MATHEMATICS CLASS XI CHAPTER – 4 PRINCIPLE OF MATHEMATICAL INDUCTION

Q.1. **Prove the following by using the principle of mathematical induction for all $n \in N$:**

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

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

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

Q.4. **Prove the following by using the principle of mathematical induction for all $n \in N$: 1.2.3 + 2.3.4 + … + $n(n+1)(n+2)$ =** $\frac{n(n+1)(n+2)(n+3)}{4}$

Q.5. **Prove the following by using the principle of mathematical induction for all $n \in N$:** $1.3+2.3^2+3.3^3+\dots+n.3^n=\frac{(2n-1)3^{n+1}+3}{4}$

Q.6. **Prove the following by using the principle of mathematical induction for all $n \in N$:** $1.2+2.3+3.4+\dots+n.(n+1)=\left[\frac{n(n+1)(n+2)}{3}\right]$

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Q.7. Prove the following by using the principle of mathematical induction for all $n \in N$: $1.3+3.5+5.7+...+(2n-1)(2n+1)=\frac{n(4n^2+6n-1)}{3}$

Q.8. Prove the following by using the principle of mathematical induction for all $n \in N$: $1.2 + 2.2^2 + 3.2^2 + \ldots + n.2^n = (n-1)\,2^{n+1} + 2$

Q.9. Prove the following by using the principle of mathematical induction for all $n \in N$: $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+...+\frac{1}{2^n}=1-\frac{1}{2^n}$

Q.10. Prove the following by using the principle of mathematical induction for all $n \in N$: $\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+...+\frac{1}{(3n-1)(3n+2)}=\frac{n}{(6n+4)}$

Q.11. Prove the following by using the principle of mathematical induction for all $n \in N$: $\frac{1}{1.2.3}+\frac{1}{2.3.4}+\frac{1}{3.4.5}+...+\frac{1}{n(n+1)(n+2)}=\frac{n(n+3)}{4(n+1)(n+2)}$

Q.12. Prove the following by using the principle of mathematical induction for all $n \in N$: $a+ar+ar^2+...+ar^{n-1}=\frac{a(r^n-1)}{r-1}$

Q.13. Prove the following by using the principle of mathematical induction for all $n \in N$: $\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right)...\left(1+\frac{(2n+1)}{n^2}\right)=(n+1)^2$

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

Q.15. **Prove the following by using the principle of mathematical induction for all $n \in N$:** $1^2 + 3^2 + 5^2 + ... + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$

Q.16. **Prove the following by using the principle of mathematical induction for all $n \in N$:** $\frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + ... + \frac{1}{(3n-2)(3n+1)} = \frac{n}{(3n+1)}$

Q.17. **Prove the following by using the principle of mathematical induction for all $n \in N$:** $\frac{1}{3.5} + \frac{1}{5.7} + \frac{1}{7.9} + ... + \frac{1}{(2n+1)(2n+3)} = \frac{n}{3(2n+3)}$

Q.18. **Prove the following by using the principle of mathematical induction for all $n \in N$:** $1 + 2 + 3 + ... + n < \frac{1}{8}(2n+1)^2$

Q.19. **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.**

Q.20. **Prove the following by using the principle of mathematical induction for all $n \in N$: $10^{2n-1} + 1$ is divisible by 11.**

Q.21. **Prove the following by using the principle of mathematical induction for all $n \in N$: $x^{2n} - y^{2n}$ is divisible by $x + y$.**

Q.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.**

Q.23. **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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Q.24. **Prove the following by using the principle of mathematical induction for all** $n \in \mathrm{N}$:

$(2n + 7) < (n + 3)^2$

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