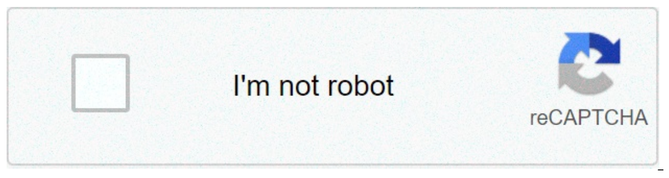

Continue

Principle of mathematical induction exercise 4.1

Search More Ncert Solutions Q23. Prove the following by using the principle of mathematical induction for all n ∈ N: \(41^{n}-14^{n} \text { is a multiple of } 27\) Answer. Let the given statement be P(n), i.e., \(\mathrm{P}(\mathrm{n}) : 41^{\mathrm{n}}-14^{\mathrm{n}} \text { is a multiple of } 27\) It can be observed that P(n) is true for n = 1
since \(41^{1}-14^{1}=27\) which is a multiple of 27. Let P(k) be true for some positive integer k, i.e., \(\begin{array}{l}{41^{\mathrm{k}}-14^{\mathrm{k}} \text { is a multiple of } 27} \\ {\therefore 41^{\mathrm{k}}-14^{\mathrm{k}}=27 \mathrm{m}, \text { where } \mathrm{m} \in \mathrm{N} \ldots \text { (1) }}\end{array}\) We shall now prove that
P(k + 1) is true whenever P(k) is true. Consider \(\begin{array}{l}{41^{k+1}-14^{k+1}} \\ {=41^{k} \cdot 41-14^{k} \cdot 14} \\ {=41\left(41^{k}-14^{k}+14^{k}\right)-14^{k} \cdot 14} \\ {=41\left(41^{k}-14^{k}\right)+41.14^{k}-14^{k} \cdot 14} \\ {=41.27 m+14^{k}(41-14)}\end{array}\) \(\begin{array}{l}{=41.27 m+27.14^{k}} \\ {=27\left(41 m-
14^{k}\right)}\end{array}\) \(\begin{array}{l}{=27 \times r, \text { where } r=\left(41 m-14^{k}\right) \text { is a natural number }} \\ {\text { Therefore, } 41^{k+1}-14^{k+1} \text { is a multiple of } 27}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural
numbers i.e., n. Page 2 Search More Ncert Solutions Q24. Prove the following by using the principle of mathematical induction for all n ∈ N: \((2 n+7) Answer. Let the given statement be P(n), i.e., \(\mathrm{P}(\mathrm{n}) :(2 \mathrm{n}+7) Page 3 Search More Ncert Solutions Q15. Prove the following by using the principle of
mathematical induction for all n ∈ N: \(1^{2}+3^{2}+5^{2}+\ldots+(2 n-1)^{2}=\frac{n(2 n-1)(2 n+1)}{3}\) Answer. Let the given statement be P(n), i.e., \(\begin{array}{l}{P(n)=1^{2}+3^{2}+5^{2}+\ldots+(2 n-1)^{2}=\frac{n(2 n-1)(2 n+1)}{3}} \\ {\text { For } n=1, \text { we have }} \\ {P(1)=1^{2}=1=\frac{1(2.1-1)(2.1+1)}{3}=\frac{1.1 .3}{3}=1, \text {
which is true. }}\end{array}\) Let P(k) be true for some positive integer k, i.e., \(P(k)=1^{2}+3^{2}+5^{2}+\ldots+(2 k-1)^{2}=\frac{k(2 k-1)(2 k+1)}{3}\) …….(1) We shall now prove that P(k + 1) is true. Consider \(\left\{1^{2}+3^{2}+5^{2}+\ldots+(2 k-1)^{2}\right\}+\{2(k+1)-1\}^{2}\) \(=\frac{k(2 k-1)(2 k+1)}{3}+(2 k+2-1)^{2}\) [Using (1)] \
(\begin{array}{l}{=\frac{k(2 k-1)(2 k+1)}{3}+(2 k+1)^{2}} \\ {=\frac{k(2 k-1)(2 k+1)+3(2 k+1)^{2}}{3}} \\ {=\frac{(2 k+1)\{k(2 k-1)+3(2 k+1)\}}{3}} \\ {=\frac{(2 k+1)\left\{2 k^{2}-k+6 k+3\right\}}{3}}\end{array}\) \(\begin{array}{l}{=\frac{(2 k+1)\left\{2 k^{2}+5 k+3\right\}}{3}} \\ {=\frac{(2 k+1)\left\{2 k^{2}+2 k+3 k+3\right\}}{3}} \\ {=\frac{(2 k+1)\{2
