x^2 - x = 0\}$ |
| 14. $\mathbb{R}^2 \subseteq \mathbb{R}^3$ | 16. $\{(x, y) : x^2 - x = 0\} \subseteq \{(x, y) : x - 1 = 0\}$ |

(D)

Find the indicated sets.

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|--|---|
| 1. $\mathcal{P}(\{\{a, b\}, \{c\}\})$ | 7. $\mathcal{P}(\{a, b\}) \times \mathcal{P}(\{0, 1\})$ |
| 2. $\mathcal{P}(\{1, 2, 3, 4\})$ | 8. $\mathcal{P}(\{1, 2\} \times \{3\})$ |
| 3. $\mathcal{P}(\{\{\emptyset\}, 5\})$ | 9. $\mathcal{P}(\{a, b\} \times \{0\})$ |
| 4. $\mathcal{P}(\{\mathbb{R}, \mathbb{Q}\})$ | 10. $\{X \in \mathcal{P}(\{1, 2, 3\}) : X \leq 1\}$ |
| 5. $\mathcal{P}(\mathcal{P}(\{2\}))$ | 11. $\{X \subseteq \mathcal{P}(\{1, 2, 3\}) : X \leq 1\}$ |
| 6. $\mathcal{P}(\{1, 2\}) \times \mathcal{P}(\{3\})$ | 12. $\{X \in \mathcal{P}(\{1, 2, 3\}) : 2 \in X\}$ |

Suppose that $|A| = m$ and $|B| = n$. Find the following cardinalities.

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|--|---|
| 13. $ \mathcal{P}(\mathcal{P}(\mathcal{P}(A))) $ | 17. $ \{X \in \mathcal{P}(A) : X \leq 1\} $ |
| 14. $ \mathcal{P}(\mathcal{P}(A)) $ | 18. $ \mathcal{P}(A \times \mathcal{P}(B)) $ |
| 15. $ \mathcal{P}(A \times B) $ | 19. $ \mathcal{P}(\mathcal{P}(\mathcal{P}(A \times \emptyset))) $ |
| 16. $ \mathcal{P}(A) \times \mathcal{P}(B) $ | 20. $ \{X \subseteq \mathcal{P}(A) : X \leq 1\} $ |

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