

Set Theory and Probability Axioms – Quiz

Probability & Statistics

Question 1

If $A = \{1, 2, 3, 4, 5\}$, which statement is correct?

- A. 3 is not in A
- B. 7 is in A
- C. 3 is an element of A
- D. A contains 6 elements

Question 1

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- B. 7 is in A
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- D. A contains 6 elements

Answer: C

The number 3 is in set A, written as 3 is in A. The set has 5 elements (1, 2, 3, 4, 5), and 7 is not in A.

Question 2

What is the empty set?

- A. A set containing zero
- B. A set containing no elements
- C. A set containing infinity
- D. A set containing all elements

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Answer: B

The empty set contains no elements. It is different from a set containing the number zero.

Question 3

The union of sets A and B represents:

- A. Elements in both A AND B only
- B. Elements in A OR B (or both)
- C. Elements in A but not in B
- D. Elements not in A

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Answer: B

The union $A \cup B$ contains all elements that are in A, in B, or in both. It combines the two sets.

Question 4

What does De Morgan's Law state about $(A \cup B)$ complement?

- A. $(A \cup B)$ complement = A complement union B complement
- B. $(A \cup B)$ complement = A complement intersection B complement
- C. $(A \cup B)$ complement = A intersection B
- D. $(A \cup B)$ complement = empty set

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- B. (A union B) complement = A complement intersection B complement
- C. (A union B) complement = A intersection B
- D. (A union B) complement = empty set

Answer: B

De Morgan's Law: (A union B) complement = A complement intersection B complement. In words: NOT(A or B) = (NOT A) AND (NOT B).

Question 5

What is the sample space for flipping a coin?

- A. $S = \{0, 1\}$
- B. $S = \{H, T\}$
- C. $S = \{1, 2, 3, 4, 5, 6\}$
- D. $S =$ all real numbers

Question 5

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- D. $S =$ all real numbers

Answer: B

The sample space is the set of all possible outcomes. For a coin flip, $S = \{H, T\}$ (Heads or Tails).

Question 6

Two events are mutually exclusive if:

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- B. They cannot occur at the same time
- C. They have equal probabilities
- D. Their union is empty

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Answer: B

Mutually exclusive events cannot occur simultaneously. Their intersection is empty ($A \cap B = \text{empty set}$).

Question 7

According to Kolmogorov's axioms, the probability of the sample space equals:

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- B. 0.5
- C. 1
- D. Infinity

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Answer: C

Kolmogorov's second axiom states $P(\text{sample space}) = 1$. Something must happen - one outcome in the sample space will occur.

Question 8

If $P(A) = 0.3$, what is $P(A \text{ complement})$?

- A. 0.3
- B. 0.7
- C. -0.3
- D. 0.09

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Answer: B

$P(A \text{ complement}) = 1 - P(A) = 1 - 0.3 = 0.7$. The complement rule is derived from the axioms.

Question 9

The general addition rule states $P(A \text{ union } B)$ equals:

- A. $P(A) + P(B)$
- B. $P(A)$ times $P(B)$
- C. $P(A) + P(B) - P(A \text{ intersection } B)$
- D. $P(A) - P(B)$

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Answer: C

$P(A \text{ union } B) = P(A) + P(B) - P(A \text{ intersection } B)$. We subtract the intersection to avoid double-counting the overlap.

Question 10

For a fair die, what is $P(\text{even number})$?

- A. $1/6$
- B. $1/3$
- C. $1/2$
- D. $2/3$

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Answer: C

Even numbers are $\{2, 4, 6\}$, which is 3 outcomes out of 6 total. $P(\text{even}) = 3/6 = 1/2$.

Question 11

What is $5!$ (five factorial)?

- A. 5
- B. 25
- C. 60
- D. 120

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- D. 120

Answer: D

$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$. Factorial means multiply all integers from n down to 1.

Question 12

When should you use permutations instead of combinations?

- A. When order doesn't matter
- B. When order matters
- C. When selecting with replacement
- D. When events are independent

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Answer: B

Permutations count arrangements where order matters. If ABC and BAC are different outcomes, use permutations.

Question 13

How many ways can you select 3 stocks from 10 for a portfolio (order doesn't matter)?

- A. 30
- B. 120
- C. 720
- D. 1000

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- D. 1000

Answer: B

This is $C(10,3) = 10!/(3! \times 7!) = (10 \times 9 \times 8)/(3 \times 2 \times 1) = 720/6 = 120$ combinations.

Question 14

If a password requires 2 letters followed by 3 digits, how many passwords are possible?

- A. $26 \times 26 \times 10 \times 10 \times 10 = 676,000$
- B. $26 + 26 + 10 + 10 + 10 = 92$
- C. $26 \times 10 = 260$
- D. $26^2 + 10^3 = 1676$

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B. $26 + 26 + 10 + 10 + 10 = 92$

C. $26 \times 10 = 260$

D. $26^2 + 10^3 = 1676$

Answer: A

By the multiplication principle: 26 choices for each letter times 10 choices for each digit = $26 \times 26 \times 10 \times 10 \times 10 = 676,000$.

Question 15

A partition of a sample space must be:

- A. Only mutually exclusive
- B. Only exhaustive
- C. Both mutually exclusive and exhaustive
- D. Neither mutually exclusive nor exhaustive

Question 15

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- A. Only mutually exclusive
- B. Only exhaustive
- C. Both mutually exclusive and exhaustive
- D. Neither mutually exclusive nor exhaustive

Answer: C

A partition divides the sample space into non-overlapping pieces (mutually exclusive) that together cover the entire space (exhaustive).

Question 16

What is the value of $0!$ (zero factorial)?

- A. 0
- B. 1
- C. Undefined
- D. Infinity

Question 16

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- A. 0
- B. 1
- C. Undefined
- D. Infinity

Answer: B

By definition, $0! = 1$. This is needed for the combination formula to work correctly (e.g., $C(n,0) = 1$).

Question 17

The intersection of sets A and B contains:

- A. All elements in A or B
- B. Only elements in both A and B
- C. Elements in A but not B
- D. Elements not in A

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- A. All elements in A or B
- B. Only elements in both A and B
- C. Elements in A but not B
- D. Elements not in A

Answer: B

The intersection A intersection B contains only elements that are in both A AND B - the overlap of the two sets.

Question 18

For rolling two dice, how many outcomes are in the sample space?

- A. 6
- B. 12
- C. 36
- D. 72

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- B. 12
- C. 36
- D. 72

Answer: C

Each die has 6 outcomes, so two dice have $6 \times 6 = 36$ equally likely outcomes in the sample space.

Question 19

$P(n,k)$ represents the number of ways to:

- A. Select k items from n without regard to order
- B. Arrange k items from n where order matters
- C. Select k items with replacement
- D. Partition n items into k groups

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- D. Partition n items into k groups

Answer: B

$P(n,k)$ is the permutation formula - it counts the number of ordered arrangements when selecting k items from n .

Which of the following violates the probability axioms?

- A. $P(A) = 0.5$
- B. $P(A) = 1$
- C. $P(A) = -0.2$
- D. $P(A) = 0$

Question 20

Which of the following violates the probability axioms?

- A. $P(A) = 0.5$
- B. $P(A) = 1$
- C. $P(A) = -0.2$
- D. $P(A) = 0$

Answer: C

Kolmogorov's first axiom states $P(A) \geq 0$. A negative probability is impossible and violates this axiom.