k(k+1)+3(k+1)\}}{3}}\end{array}\) \(\begin{array}{l}{=\frac{(2 k+1)(k+1)(2 k+3)}{3}} \\ {=\frac{(k+1)\{2(k+1)-1\}\{2(k+1)+1\}}{3}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 4 Search More Ncert Solutions Q16. Prove the
following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+\ldots+\frac{1}{(3 n-2)(3 n+1)}=\frac{n}{(3 n+1)}\) Answer. Let the given statement be P(n), i.e., \(\begin{array}{l}{P(n) : \frac{1}{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+\ldots+\frac{1}{(3 n-2)(3 n+1)}=\frac{n}{(3 n+1)}} \\ {\text { For } n=1,
\text { we have }} \\ {P(1)=\frac{1}{1.4}=\frac{1}{3.1+1}=\frac{1}{4}=\frac{1}{1.4}, \text { which is true. }}\end{array}\) Let P(k) be true for some positive integer k, i.e., \(P(k)=\frac{1}{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+\ldots+\frac{1}{(3 k-2)(3 k+1)}=\frac{k}{3 k+1}\) ………..(1) We shall now prove that P(k + 1) is true. Consider \(\left\{\frac{1}
{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+\ldots+\frac{1}{(3 k-2)(3 k+1)}\right\}+\frac{1}{\{3(k+1)-2\}\{3(k+1)+1\}}\) \(=\frac{k}{3 k+1}+\frac{1}{(3 k+1)(3 k+4)}\) [Using (1)] \(\begin{array}{l}{=\frac{1}{(3 k+1)}\left\{k+\frac{1}{(3 k+4)}\right\}} \\ {=\frac{1}{(3 k+1)}\left\{\frac{k(3 k+4)+1}{(3 k+4)}\right\}} \\ {=\frac{1}{(3 k+1)}\left\{\frac{3 k^{2}+4 k+1}{(3
k+4)}\right\}}\end{array}\) \(\begin{array}{l}{=\frac{1}{(3 k+1)}\left\{\frac{3 k^{2}+3 k+k+1}{(3 k+4)}\right\}} \\ {=\frac{(3 k+1)(k+1)}{(3 k+1)(3 k+4)}} \\ {=\frac{(k+1)}{3(k+1)+1}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 5
Search More Ncert Solutions Q17. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{3.5}+\frac{1}{5.7}+\frac{1}{7.9}+\ldots+\frac{1}{(2 n+1)(2 n+3)}=\frac{n}{3(2 n+3)}\) Answer. Let the given statement be P(n), i.e., \(P(n) : \frac{1}{3.5}+\frac{1}{5.7}+\frac{1}{7.9}+\ldots+\frac{1}{(2 n+1)(2 n+3)}=\frac{n}
{3(2 n+3)}\) For n = 1, we have \(P(1) : \frac{1}{3.5}=\frac{1}{3(2.1+3)}=\frac{1}{3.5}\) , which is true. Let P(k) be true for some positive integer k, i.e., \(P(k) : \frac{1}{3.5}+\frac{1}{5.7}+\frac{1}{7.9}+\ldots+\frac{1}{(2 k+1)(2 k+3)}=\frac{k}{3(2 k+3)}\) ……(1) We shall now prove that P(k + 1) is true. Consider \(\left[\frac{1}{3.5}+\frac{1}
{5.7}+\frac{1}{7.9}+\ldots+\frac{1}{(2 k+1)(2 k+3)}\right]+\frac{1}{\{2(k+1)+1\}\{2(k+1)+3\}}\) \(=\frac{k}{3(2 k+3)}+\frac{1}{(2 k+3)(2 k+5)}\) \([\mathrm{U} \operatorname{sing}(1)]\) \(\begin{array}{l}{=\frac{1}{(2 k+3)}\left[\frac{k}{3}+\frac{1}{(2 k+5)}\right]} \\ {=\frac{1}{(2 k+3)}\left[\frac{k(2 k+5)+3}{3(2 k+5)}\right]} \\ {=\frac{1}{(2 k+3)}\left[\frac{2
