# Mathematical Induction MCQs - Class 11 Mathematics

*Prepared for Entry Test Preparation*

## Multiple Choice Questions

**1.** What is the sum of the first $n$ odd numbers $1 + 3 + 5 + \cdots + (2n - 1)$?

(a) $n^2$

(b) $n(n + 1)$

(c) $\frac{n(2n-1)}{2}$

(d) $2n - 1$

**2.** The sum $1 + 2 + 4 + \cdots + 2^{n-1}$ equals:

(a) $2^n - 1$

(b) $2^{n+1} - 1$

(c) $2^n$

(d) $2^{n-1}$

**3.** For what positive integers $n$ is $n^2 + n$ divisible by 2?

(a) All $n$

(b) Odd $n$

(c) Even $n$

(d) $n \geq 2$

**4.** Prove $1 + 4 + 7 + \cdots + (3n - 2) = \frac{n(3n-1)}{2}$. What is the base case value for $n = 1$?

(a) 1

(b) 2

(c) 3

(d) 4

**5.** The sum $2 + 4 + 6 + \cdots + 2n$ equals:

(a) $n(n + 1)$

(b) $2n^2$

(c) $n(2n + 1)$

(d) $\frac{n(n+1)}{2}$

**6.** For $n \geq 3$, which inequality holds?

(a) $n^2 > n + 3$

(b) $n^2 < n + 3$

(c) $n^2 = n + 3$

(d) $n^2 \leq n + 3$

**7.** The sum $1 \times 2 + 2 \times 3 + \cdots + n(n + 1)$ equals:

(a) $\frac{n(n+1)(n+2)}{3}$

(b) $\frac{n(n+1)}{2}$

(c) $\frac{n(n+1)(2n+1)}{6}$

(d) $n(n + 1)$

**8.** Prove $5^n - 1$ is divisible by 4. What is the value for $n = 1$?

(a) 2

(b) 4

(c) 5

(d) 8

**9.** The sum $\frac{1}{1\times2} + \frac{1}{2\times3} + \cdots + \frac{1}{n(n+1)}$ equals:

(a) $\frac{n}{n+1}$

(b) $\frac{n+1}{n}$

(c) $\frac{1}{n+1}$

(d) $\frac{n}{2n+1}$

**10.** For $n \geq 4$, which holds true?

(a) $n! > n^2$

(b) $n! < n^2$

(c) $n! = n^2$

(d) $n! \leq n^2$

**11.** The sum $1^2 + 3^2 + 5^2 + \cdots + (2n - 1)^2$ equals:

(a) $\frac{n(4n^2-1)}{3}$

(b) $n^2(2n^2 - 1)$

(c) $\frac{n(n+1)(2n+1)}{6}$

(d) $\frac{n(2n-1)}{2}$

**12.** Prove $n^3 - n$ is divisible by 6. What is the value for $n = 1$?

(a) 0

(b) 1

(c) 2

(d) 6

**13.** The sum $1^3 + 3^3 + 5^3 + \cdots + (2n-1)^3$ equals:

(a) $n^2(2n^2 - 1)$

(b) $\frac{n(4n^2-1)}{3}$

(c) $n(2n-1)^2$

(d) $\frac{n(n+1)(2n+1)}{6}$

**14.** For an arithmetic progression, the $n$-th term is:

(a) $a_n = a_1 + (n-1)d$

(b) $a_n = a_1 r^{n-1}$

(c) $a_n = a_1 + nd$

(d) $a_n = a_1 + (n-1)d^2$

**15.** The sum $\frac{1}{3} + \frac{1}{3^2} + \cdots + \frac{1}{3^n}$ equals:

(a) $\frac{1}{2}\left[1 - \frac{1}{3^n}\right]$

(b) $\frac{1}{3^n}$

(c) $\frac{1}{2}$

(d) $1 - \frac{1}{3^n}$

**16.** Prove $(x+1)$ is a factor of $x^{2n} - 1$. For $n = 1$, the expression is:

(a) $x^2 - 1$

(b) $x^2 + 1$

(c) $x - 1$

(d) $x + 1$

**17.** For $n > 6$, which holds?

(a) $3^n < n!$

(b) $3^n > n!$

(c) $3^n = n!$

(d) $3^n \leq n!$

**18.** The sum $1 \cdot 1! + 2 \cdot 2! + \cdots + n \cdot n!$ equals:

(a) $(n+1)! - 1$

(b) $n!$

(c) $(n+1)!$

(d) $n(n+1)!$

**19.** Prove $\ln x^n = n \ln x$ for $n \geq 0$. What is the base case for $n = 0$?

(a) 0

(b) 1

(c) $\ln x$

(d) $x$

