



Attempt all questions before checking the answer key.
Show set operations clearly. $N = \{1, 2, 3, \dots\}$;
complements are relative to the stated universal set.

A. Very short answers - 1 mark each

1. Write the set of prime divisors of 84 in roster form.
2. Express $\{2, 4, 6, 8, 10\}$ in set-builder form.
3. Distinguish $\emptyset$ from $\{\emptyset\}$ by stating the number of elements in each.
4. Are $\{1, 2, 3\}$ and $\{3, 1, 2, 2\}$ equal? Justify.
5. Write $(-2, 5]$ in set-builder notation.

B. Short answers / practice - 2 marks each

6. For $A = \{1, 2, 3, 5\}$ and $B = \{2, 4, 5, 6\}$, find $A \cup B$ and $A \cap B$.
7. For the same sets $A = \{1, 2, 3, 5\}$, $B = \{2, 4, 5, 6\}$, find $A - B$ and $B - A$. Are they equal?
8. Let $U = \{1, 2, \dots, 10\}$ and A be its even elements. Find A' and $A \cap A'$.
9. For $A = (-3, 4]$ and $B = [1, 7)$, find their union and intersection.
10. List every subset of $\{a, b\}$. Distinguish a proper subset from the set itself.
11. Find the number of subsets of a four-element set.
12. Is the empty set a subset of every set?
13. Find $[-1, 3) \cap [2, 5]$.
14. Find $[0, 2] \cup (2, 4]$.
15. Let $A = \{1, 2, 3\}$. Find $A - A$.
16. Can a finite set be a proper subset of itself?
17. List subsets of $\{p, q, r\}$ containing p .
18. If $A \subseteq B$ and $B \subseteq C$, prove $A \subseteq C$.
19. Find complement of $(1, 4)$ in R .
20. Prove $A \cup \emptyset = A$ and $A \cap \emptyset = \emptyset$.

C. Short answers - 3 marks each

21. For $U = \{1, \dots, 8\}$, $A = \{1, 2, 4, 8\}$ and $B = \{2, 3, 5, 7\}$, verify $(A \cup B)' = A' \cap B'$.

22. Using Venn diagrams, distinguish $A - B$, $B - A$ and $(A \cup B) - (A \cap B)$.

23. For $A = [-2, 3]$, $B = (0, 5)$ and $C = [2, 6]$, find $A \cap (B \cup C)$ and $(A \cap B) \cup (A \cap C)$.

24. If $A \subseteq B$, prove $A \cap B = A$ and $A \cup B = B$ using membership arguments.

25. Find sets A and B if $A \cup B = \{1, 2, 3, 4, 5\}$, $A \cap B = \{2, 4\}$ and $A - B = \{1\}$. Show each step.

D. Long answers - 5 marks each

26. Prove both De Morgan laws using element arguments, then verify them for $U = \{1, \dots, 6\}$, $A = \{1, 2, 3\}$, $B = \{3, 4, 5\}$.

27. Prove $A - (B \cup C) = (A - B) \cap (A - C)$. Illustrate the equality with a Venn diagram and a finite-set example.

28. For $U = R$, $A = (-\infty, 2]$ and $B = (-1, 5)$, find $A \cup B$, $A \cap B$, $A - B$, $B - A$ and $(A \cup B)'$.

29. Prove $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$. Explain why replacing $\cap$ by set difference does not give the same distributive law.

30. Prove that $A \cup B = A \cap B$ implies $A = B$. Also prove that $A - B = \emptyset$ if and only if $A \subseteq B$.

ANSWER KEY - Numerical / short answers

- 1) $\{2, 3, 7\}$. 2) $\{2n : n \in N, 1 \leq n \leq 5\}$. 3) 0 and 1 elements respectively. 4) Yes; repetition and order do not change a set. 5) $\{x \in R : -2 < x \leq 5\}$. 6) Union $\{1, 2, 3, 4, 5, 6\}$; intersection $\{2, 5\}$. 7) $\{1, 3\}$ and $\{4, 6\}$; no. 8) $A' = \{1, 3, 5, 7, 9\}$; intersection $\emptyset$. 9) Union $(-3, 7)$; intersection $[1, 4]$. 10) $\emptyset$, $\{a\}$, $\{b\}$, $\{a, b\}$; first three are proper subsets. 11) 16. 12) Yes. 13) $[2, 3)$. 14) $[0, 4]$. 15) $\emptyset$. 16) No. 17) $\{p\}$, $\{p, q\}$, $\{p, r\}$, $\{p, q, r\}$. 18) $(-\infty, 1] \cup [4, \infty)$. 19) Both sides = $\{6\}$. 20) Both sets = $(0, 3]$. 21) $A = \{1, 2, 4\}$; $B = \{2, 3, 4, 5\}$. 22) $(A \cup B)' = \{6\}$; $(A \cap B)' = \{1, 2, 4, 5, 6\}$. 23) Union $(-\infty, 5)$; intersection $(-1, 2]$; $A - B = (-\infty, -1]$; $B - A = (2, 5)$; complement $[5, \infty)$.