k^{2}+5 k+3}{3(2 k+5)}\right]}\end{array}\) \(\begin{array}{l}{=\frac{1}{(2 k+3)}\left[\frac{2 k^{2}+2 k+3 k+3}{3(2 k+5)}\right]} \\ {=\frac{1}{(2 k+3)}\left[\frac{2 k(k+1)+3(k+1)}{3(2 k+5)}\right]} \\ {=\frac{(k+1)(2 k+3)}{3(2 k+3)(2 k+5)}} \\ {=\frac{(k+1)}{3\{2(k+1)+3\}}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of
mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 6 Search More Ncert Solutions Q18. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1+2+3+\ldots+n Answer. Let the given statement be P(n), i.e., \(\mathrm{P}(n) : 1+2+3+\ldots+n Page 7 Search More Ncert Solutions
Q19. Prove the following by using the principle of mathematical induction for all n ∈ N: \(n(n+1)(n+5) \text { is a multiple of } 3\) Answer. Let the given statement be P(n), i.e., P(n): n (n + 1) (n + 5), which is a multiple of 3. It can be noted that P(n) is true for n = 1 since 1 (1 + 1) (1 + 5) = 12, which is a multiple of 3. Let P(k) be true for some
positive integer k, i.e., k (k + 1) (k + 5) is a multiple of 3. ∴k (k + 1) (k + 5) = 3m, where m ∈ N … (1) We shall now prove that P(k + 1) is true whenever P(k) is true. Consider \(\begin{array}{l}{(k+1)\{(k+1)+1\}\{(k+1)+5\}} \\ {=(k+1)(k+2)\{(k+5)+1\}} \\ {=(k+1)(k+2)(k+5)+(k+1)(k+2)} \\ {=\{k(k+1)(k+5)+2(k+1)(k+5)\}} \\ {=3 m+(k+1)\{2(k+5)+
(k+2)\}} \\ {=3 m+(k+1)\{2 k+10+k+2\}} \\ {=3 m+(k+1)\{2 k+12)} \\ {=3 m+3(k+1)(k+4)}\end{array}\) \(\begin{array}{l}{=3\{m+(k+1)(k+4)\}=3 \times q, \text { where } q=\{m+(k+1)(k+4)\} \text { is some natural number }} \\ {\text { Therefore, }(k+1)\{(k+1)+1\}\{(k+1)+5\} \text { is a multiple of } 3 .}\end{array}\) Thus, P(k + 1) is true whenever P(k) is
true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 8 Search More Ncert Solutions Q20. Prove the following by using the principle of mathematical induction for all n ∈ N: \(10^{1 n-1}+1 \text { is divisible by } 11\) Answer. Let the given statement be P(n), i.e., \(\begin{array}{l}
{\mathrm{P}(\mathrm{n}) : 10^{2 \mathrm{n}-1}+1 \text { is divisible by } 11 .} \\ {\text { It can be observed that } \mathrm{P}(\mathrm{n}) \text { is true for } \mathrm{n}=1 \text { since } \mathrm{P}(1)=10^{2.1-1}+1=} \\ {11, \text { which is divisible by } 11 .}\end{array}\) Let P(k) be true for some positive integer k, i.e., \(\begin{array}{l}{10^{2
\mathrm{k}-1}+1 \text { is divisible by } 11 .} \\ {\therefore 10^{2 \mathrm{k}-1}+1=11 \mathrm{m}, \text { where } \mathrm{m} \in \mathrm{N} \ldots(1)}\end{array}\) We shall now prove that P(k + 1) is true whenever P(k) is true. Consider \(\begin{array}{l}{10^{2(k+1)-1}+1} \\ {=10^{2 k+2-1}+1} \\ {=10^{2 k+1}+1} \\ {=10^{2}\left(10^{2 k-1}+1-
1\right)+1} \\ {=10^{2}\left(10^{2 k-1}+1\right)-10^{2}+1}\end{array}\) \(=10^{2} \cdot 11 m-100+1\) \([\text { Using }(1)]\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 9 Search More Ncert Solutions Q21. Prove the following by using
