MATHS

BOOKS - PSEB

PRINCIPLE OF MATHEMATICAL INDUCTION

Exercise

1. 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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2. 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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3. 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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4. 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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5. 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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6. 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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7. Prove the following by using the principle of mathematical induction for all $n \in N$:-

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

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8. 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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9. 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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10. 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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11. Prove the following by using the principle of mathematical induction for all $n \in N$:- $a + ar + ar^2 + ... + ar^{n-1} = \frac{a(r^n - 1)}{r - 1}$.

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

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

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15. Prove the following by using the principle of mathematical induction for all $n \in N$:-
$\frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + ... + \frac{1}{(3n-2)(3n+1)} = \frac{n}{(3n+1)}$.

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

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

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18. 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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19. 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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20. 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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21. 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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22. 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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23. Prove the following by using the principle of mathematical induction for all $n \in N$:- $(2n+7) < (n+3)^2$.

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