# MATHS

## NCERT - NCERT MATHEMATICS(HINGLISH)

## PRINCIPLE OF MATHEMATICAL INDUCTION

### Solved Examples

**1.** Prove the rule of exponents $(ab)^n = a^n b^n$ by using principle of mathematical induction for every natural number.

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**2.** Prove that $1^2 + 2^2 + \vdots + n^2 > \frac{n^3}{3}, n \in N$

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**3.** Prove that $2.\ 7^n + 3.\ 5^n - 5$is divisible by 24, for all $n \in N$.

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**4.** Prove that $(1+x)^n \geq (1+nx)$, for all natural number n, where $x \succ 1$.

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**5.** For every positive integer n, prove that $7^n - 3^n$is divisible by 4.

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**6.** For all $n \geq 1$, prove that $\frac{1}{1.\ 2} + \frac{1}{2.\ 3} + \frac{1}{3.\ 4} + \ldots.\ + \frac{1}{n(n+1)} = \frac{n}{n+1}$

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**7.** Prove that $2^n > n$for all positive integers n.

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**8.** For all $n \geq 1$, prove that $1^2 + 2^2 + 3^2 + 4^2 + \ldots\ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$

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## Exercise 4 1

**1.** Prove the following by using the principle of mathematical induction for all $n \in N$: $\left(1 + \frac{3}{1}\right)\left(1 + \frac{5}{4}\right)\left(1 + \frac{7}{9}\right)\ldots\left(1 + \frac{(2n+1)}{n^2}\right) = (n+1)^2$

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**2.** Prove the following by using the principle of mathematical induction for all $n \in N$:$a + ar + ar^2 + \ldots + ar^{n-1} = \dfrac{a(r^n - 1)}{r - 1}$

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**3.** Prove the following by using the principle of mathematical induction for all $n \in N$:

$$\frac{1}{1.\,2.\,3} + \frac{1}{2.\,3.\,4} + \frac{1}{3.\,4.\,5} + \ldots + \frac{1}{n(n+1)(n+2)} = \frac{n(n+3)}{4(n+1)(n+2)}$$

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**4.** Prove the following by using the principle of mathematical induction for all $n \in N$:

$$\frac{1}{2.\,5} + \frac{1}{5.\,8} + \frac{1}{8.\,11} + \ldots + \frac{1}{(3n-1)(3n+2)} = \frac{n}{(6n+4)}$$

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**5.** Prove the following by using the principle of mathematical induction for all $n \in N$: $\frac{1}{3.5} + \frac{1}{5.7} + \frac{1}{7.9} + \ldots + \frac{1}{(2n+1)(2n+3)} = \frac{n}{3(2n+3)}$.

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**6.** Prove the following by using the principle of mathematical induction for all $n \in N$: $\frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + \ldots + \frac{1}{(3n-1)(3n+1)} = \frac{n}{(3n+1)}$.

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**7.** Prove the following by using the principle of mathematical induction for all $n \in N$: $1^2 + 3^2 + 5^2 + \ldots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$

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**8.** Prove the following by using the principle of mathematical induction for all $n \in N$: $\left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right)...\left(1+\frac{1}{n}\right)=(n+1)$

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**9.** Prove the following by using the principle of mathematical induction for all $n \in N$: $n(n+1)(n+5)$ is a multiple of 3.

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**10.** Prove the following by using the principle of mathematical induction for all $n \in N$: $1+2+3+...+n<\frac{1}{8}(2n+1)^2$.

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**11.** Prove the following by using the principle of mathematical induction for all $n \in N$: $(2n+7)<(n+3)^2$.

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**12.** Prove the following by using the principle of mathematical induction for all $n \in N$:$3^{2n+2} - 8n - 9$is divisible by 8.

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**13.** Prove the following by using the principle of mathematical induction for all $n \in N$:$41^{n} - 14^{n}$is a multiple of 27.

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**14.** Prove the following by using the principle of mathematical induction for all $n \in N$:$10^{2n-1} + 1$is divisible by 11.

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**15.** Prove the following by using the principle of mathematical induction for all $n \in N$: $x^{2n} - y^{2n}$ is divisible by $x + y$.

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**16.** Prove the following by using the principle of mathematical induction for all $n \in N$: $1 + 3 + 3^2 + \ldots + 3^{n-1} = \frac{(3^n - 1)}{2}$

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**17.** Prove the following by using the principle of mathematical induction for all $n \in N$: $1^3 + 2^3 + 3^3 + \ldots + n^3 = \left(\frac{n(n+1)}{2}\right)^2$

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**18.** Prove the following by using the principle of mathematical induction for all $n \in N$:

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

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**19.** Prove the following by using the principle of mathematical induction for all $n \in N$:

$$1.\ 2.\ 3+2.\ 3.\ 4+\ldots+n(n+1)(n+2)=\frac{n(n+1)(n+2)(n+3)}{4}$$

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**20.** Prove the following by using the principle of mathematical induction for all $n \in N$:$1.\ 3+2.\ 3^2+3.\ 3^3+\ldots+n.3^n=\frac{(2n-1)3^{n+1}+3}{4}$

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**21.** Prove the following by using the principle of mathematical induction for all $n \in N$:

$1.\,2 + 2.\,3 + 3.\,4 + \ldots + n(n+1) = \left[\frac{n(n+1)(n+2)}{3}\right]$

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**22.** Prove the following by using the principle of mathematical induction for all $n \in N$:

$1.\,3 + 3.\,5 + 5.\,7 + \ldots + (2n1)(2n+1) = \frac{n(4n^2 + 6n - 1)}{3}$

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**23.** Prove the following by using the principle of mathematical induction for all $n \in N$:$1.\,2 + 2.\,2^2 + 3.\,2^2 + \ldots + n.2^n = (n-1)2^{n+1} + 2$

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**24.** Prove the following by using the principle of mathematical induction for all $n \in N$:$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots + \frac{1}{2^n} = 1 - \frac{1}{2^n}$

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