the principle of mathematical induction for all n ∈ N: \(x^{2 x}-y^{3 n} \text { is divisible by } x+y\) Answer. Let the given statement be P(n), i.e., \(\begin{array}{l}{P(n) : x^{2 n}-y^{2 n} \text { is divisible by } x+y \text { . }} \\ {\text { It can be observed that } P(n) \text { is true for } n=1 \text { . }} \\ {\text { This is so because } x^{2} \times 1-y^{2}
\times 1=x^{2}-y^{2}=(x+y)(x-y) \text { is divisible by }} \\ {(x+y) .}\end{array}\) Let P(k) be true for some positive integer k, i.e., \(\begin{array}{l}{x^{2 k}-y^{2 k} \text { is divisible by } x+y .} \\ {\therefore x^{2 k}-y^{2 k}=m(x+y), \text { where } m \in N \ldots(1)}\end{array}\) We shall now prove that P(k + 1) is true whenever P(k) is true. Consider \
(\begin{array}{l}{x^{2(k+1)}-y^{2(k+1)}} \\ {=x^{2 k} \cdot x^{2}-y^{2 k} \cdot y^{2}} \\ {=x^{2}\left(x^{2 k}-y^{2 k}+y^{2 k}\right)-y^{2 k} \cdot y^{2}}\end{array}\) \(=x^{2}\left\{m(x+y)+y^{2 k}\right\}-y^{2 k} \cdot y^{2} \quad[\text { Using }(1)]\) \(\begin{array}{l}{=m(x+y) x^{2}+y^{2 k} \cdot x^{2}-y^{2 k} \cdot y^{2}} \\ {=m(x+y) x^{2}+y^{2 k}\left(x^{2}-
y^{2}\right)} \\ {=m(x+y) x^{2}+y^{2 k}(x+y)(x-y)} \\ {=(x+y)\left\{m x^{2}+y^{2 k}(x-y)\right\}, \text { which is a factor of }(x+y)}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 10 Search More Ncert Solutions Q22. Prove the
following by using the principle of mathematical induction for all n ∈ N: \(3^{2 n+2}-8 n-9 \text { is divisible by } 8\) Answer. Let the given statement be P(n), i.e., \(\mathrm{P}(\mathrm{n}) : 3^{2 \mathrm{n}+2}-8 \mathrm{n}-9 \text { is divisible by } 8\) \(\begin{array}{l}{\text { It can be observed that } P(n) \text { is true for } n=1 \text { since }
3^{2 \times 1+2}-8 \times 1-9=} \\ {64, \text { which is divisible by } 8 \text { . }}\end{array}\) Let P(k) be true for some positive integer k, i.e., \(\begin{array}{l}{3^{2 k+2}-8 k-9 \text { is divisible by } 8 \text { . }} \\ {\therefore 3^{2 k+2}-8 k-9=8 m ; \text { where } m \in N \ldots(1)}\end{array}\) We shall now prove that P(k + 1) is true whenever P(k)
is true. Consider \(\begin{array}{l}{3^{2(k+1)+2}-8(k+1)-9} \\ {=3^{2 k+2} \cdot 3^{2}-8 k-8-9} \\ {=3^{2}\left(3^{2 k+2}-8 k-9+8 k+9\right)-8 k-17} \\ {=3^{2}\left(3^{2 k+2}-8 k-9\right)+3^{2}(8 k+9)-8 k-17} \\ {=9.8 m+9(8 k+9)-8 k-17}\end{array}\) \(\begin{array}{l}{=9.8 m+9(8 k+9)-8 k-17} \\ {=9.8 m+72 k+81-8 k-17} \\ {=9.8 m+64 k+64} \\ {=8(9
m+8 k+8)} \\ {=8 r, \text { where } r=(9 m+8 k+8) \text { is a natural number }} \\ {\text { Therefore, } 3^{2(k+1)+2}-8(k+1)-9 \text { is divisible by } 8 \text { . }}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 11 Search More
