Set Theory and Logic Exercise 2.3 MCQs with Solutions

Set Theory and Logic MCQs (Exercise 2.3)

These multiple-choice questions test new concepts from Exercise 2.3, critical for entry tests, divided into low, medium, and high difficulty levels.

Questions

1. What does the idempotent law $A \cup A = A$ mean?

   a) A set intersected with itself is empty

   b) A set unioned with itself is the same set

   c) A set unioned with its complement is empty

   d) A set intersected with the universal set is empty

2. If $A = \{1, 2\}$, what is $A \cap A$?

   a) $\{\emptyset\}$

   b) $\{1, 2\}$

   c) $\{1\}$

   d) $\{2\}$

3. What is the identity law for union?

   a) $A \cup U = A$

   b) $A \cup \emptyset = A$

   c) $A \cup A' = \emptyset$

   d) $A \cup A = \emptyset$

4. If $U = \{1, 2, 3\}$, $A = \{1\}$, what is $A \cup A'$?

   a) $\{1\}$

   b) $\{2, 3\}$

   c) $\{1, 2, 3\}$

   d) $\{\emptyset\}$

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5. Which is a proposition?

    a) What is 2 + 2?

    b) $2 + 2 = 4$

    c) Add 2 and 2

    d) 2 is a number

6. What does p $\land$ q represent in symbolic logic?

    a) p or q

    b) p and q

    c) If p, then q

    d) Not p

7. What is inductive logic?

    a) Concluding specifics from general facts

    b) Generalizing from specific observations

    c) Using symbols for statements

    d) Assuming statements are true or false

8. If A = {1, 2, 3}, B = {2, 3, 4}, C = {3, 4, 5}, what is $(A \cap B) \cap C$?

    a) {3}

    b) {2, 3}

    c) {2}

    d) {$\emptyset$}

9. If A = {1, 2}, U = {1, 2, 3, 4}, what is $A \cap U$?

    a) {3, 4}

    b) {1, 2}

    c) {1, 2, 3, 4}

    d) {$\emptyset$}

10. If A = {1, 2}, B = {3, 4}, U = {1, 2, 3, 4}, what is $A \cap B$'?

    a) {1, 2}

    b) {3, 4}

    c) {$\emptyset$}

    d) {1, 2, 3, 4}

11. If $A \cap B = \emptyset$, what is $(A - B) \cap B$?

    a) A

b) B

c) ∅

d) A ∪ B

12. Which law states A ∩ (A ∪ B) = A?

    a) Idempotent law

    b) Identity law

    c) Absorption law

    d) Complement law

13. If p = "It is raining" and q = "It is cold," what does $p \rightarrow q$ mean?

    a) It is raining and cold

    b) If it is raining, then it is cold

    c) It is raining or cold

    d) It is not raining

14. What characterizes Aristotelian logic?

    a) Allows multiple truth values

    b) Statements are true or false only

    c) Uses inductive reasoning

    d) Ignores propositions

15. If A = {1, 2, 3}, B = {2, 3, 4}, C = {3, 4, 5}, what is A ∩ (B ∩ C)?

    a) {2, 3}

    b) {3}

    c) {4}

    d) {∅}

16. If A = {1, 2}, B = {2, 3}, U = {1, 2, 3, 4}, what is A ∪ (A' ∩ B)?

    a) {1, 2}

    b) {1, 2, 3}

    c) {2, 3}

    d) {3, 4}

17. If A = {1, 2}, B = {3, 4}, what is (A - B) ∪ B?

    a) {1, 2}

    b) {3, 4}

    c) {1, 2, 3, 4}

   d) $\{\emptyset\}$

18. Which is true if A ∩ B = ∅?

   a) A ∩ B' = B

   b) A ∩ B' = A

   c) A ∪ B' = A

   d) A ∪ B = ∅

19. If p ↔ q is true, what must be true?

   a) p and q have the same truth value

   b) p is true, q is false

   c) p is false, q is true

   d) p and q are both false

20. Which is an example of deductive logic?

   a) Observing rain daily, concluding it always rains

   b) All birds fly; penguins are birds; penguins fly

   c) Seeing a bird fly, concluding all birds fly

   d) Assuming a statement is neither true nor false

Solutions with Explanations

1. **Answer: B** The idempotent law A ∪ A = A means a set unioned with itself remains unchanged.

2. **Answer: B** A ∩ A = {1, 2} ∩ {1, 2} = {1, 2}, per the idempotent law.

3. **Answer: B** The identity law A ∪ ∅ = A states that union with the empty set leaves the set unchanged.

4. **Answer: C** A' = {2, 3}, A ∪ A' = {1} ∪ {2, 3} = {1, 2, 3} = U, per the complement law.

5. **Answer: B** A proposition is a true or false statement; "2 + 2 = 4" is true.

6. **Answer: B** In symbolic logic, p ∧ q means "p and q" (conjunction).

7. **Answer: B** Inductive logic generalizes from specific observations, e.g., observing patterns to predict outcomes.

8. **Answer: A** (A ∩ B) = {2, 3}, (A ∩ B) ∩ C = {2, 3} ∩ {3, 4, 5} = {3}, per associative property.

9. **Answer: B** A ∩ U = {1, 2} ∩ {1, 2, 3, 4} = {1, 2} = A, per identity law.

10. **Answer: A** A ∩ B = ∅, B' = {1, 2}, A ∩ B' = {1, 2} = A, per set difference identity.

11. **Answer: C** (A - B) = A if A ∩ B = ∅, so (A - B) ∩ B = A ∩ B = ∅.

12. **Answer: C** A ∩ (A ∪ B) = A is the absorption law.

13. **Answer: B** p → q means "if p, then q" (conditional), e.g., "If it is raining, then it is cold."

14. **Answer: B** Aristotelian logic assumes statements are strictly true or false.

15. **Answer: B** B ∩ C = {3, 4}, A ∩ (B ∩ C) = {1, 2, 3} ∩ {3, 4} = {3}, per associative property.

16. **Answer: B** A' = {3, 4}, A' ∩ B = {3}, A ∪ (A' ∩ B) = {1, 2} ∪ {3} = {1, 2, 3}, per union with complement intersection.

17. **Answer: C** A - B = {1, 2}, (A - B) ∪ B = {1, 2} ∪ {3, 4} = {1, 2, 3, 4} = A ∪ B.

18. **Answer: B** If A ∩ B = ∅, then A ∩ B' = A, per set difference identity.

19. **Answer: A** p ↔ q (biconditional) is true when p and q have the same truth value.

20. **Answer: B** Deductive logic applies general rules to specifics, e.g., "All birds fly; penguins are birds; penguins fly" (though factually incorrect, it's deductive).