MATHS

BOOKS - NAGEEN PRAKASHAN ENGLISH

PRINCIPLE OF MATHEMATICAL INDUCTION

Examples

1. By the principle of mathematical induction , prove that , for all integers n $\geq$ 1,

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

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2. Prove by the principle of mathematical induction that for all $n \in N: 1^2 + 2^2 + 3^2 + \quad + n^2 = \frac{1}{6}n(n+1)(2n+1)$

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3. Prove the following by the principle of mathematical induction: $\frac{1}{1.\ 2} + \frac{1}{2.\ 3} + \frac{1}{3.\ 4} + \quad + \frac{1}{n(n+1)} = \frac{n}{n+1}$

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4. If $n \in N$, then $n\left(n^2 - 1\right)$ is divisible by

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Exercise 4

1. By the principle of mathematical induction prove that for all natural number 'n' the following statement are true :

$(a) 2 + 4 + 6 + \ldots\ldots. + 2n = n(n+1)$

$(b) 1 + 4 + 7 + \ldots\ldots + (3n-2) = \frac{1}{2}n(3n-1)$

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

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2. By the principle of mathematical induction prove that for every $n \in N,$ the following statements are true:

$1 + 5 + 9 + \ldots. + (4n-3) = 2n^2 - n$

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3. By the principle of mathematical induction prove that for all natural numbers 'n' the following statements are true,

$2 + 2^2 + 2^3 + â€¦. . + 2^n = 2(2^n - 1)$

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4. By the principle of mathematical induction prove that the following statements are true for all natural numbers 'n'

$$(a)\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \ldots\ldots + \frac{1}{(2n-1)(2n+1)} = \frac{n}{2n+1}$$

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

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5. By the principle of mathematical induction prove that the following statement are true for all natural numbers 'n' $n(n+1)(n+5)$ is a multiple of 3.

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

$2.7^n + 3.5^n - 5$ is divisible 25 for all $n \in N$.

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7. Prove by induction that the sum $S_n = n^3 + 3n^2 + 5n + 3$ is divisible by 3 for all $n \in N$.

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8. if $a^1 = a, a^{r+1} = a^r . a$ prove that :

$(ab)^n = a^n b^n$, Where $n \in N$

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9. By the principle of mathematical induction prove that $3^{2^n} - 1,$ is divisible by 2^{n+2}

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10. Prove the following by the principle of mathematical induction: $7^{2n} + 2^{3n-3}.\,3^{n-1}$ is divisible 25 for all $n \in N$.

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11. Prove the following by the principle of mathematical induction: $7 + 77 + 777 + \;\; + 777 + \;\; + \ddot{n} - digits7 = \frac{7}{81}\left(10^{n+1} - 9n - 10\right)$ for all $n \in NB$.

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

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13. Using the principle of mathematical induction ,prove that $(1+x)^n \geq (1+nx)$ for all $n \in N$, where x>-1.

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14. Using binomial theorem, prove that $2^{3n} - 7n - 1$ is divisible by 49, where $n \in N$.

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15. $1 + \frac{1}{1+2} + \frac{1}{1+2+3} + \frac{1}{1+2+3+n} = \frac{2n}{n+1}$

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16. Using the principle of mathematical induction, prove that :

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

for all $n \in N$.

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17. Using the principle of mathematical induction, prove that :

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

for all $n \in N$.

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18. $1.3+2.3^2+3.3^3+\ldots\ldots\ldots\ldots.+n.3^n=\frac{(2n-1)3^{n+1}+3}{4}$

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19. Prove by PMI that $1.2 + 2.3 + 3.4 + ... + n(n+1) = \frac{(n)(n+1)(n+2)}{3}, \forall n \in N$

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20. $1.3 + 3.5 + 5.7 + ... + (2n-1)(2n+1) = \frac{n(4n^2 + 6n - 1)}{3}$

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

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

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

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

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

$$\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ +\frac{1}{(3n-1)(3n+2)}=\frac{n}{6n+4}$$

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24. Using the principle of mathematical induction prove that

$$\frac{1}{1.2.3}+\frac{1}{2.3.4}+\frac{1}{3.4.5}+\ +\frac{1}{n(n+1)(n+2)}=\frac{n(n+3)}{4(n+1)(n+2)}$$

for all $n \in N$

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

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

$$\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right)\vdots 1+\frac{(2n+1)}{n^2}=(n+1)^2$$

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

$$\left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right)\vdots 1+\frac{1}{n}=(n+1)$$

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28. Prove by using the principle of mathemtical induction:

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

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

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

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

$$\frac{1}{3.5} + \frac{1}{5.7} + \frac{1}{7.9} + \frac{1}{(2n+1)(2n+3)} = \frac{n}{3(2n+3)}$$

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

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32. n(n+1)(n+5) is a multiple 3.

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33. Prove by the principle of induction that for all $nN, \left(10^{2n-1}+1\right)$ is divisible by 11.

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34. Prove the following by the principle of mathematical induction: $x^{2n-1}+y^{2n-1}$ is divisible by $x+y$ for all $n \in N$.

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35. 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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36. 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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37. Prove the following by using the principle of mathematical induction for all $n \in N : (2n + 7) < (n + 3)^2$.

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Exercise 4 1

1. Using principle of mathematical induction, prove that

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

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