Ncert Solutions Q4. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.2.3+2.3 .4+\ldots+n(n+1)(n+2)=\frac{n(n+1)(n+2)(n+3)}{4}\) Answer. \(\begin{array}{l}{\text { Let the given statement be } P(n), \text { i.e., }} \\ {P(n) : 1.2 .3+2.3 .4+\ldots+n(n+1)(n+2)=\frac{n(n+1)(n+2)(n+3)}{4}}\end{array}\) \
(\begin{array}{l}{\text { For } n=1, \text { we have }} \\ {P(1) : 1.2 \cdot 3=6=\frac{1(1+1)(1+2)(1+3)}{4}=\frac{1.23 .4}{4}=6}\end{array}\) , which is true Let P(k) be true for some positive integer k, i.e., \(1.2 .3+2.3 .4+\ldots+k(k+1)(k+2)=\frac{k(k+1)(k+2)(k+3)}{4}\) ……………(i) \(\begin{array}{l}{\text { We shall now prove that } P(k+1) \text { is
true. }} \\ {\text { Consider }} \\ {1.2 .3+2.3 .4+\ldots+k(k+1)(k+2)+(k+1)(k+2)(k+3)} \\ {=\{1.2 .3+2.3 .4+\ldots+k(k+1)(k+2)\}+(k+1)(k+2)(k+3)}\end{array}\) \(\begin{array}{l}{=\frac{k(k+1)(k+2)(k+3)}{4}+(k+1)(k+2)(k+3) \quad[\text { Using }(i)]} \\ {=(k+1)(k+2)(k+3)\left(\frac{k}{4}+1\right)} \\ {=\frac{(k+1)(k+2)(k+3)(k+4)}{4}} \\ {=\frac{(k+1)(k+1+1)
(k+1+2)(k+1+3)}{4}}\end{array}\) \(\begin{array}{l}{\text { Thus, } P(k+1) \text { is true whenever } P(k) \text { is true. }} \\ {\text { Hence, by the principle of mathematical induction, statement } P(n) \text { is true for all natural }} \\ {\text { numbers I.e., } n \text { . }}\end{array}\) Page 12 Search More Ncert Solutions Q5. Prove the following by
using the principle of mathematical induction for all n ∈ N: \(1.3+2.3^{2}+3.3^{3}+\ldots+n 3^{n}=\frac{(2 n-1) 3^{n+1}+3}{4}\) Answer. \(\begin{array}{l}{\text { Let the given statement be } P(n), \text { i.e., }} \\ {1.3+2.3^{2}+3.3^{\circ}+\ldots+n 3^{n}=\frac{(2 n-1) 3^{n+1}+3}{4}}\end{array}\) \(\begin{array}{l}{P(n) :} \\ {\text { For } n=1, \text { we
have }}\end{array}\) \(P(1) : 1.3=3 \quad=\frac{(2.1-1) 3^{1+1}+3}{4}=\frac{3^{2}+3}{4}=\frac{12}{4}=3\) \(\begin{array}{l}{\text { Let } P(k) \text { be true for some positive integer } k, \text { i.e., }} \\ {1.3+2.3^{2}+3.3^{3}+\ldots+k 3^{4}=\frac{(2 k-1) 3^{k+1}+3}{4}} \\ {\text { We shall now prove that } P(k+1) \text { is true. }}\end{array}\) ……….(i)
Consider \(\begin{array}{l}{1.3+2.3^{2}+3.3^{3}+\ldots+k 3^{k}+(k+1) 3^{k+1}} \\ {=\left(1.3+2.3^{2}+3.3^{3}+\ldots+k .3^{k}\right)+(k+1) 3^{k+1}}\end{array}\) \(=\frac{(2 k-1) 3^{k+1}+3}{4}+(k+1) 3^{k+1} \quad[\text { Using }(\mathbf{i})]\) \(\begin{array}{l}{=\frac{(2 k-1) 3^{3+1}+3+4(k+1) 3^{k+1}}{4}} \\ {=\frac{3^{t+1}\{2 k-1+4(k+1)\}+3}
{4}}\end{array}\) \(\begin{aligned} &=\frac{3^{k+1}\{6 k+3\}+3}{4} \\ &=\frac{3^{k+1} \cdot 3\{2 k+1\}+3}{4} \end{aligned}\) \(\begin{array}{l}{=\frac{3^{(k+1)+1}\{2 k+1\}+3}{4}} \\ {=\frac{\{2(k+1)-1\} 3^{(k+1)+1}+3}{4}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is
