MATHS

NCERT - NCERT MATHEMATICS (ENGLISH)

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

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

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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 $1^2 + 2^2 + 3^2 + 4^2 + \vdots + n^2 = \frac{n(n+1)(2n+1)}{6}$

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Exercise 4 1

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

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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 the principle of mathematical induction:

$$\frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + \ldots. + \frac{1}{(3n-2)(3n+1)} = \frac{n}{3n+1}$$

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7. Prove by the principal of mathematcal induction that for all $n \in N$.

$$1^2 + 3^2 + 5^2 + \ldots\ldots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$$

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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 the principle of mathematical induction: $n(n+1)(n+5)$ is a multiple of 3 for all $n \in N$.

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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 by the principle of induction that for all nN, $\left(10^{2n-1} + 1\right)$ 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 the principle of mathematical induction: $1 + 3 + 3^2 + \ + 3^{n-1} = \frac{3^n - 1}{2}$

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

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18. Using the principle of mathematical induction, prove that

$$1 + \frac{1}{1+2} + \frac{1}{1+2+3} + \dots . + \frac{1}{1+2+3+\dots . + n} = \frac{2n}{n+1}$$

for all $n \in N$.

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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. Using the principle of mathematical induction prove that :

$1.\,3 + 2.\,3^2 + 3.\,3^3 + \ + n.3^n = \frac{(2n+1)3^{n+1}+3}{4}$ for all $n \in N$.

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21. Prove the following by the principle of mathematical induction:

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

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22. Prove the following by the principle of mathematical induction:

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

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23. Prove the following by the principle of mathematical induction:

$$1.\,2 + 2.\,2^2 + 3.\,2^3 + \quad + n.2^n = (n-1)2^{n+1} + 2$$

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24. Prove the following by the principle of mathematical induction:

$$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \quad + \frac{1}{2^n} = 1 - \frac{1}{2^n}$$

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