

1. Label each of the following statements as true or false.

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|------------------------------------|--|---|
| a) $\{1, 2\} \subseteq \mathbb{N}$ | d) $\mathbb{N} \subseteq \mathbb{Z}$ | g) $-3 \in \mathbb{N}$ and $7 \in \mathbb{Z}$ |
| b) $4 < 4$ | e) $-5 \in \mathbb{Z}$ | h) For all sets S , $\emptyset \subseteq S$. |
| c) $5 \geq 5$ | f) $-3 \in \mathbb{N}$ or $7 \in \mathbb{Z}$ | i) $\mathbb{Z} \subseteq \mathbb{N}$ |

2. Suppose that $A = \{1, 2, 3, 4, 5\}$. Label each of the following statements as true or false.

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| a) $1 \in A$ | c) $7 \notin A$ | e) $\{1, 3, 5, 6\} \subseteq A$ | g) $A \subseteq A$ |
| b) $1 \subseteq A$ | d) $\{1, 2\} \in A$ | f) $A \subseteq \mathbb{N}$ | h) $\{3, 4\} \not\subseteq A$ |

3. Suppose that $U = \{0, 1, 2, 3, \dots, 19, 20\}$. Find each of the following sets.

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| a) $A = \{x \in U : x \text{ is divisible by } 3\}$ | f) $F = \{x \in U : x < 4 \text{ or } x < 8\}$ |
| b) $B = \{x \in U : x \text{ is divisible by } 5 \text{ or } x < 8\}$ | g) $G = \{x \in U : x < 4 \text{ and } x < 8\}$ |
| c) $C = \{x \in U : x \text{ is divisible by } 5 \text{ and } x < 8\}$ | h) $H = \{x \in U : x \text{ is divisible by } 4\}$ |
| d) $D = \{x \in U : x < 12 \text{ or } x \geq 7\}$ | i) $I = \{x \in U : x \text{ is divisible by } 3 \text{ or } x \text{ is divisible by } 4\}$ |
| e) $E = \{x \in U : x < 12 \text{ and } x \geq 7\}$ | j) $J = \{x \in U : x \text{ is divisible by } 3 \text{ and } x \text{ is divisible by } 4\}$ |

4. Suppose that $P = \{1, 3, 6, 10\}$, and $S = \{1, 2, 5, 6, 9, 10\}$, and $T = \{3, 5, 6, 7, 8, 9, 10\}$

- a) Draw a Venn-diagram depicting P , S , and T .
- b) Find each of the following.
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|----------------------|-------------------------|--------------------------|-------------------------|
| i) $S \cap P \cap T$ | ii) $S \cup (P \cap T)$ | iii) $(S \cup P) \cap T$ | iv) $P \cup (S \cap T)$ |
|----------------------|-------------------------|--------------------------|-------------------------|
- c) Find an operation or (operations) on P , S , and/or T so that the result is the set $\{1, 6, 10\}$.
- d) True or false? $P \subseteq S \cup T$
- e) True or false? $S \cap T \subseteq P$

5. Suppose that $T = \{n \in \mathbb{Z} : n \text{ is divisible by } 3\}$, $S = \{n \in \mathbb{Z} : n \text{ is divisible by } 6\}$, and $E = \{n \in \mathbb{Z} : n \text{ is divisible by } 2\}$. Label each of the statements as true or false.

- a) $T \cap E = S$ b) $E \subseteq S$ c) $S \subseteq T$ d) $T \cup E = S$

6. Evaluate each of the given numerical expressions.

- a) $5 - 2(20 - 12 \div 2(-3^2 + 15))$ b) $\sqrt{2\sqrt{3 \cdot 7 - 5} - \sqrt{2^3 - (-1)^3} - 1}$ c) $\frac{-1^2 - 2(-3^2 - 2(3^2 - 7))}{-2^2 - 1}$

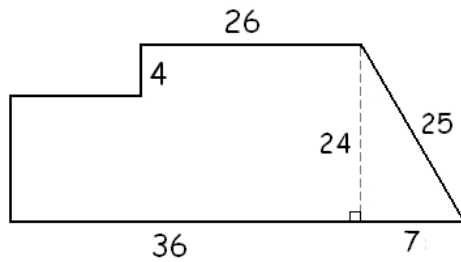
7. Evaluate each of the given algebraic expressions if $x = -3$, $y = 4$, and $z = -5$.

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|---------------------------|--------------|-----------------|----------------------------|
| a) xyz | d) $x -y-z $ | g) $-x^2 + y^2$ | j) $\frac{-x+y+z}{x+2y+z}$ |
| b) $x-y-z$ | e) $x- y-z $ | h) $-x^3 + y^3$ | k) $-z^2 + x^2 + (-y)^2$ |
| c) $\frac{-x-2y-5z}{x+1}$ | f) $x-y -z $ | i) $(-x+y)^2$ | l) $(z-x)^y$ |

8. a) Consider the equation $-2x(3x - x^2) + 5 = (x + 2)(x - 2)$. Find all the numbers from $-2, -1, 0, 1, 2, 3$ that are solutions of the equation.

b) Consider the inequality $-2x(3x - x^2) + 5 < (x + 2)(x - 2)$. Find all the numbers from $-2, -1, 0, 1, 2, 3$ that are solutions of the inequality.

9. Translate each of the following to algebraic statements.
- The sum of three and the opposite of A is one less than half of the square of B .
 - Three times the sum of x and the quotient of y and z is two greater than the opposite of the sum of x and z .
 - The difference of 5 and three times A is four less than twice the square root of B .
 - Twice the difference of S and R is three less than five times Q .
10. We asked 100 students about their classes. 63 of them are taking Physics, 73 are taking Math, and 48 take both. How many students take neither of the two subjects?
11. Compute the perimeter and area of the object shown on the picture.



Answers

1. a) true b) false c) true d) true e) true f) true g) false h) true i) false
2. a) true b) false c) true d) false e) false f) true g) true h) false
3. a) $\{0, 3, 6, 9, 12, 15, 18\}$ b) $\{0, 1, 2, 3, 4, 5, 6, 7, 10, 15, 20\}$ c) $\{0, 5\}$ d) U or $\{0, 1, 2, 3, \dots, 19, 20\}$
 e) $\{7, 8, 9, 10, 11\}$ f) $\{0, 1, 2, 3, 4, 5, 6, 7\}$ g) $\{0, 1, 2, 3\}$ h) $\{0, 4, 8, 12, 16, 20\}$
 i) $\{0, 3, 4, 6, 8, 9, 12, 15, 16, 18, 20\}$ j) $\{0, 12\}$
4. a) b) i) $\{6, 10\}$ ii) $\{1, 2, 3, 5, 6, 9, 10\}$ iii) $\{3, 5, 6, 9, 10\}$
 iv) $\{1, 3, 5, 6, 9, 10\}$ c) $P \cap S$ d) true e) false
5. a) true b) false c) true d) false
6. a) 37 b) 2 c) -5
7. a) 60 b) -2 c) -10 d) -3 e) -12 f) -23 g) 7 h) 91 i) 49 j) undefined k) 0 l) 16
8. a) -1 and 3 b) -2 and 2
9. a) $3 + (-A) = \frac{B^2}{2} - 1$ b) $3\left(x + \frac{y}{z}\right) = -(x + z) + 2$ c) $5 - 3A = 2\sqrt{B} - 4$ d) $2(S - R) = 5Q - 3$
10. 12
11. $P = 128$ unit $A = 908$ unit²