true for all natural numbers i.e., n. Page 13 Search More Ncert Solutions Q6. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.2+2.3+3.4+\ldots+n .(n+1)=\left[\frac{n(n+1)(n+2)}{3}\right]\) Answer. Let the given statement be P(n), i.e., P(n) : \(1.2+2.3+3.4+\ldots+n \cdot(n+1)=\left[\frac{n(n+1)(n+2)}
{3}\right]\) For n = 1, we have P(1): \(1.2=2=\frac{1(1+1)(1+2)}{3}=\frac{1.2 .3}{3}=2\)which is true. Let P(k) be true for some positive integer k, i.e., \(1.2+2.3+3.4+\ldots .+k .(k+1)=\left[\frac{k(k+1)(k+2)}{3}\right]\) ……….(i) We shall now prove that P(k + 1) is true. Consider 1.2 + 2.3 + 3.4 + … + k.(k + 1) + (k + 1).(k + 2) = [1.2 + 2.3 + 3.4 +
… + k.(k + 1)] + (k + 1).(k + 2) \(=\frac{k(k+1)(k+2)}{3}+(k+1)(k+2) \quad[\text { Using }(\mathrm{i})]\) \(\begin{array}{l}{=(k+1)(k+2)\left(\frac{k}{3}+1\right)} \\ {=\frac{(k+1)(k+2)(k+3)}{3}} \\ {=\frac{(k+1)(k+1+1)(k+1+2)}{3}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement
P(n) is true for all natural numbers i.e., n. Page 14 Search More Ncert Solutions Q7. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.3+3.5+5.7+\ldots+(2 n-1)(2 n+1)=\frac{n\left(4 n^{2}+6 n-1\right)}{3}\) Answer. Let the given statement be P(n), i.e., P(n) : \(1.3+3.5+5.7+\ldots+(2 n-1)(2
n+1)=\frac{n\left(4 n^{2}+6 n-1\right)}{3}\) \(\begin{array}{l}{\text { For } n=1, \text { we have }} \\ {P(1) : 1.3=3=\frac{1\left(4.1^{2}+6.1-1\right)}{3}=\frac{4+6-1}{3}=\frac{9}{3}=3}\end{array}\) , which is true Let P(k) be true for sorne positive integer k, i.e., \(1.3+3.5+5.7+\ldots .+(2 k-1)(2 k+1)=\frac{k\left(4 k^{2}+6 k-1\right)}{3}\) ……..(i) \
(\begin{array}{l}{\text { We shall now prove that } P(k+1) \text { is true. }} \\ {\text { Consider }} \\ {(1.3+3.5+5.7+\ldots+(2 k-1)(2 k+1)+\{2(k+1)-1\}\{2(k+1)+1\}}\end{array}\) \(=\frac{k\left(4 k^{2}+6 k-1\right)}{3}+(2 k+2-1)(2 k+2+1) \quad[\text { Using (i) }]\) \(\begin{array}{l}{=\frac{k\left(4 k^{2}+6 k-1\right)}{3}+(2 k+1)(2 k+3)} \\ {=\frac{k\left(4
k^{2}+6 k-1\right)}{3}+\left(4 k^{2}+8 k+3\right)} \\ {=\frac{k\left(4 k^{2}+6 k-1\right)+3\left(4 k^{2}+8 k+3\right)}{3}} \\ {=\frac{4 k^{3}+6 k^{2}-k+12 k^{2}+24 k+9}{3}} \\ {=\frac{4 k^{3}+18 k^{2}+93 k+9}{3}} \\ {=\frac{4 k^{3}+14 k^{2}+9 k+4 k^{2}+14 k+9}{3}}\end{array}\) \(\begin{array}{l}{=\frac{k\left(4 k^{2}+14 k+9\right)+1\left(4 k^{2}+14
k+9\right)}{3}} \\ {=\frac{(k+1)\left(4 k^{2}+14 k+9\right)}{3}}\end{array}\) \(\begin{array}{l}{=\frac{(k+1)\left\{4 k^{2}+8 k+4+6 k+6-1\right\}}{3}} \\ {=\frac{(k+1)\left\{4\left(k^{2}+2 k+1\right)+6(k+1)-1\right\}}{3}} \\ {=\frac{(k+1)\left\{4(k+1)^{2}+6(k+1)-1\right\}}{3}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of
mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 15 Search More Ncert Solutions Q8. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.2+2.2^{2}+3.2^{3}+\ldots+n .2^{\circ}=(n-1) 2^{n+1}+2\) Answer. Let the given statement be P(n), i.e., \(P(n) :
