

[Download Doubtnut Now](#)**EXERCISE 4.1 - Question No. 1**

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1 + 3 + 3^2 + \dots + 3^{n-1} = \frac{(3^n - 1)}{2}$$

[Watch Free Video Solution on Doubtnut Now](#) **EXERCISE 4.1 - Question No. 2**

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1^3 + 2^3 + 3^3 + \dots + n^3 = \left( \frac{n(n+1)}{2} \right)^2$$

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**EXERCISE 4.1 - Question No. 3**

Prove the following by using the principle of mathematical induction for all

$$n \in \mathbb{N} : 1 + \frac{1}{(1+2)} + \frac{1}{(1+2+3)} + \dots + \frac{1}{\left(1+2+3+\dots+n\right)} = \frac{2n}{(n+1)}$$

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**EXERCISE 4.1 - Question No. 4**

Prove the following by using the principle of mathematical induction for all

$n \in \mathbb{N} :$

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

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**EXERCISE 4.1 - Question No. 5**

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1 \cdot 3 + 2 \cdot 3^2 + 3 \cdot 3^3 + \dots + n \cdot 3^n = \frac{(2n - 1)3^{n+1} + 3}{4}$$

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#### EXERCISE 4.1 - Question No. 6

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1 \cdot 2 + 2 \cdot 3 + 3 \cdot 4 + \dots + n(n + 1) = \left[ \frac{n(n + 1)(n + 2)}{3} \right]$$

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#### EXERCISE 4.1 - Question No. 7

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1 \cdot 3 + 3 \cdot 5 + 5 \cdot 7 + \dots + (2n-1)(2n+1) = \frac{n(4n^2 + 6n - 1)}{3}$$

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**EXERCISE 4.1 - Question No. 8**

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1 \cdot 2 + 2 \cdot 2^2 + 3 \cdot 2^2 + \dots + n \cdot 2^n = (n - 1)2^{n+1} + 2$$

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**EXERCISE 4.1 - Question No. 9**

Prove the following by using the principle of mathematical induction for all

$$n \in N : \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots + \frac{1}{2^n} = 1 - \frac{1}{2^n}$$

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**EXERCISE 4.1 - Question No. 10**

Prove the following by using the principle of mathematical induction for all

$$n \in N : \frac{1}{2 \cdot 5} + \frac{1}{5 \cdot 8} + \frac{1}{8 \cdot 11} + \dots + \frac{1}{(3n-1)(3n+2)} = \frac{n}{(6n+4)}$$

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#### EXERCISE 4.1 - Question No. 11

Prove the following by using the principle of mathematical induction for all

$n \in N :$

$$\frac{1}{1 \cdot 2 \cdot 3} + \frac{1}{2 \cdot 3 \cdot 4} + \frac{1}{3 \cdot 4 \cdot 5} + \dots + \frac{1}{n(n+1)(n+2)} = \frac{n(n+3)}{4(n+1)(n+2)}$$

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#### EXERCISE 4.1 - Question No. 12

Prove the following by using the principle of mathematical induction for all

$$n \in N : a + ar + ar^2 + \dots + ar^{n-1} = \frac{a(r^n - 1)}{r - 1}$$

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**EXERCISE 4.1 - Question No. 13**

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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**EXERCISE 4.1 - Question No. 14**

Prove the following by using the principle of mathematical induction for all

$$n \in N : \left(1 + \frac{1}{1}\right) \left(1 + \frac{1}{2}\right) \left(1 + \frac{1}{3}\right) \dots \left(1 + \frac{1}{n}\right) = (n+1)$$

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**EXERCISE 4.1 - Question No. 15**

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1^2 + 3^2 + 5^2 + \dots + (2n - 1)^2 = \frac{n(2n - 1)(2n + 1)}{3}$$

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#### EXERCISE 4.1 - Question No. 16

Prove the following by using the principle of mathematical induction for all

$$n \in N : \frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + \dots + \frac{1}{(3n - 1)(3n + 1)} = \frac{n}{(3n + 1)}.$$

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#### EXERCISE 4.1 - Question No. 17

Prove the following by using the principle of mathematical induction for all

$$n \in N : \frac{1}{3.5} + \frac{1}{5.7} + \frac{1}{7.9} + \dots + \frac{1}{(2n + 1)(2n + 3)} = \frac{n}{3(2n + 3)}.$$

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**EXERCISE 4.1 - Question No. 18**

Prove the following by using the principle of mathematical induction for all

$$n \in N : 1 + 2 + 3 + \dots + n < \frac{1}{8}(2n + 1)^2 .$$

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**EXERCISE 4.1 - Question No. 19**

Prove the following by using the principle of mathematical induction for all

$$n \in N : n(n + 1)(n + 5) \text{ is a multiple of } 3.$$

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**EXERCISE 4.1 - Question No. 20**



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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#### EXERCISE 4.1 - Question No. 21

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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#### EXERCISE 4.1 - Question No. 22

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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**EXERCISE 4.1 - Question No. 23**

Prove the following by using the principle of mathematical induction for all

$n \in \mathbb{N} : 41^n - 14^n$  is a multiple of 27.

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**EXERCISE 4.1 - Question No. 24**

Prove the following by using the principle of mathematical induction for all

$n \in \mathbb{N} : (2n + 7) < (n + 3)^2$ .

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**SOLVED EXAMPLES - Question No. 1**

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

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**SOLVED EXAMPLES - Question No. 2**

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

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**SOLVED EXAMPLES - Question No. 3**

For all  $n \geq 1$ , prove that  $\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \dots + \frac{1}{n(n+1)} = \frac{n}{n+1}$

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**SOLVED EXAMPLES - Question No. 4**

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

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#### SOLVED EXAMPLES - Question No. 5

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

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#### SOLVED EXAMPLES - Question No. 6

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

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#### SOLVED EXAMPLES - Question No. 7

Prove that  $1^2 + 2^2 + \dots + n^2 > \frac{n^3}{3}$ ,  $n \in \mathbb{N}$

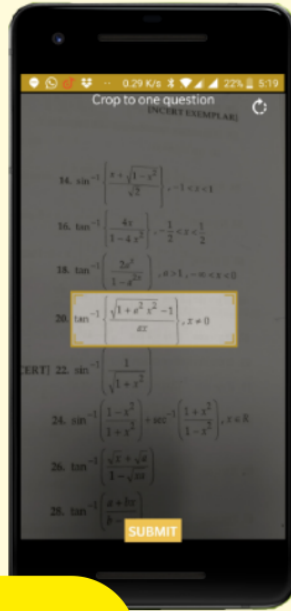
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### SOLVED EXAMPLES - Question No. 8

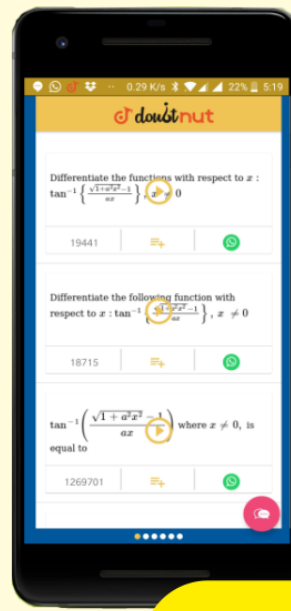
Prove the rule of exponents  $(ab)^n = a^n b^n$  by using principle of mathematical induction for every natural number.

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