MATHS

BOOKS - A N EXCEL PUBLICATION

PRINCIPLE OF MATHEMATICL INDUCTION

Question Bank

1. Prove by using the principal of Mathematical Induction $P(n) = 1 + 3 + 3^2 + \ldots\ldots + 3^{n-1} = \frac{3^n - 1}{2}$ is true for all $n \in N$

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2. Using mathematical induction prove that $1^3 + 2^3 + 3^3 + \ldots\ldots + n^3 = \left[\frac{n(n+1)}{2}\right]^2$

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3. For all $n \geq 1$, prove that

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

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4. For all $n \geq 1,$ prove that

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

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5. Using mathematical induction prove $1\cdot 3+2\cdot 3^2+3\cdot 3^3+\ldots.+n\cdot 3^n=\frac{(2n-1)3^{n+1}+3}{4}$ for all $n \in N$

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6. Prove that by $1.2 + 2.3 + 3.4 + \ldots.. + n(n+1) = \frac{n(n+1)(n+2)}{3}$ by using the principle of mathematical induction for all $n \in N$.

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7. Using mathematical induction prove that

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

true for all $n \in N$

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8. Using mathematical induction prove that

$1 \cdot 2 + 2 \cdot 2^2 + \ldots\ldots + n \cdot 2^n = (n-1)2^{n+1} + 2$ for all $n \in N$

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9. Using the principal of Mathematical induction, prove that

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

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10. Using mathimatical induction prove that

$\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots\ldots+\frac{1}{(3n-1)(3n+2)}=\frac{n}{6n+4}$ for all $n\in N$.

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11. Using mathematical induction prove that

$\frac{1}{1.2.3}+\frac{1}{2.3.4}+\ldots\ldots+\frac{1}{n(n+1)(n+2)}=\frac{n(n+3)}{4(n+1)(n+2)}$ for all $n\in N$.

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12. Consider the following statement:

$$P(n): a + ar + ar^2 + \ldots\ldots + ar^{n-1} = \frac{a(r^n - 1)}{r - 1}$$

Hence by using the principle of mathematical induction, prove that $P(n)$ is true for all natural numbers n.

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13. Using mathematical induction prove that

$$\left(1 + \frac{3}{1}\right)\left(1 + \frac{5}{4}\right)\left(1 + \frac{7}{9}\right)\ldots\ldots\left(1 + \frac{2n+1}{n^2}\right) = (n+1)^2$$ for all $n \in N$

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14. Using mathematical induction prove that

$$\left(1 + \frac{1}{1}\right)\left(1 + \frac{1}{2}\right)\left(1 + \frac{1}{3}\right)\ldots\ldots\left(1 + \frac{1}{n}\right) = n + 1$$ for all $n \in N$

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15. Using mathematical induction prove that

$$1^2 + 3^2 + 5^2 + \ldots. + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3} \text{ for all } n \in N$$

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16. Using mathematical induction prove that

$$\frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + \ldots\ldots + \frac{1}{(3n-2)(3n+1)} = \frac{n}{3n+1} \quad \text{for all}$$

$n \in N$

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17. Using mathematical induction prove that

$$\frac{1}{3.5} + \frac{1}{5.7} + \frac{1}{7.9} + \ldots\ldots + \frac{1}{(2n+1)(2n+3)} = \frac{n}{3(2n+3)} \quad \text{for all}$$

$n \in N$

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18. For all $n \geq 1$,prove that

$$1 + 2 + 3 + \ldots\ldots + n < \frac{1}{8}(2n + 1)^2$$

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19. Using principle of mathematical induction prove that $n(n + 1)(n + 5)$ is a multiple of 3 for all $n \in N$.

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20. Using mathematical induction prove that $10^{2n - 1} + 1$ is divisible by 11 for all $n \in N$

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21. Using mathematical induction prove that $x^{2n} - y^{2n}$ is divisible by x+y for all $n \in N$

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22. Consider the statement

$P(n) = 3^{2n+2} - 8n - 9$ is divisible by 8

Prove the statement using the principle of mathematical induction for all natural numbers.

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23. Using mathematical induction prove that

$41^n - 14^n$ is a multiple of 27 for all $n \in N$

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24. Using mathematical induction prove that $(2n + 7) < (n + 3)^2$ for all $n \in N$

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25. Consider the statement $P(n) : 2^{3n} - 1$ is divisible by 7

Is the statement p(1) true? justify your answer

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26. Consider the statement $P(n) : 2^{3n} - 1$ is divisible by 7

If p(k) is true, show that p(k+1) is also true

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27. Let P(n) be the statement "n+3" is prime. Is P(3) true?

What is your opinion when n=4?

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28. Let P(n) denotes the statement $10^{2n-1} + 1$ is divisible by 11. If P(m) is true, prove that P(m+1) is also true.

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29. Using mathematical induction prove that $1^3 + 2^3 + 3^3 + \ldots\ldots + n^3 = \left[\frac{n(n+1)}{2}\right]^2$

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30. Let P(n) : n(n+1)(n+2) is divisible by 6. Determine whether the statement is true or false, when n=3 and n=5. Justify your answer.

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31. Let P(n) denotes the statement $2^n > n$ and if P(n) is true, show that P(n+1) is also true

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32. Show that $x^n - 1$ is divisible by x-1

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33. Let P(n) denotes the statement $'3^n > 2^n'$. Is P(1) true?

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34. By using mathematical induction prove that $1 + 4 + 7 + \ldots + (3n - 2) = \frac{n(3n - 1)}{2}$

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35. For all $n \geq 1,$ prove that $1.2.3 + 2.3.4 + \ldots\ldots + n(n + 1)(n + 2) = \frac{n(n + 1)(n + 2)(n + 3)}{4}$

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36. For all $n \geq 1$, prove that

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

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37. Let P(n) denotes the statement $n^3+(n+1)^3+(n+2)^3$ is a multiple of 9

Prove that P(1) is true

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38. Let P(n) denotes the statement $n^3+(n+1)^3+(n+2)^3$ is a multiple of 9

If P(k) is true, prove that P(k+1) is also true

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39. Let P(n) denotes the statement $2^{n+3} \leq (n+3)!$ Are P(1) and P(2) true?

Justify your answer.

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40. By mathematical induction prove that the statement $3^{4n+1} + 2^{2n+2}$ is divisible by 7 is true for all $n \in N$

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