**20.** The sum $1^2 - 2^2 + 3^2 - 4^2 + \cdots + (-1)^{n-1}n^2$ equals:

(a) $\frac{(-1)^{n-1}n(n+1)}{2}$

(b) $\frac{n(n+1)}{2}$

(c) $\frac{n(2n+1)}{6}$

(d) $(-1)^n n^2$

# Solutions and Explanations

1. **Answer: a** $n^2$ *Explanation*: From Q.2, the sum of the first $n$ odd numbers is $1 + 3 + \cdots + (2n-1) = n^2$.
2. **Answer: a** $2^n - 1$ *Explanation*: From Q.4, the geometric series sum is $1 + 2 + \cdots + 2^{n-1} = 2^n - 1$.
3. **Answer: a** All $n$ *Explanation*: From Q.21(i), $n^2+n = n(n+1)$, which is divisible by 2 for all positive integers $n$.
4. **Answer: a** 1 *Explanation*: From Q.3, base case: $n = 1$, $3(1) - 2 = 1$, and $\frac{1(3\cdot 1-1)}{2} = \frac{2}{2} = 1$.
5. **Answer: a** $n(n+1)$ *Explanation*: From Q.6, the sum of even numbers is $2 + 4 + \cdots + 2n = n(n+1)$.
6. **Answer: a** $n^2 > n + 3$ *Explanation*: From Q.33, $n^2 > n + 3$ holds for $n \geq 3$.
7. **Answer: a** $\frac{n(n+1)(n+2)}{3}$ *Explanation*: From Q.9, the sum is $1 \times 2 + 2 \times 3 + \cdots + n(n+1) = \frac{n(n+1)(n+2)}{3}$.
8. **Answer: b** 4 *Explanation*: From Q.21(iii), base case: $n = 1$, $5^1 - 1 = 4$, which is divisible by 4.
9. **Answer: a** $\frac{n}{n+1}$ *Explanation*: From Q.11, the sum is $\frac{1}{1\times 2} + \cdots + \frac{1}{n(n+1)} = \frac{n}{n+1}$.
10. **Answer: a** $n! > n^2$ *Explanation*: From Q.36, $n! > n^2$ for $n \geq 4$.
11. **Answer: a** $\frac{n(4n^2-1)}{3}$ *Explanation*: From Q.19, the sum of squares of odd numbers is $1^2 + 3^2 + \cdots + (2n-1)^2 = \frac{n(4n^2-1)}{3}$.
12. **Answer: a** 0 *Explanation*: From Q.21(v), base case: $n = 1$, $1^3 - 1 = 0$, which is divisible by 6.
13. **Answer: a** $n^2(2n^2-1)$ *Explanation*: From Q.24, the sum of cubes of odd numbers is $1^3 + 3^3 + \cdots + (2n-1)^3 = n^2(2n^2-1)$.

14. **Answer: a** $a_n = a_1 + (n-1)d$ *Explanation*: From Q.17, the $n$-th term of an arithmetic progression is $a_n = a_1 + (n-1)d$.
15. **Answer: a** $\frac{1}{2}\left[1 - \frac{1}{3^n}\right]$ *Explanation*: From Q.22, the geometric series sum is $\frac{1}{3} + \frac{1}{3^2} + \cdots + \frac{1}{3^n} = \frac{1}{2}\left[1 - \frac{1}{3^n}\right]$.
16. **Answer: a** $x^2 - 1$ *Explanation*: From Q.25, base case: $n = 1$, $x^{2\cdot 1} - 1 = x^2 - 1$, which has $x + 1$ as a factor.
17. **Answer: a** $3^n < n!$ *Explanation*: From Q.35, $3^n < n!$ for $n > 6$.
18. **Answer: a** $(n+1)! - 1$ *Explanation*: From Q.16, the sum is $1 \cdot 1! + 2 \cdot 2! + \cdots + n \cdot n! = (n+1)! - 1$.
19. **Answer: a** 0 *Explanation*: From Q.31, base case: $n = 0$, $\ln x^0 = \ln 1 = 0 = 0 \cdot \ln x$.
20. **Answer: a** $\frac{(-1)^{n-1} n(n+1)}{2}$ *Explanation*: From Q.23, the alternating sum is $1^2 - 2^2 + 3^2 - \cdots + (-1)^{n-1} n^2 = \frac{(-1)^{n-1} n(n+1)}{2}$.