1.2+2.2^{2}+3.2^{2}+\ldots+n .2^{n}=(n-1) 2^{n+1}+2\) For n = 1, we have \(P(1) : 1.2=2=(1-1) 2^{1+1}+2=0+2=2,\) Let P(k) be true for some positive integer k, i.e., \(1.2+2.2^{2}+3.2^{2}+\ldots+\mathrm{k} .2^{\mathrm{k}}=(\mathrm{k}-1) 2^{\mathrm{k}+1}+2 \ldots\)..(i) We shall now prove that P(k + 1) is true. Consider \(\begin{array}{l}{\left\
{1.2+2.2^{2}+3.2^{3}+\ldots+k .2^{k}\right\}+(k+1) \cdot 2^{k+1}} \\ {=(k-1) 2^{k+1}+2+(k+1) 2^{k+1}} \\ {=2^{k+1}\{(k-1)+(k+1)\}+2} \\ {=2^{k+1} \cdot 2 k+2} \\ {=k .2^{(k+1)+1}+2} \\ {=\{(k+1)-1\} 2^{(k+1)+1}+2}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for
all natural numbers i.e., n. Page 16 Search More Ncert Solutions Q9. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots+\frac{1}{2^{n}}=1-\frac{1}{2^{n}}\) Answer. Let the given statement be P(n), i.e., P(n): \(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots+\frac{1}{2^{n}}=1-
\frac{1}{2^{n}}\) For n = 1, we have P(1): \(\frac{1}{2}=1-\frac{1}{2^{1}}=\frac{1}{2}\), which is true Let P(k) be true for some positive integer k, i.e., \(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots+\frac{1}{2^{k}}=1-\frac{1}{2^{k}}\) We shall now prove that P(k + 1) is true. Consider \(\begin{array}{l}{\left(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots
\ldots+\frac{1}{2^{k}}\right)+\frac{1}{2^{k+1}}} \\ {=\left(1-\frac{1}{2^{k}}\right)+\frac{1}{2^{k+1}}}\end{array}\) [using(i)] \(\begin{array}{l}{=1-\frac{1}{2^{k}}+\frac{1}{2 \cdot 2^{k}}} \\ {=1-\frac{1}{2^{k}}\left(1-\frac{1}{2}\right)} \\ {=1-\frac{1}{2^{k}}\left(\frac{1}{2}\right)} \\ {=1-\frac{1}{2^{k+1}}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true.
Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 17 Search More Ncert Solutions Q10. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots+\frac{1}{(3 n-1)(3 n+2)}=\frac{n}{(6 n+4)}\) Answer. Let the
given statement be P(n), i.e., P(n): \(\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots+\frac{1}{(3 n-1)(3 n+2)}=\frac{n}{(6 n+4)}\) For n = 1, we have \(P(1)=\frac{1}{2.5}=\frac{1}{10}=\frac{1}{6.1+4}=\frac{1}{10}\) , which is true. Let P(k) be true for some positive integer k, i.e., \(\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots+\frac{1}{(3 k-1)(3
k+2)}=\frac{k}{6 k+4}\) ….(i) We shall now prove that P(k + 1) is true. Consider \(\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots \ldots+\frac{1}{(3 k-1)(3 k+2)}+\frac{1}{\{3(k+1)-1\}\{3(k+1)+2\}}\) \(=\frac{k}{6 k+4}+\frac{1}{(3 k+3-1)(3 k+3+2)} \quad[\text { Using }(\mathrm{i})]\) \(\begin{array}{l}{=\frac{k}{6 k+4}+\frac{1}{(3 k+2)(3 k+5)}} \\
{=\frac{k}{2(3 k+2)}+\frac{1}{(3 k+2)(3 k+5)}} \\ {=\frac{1}{(3 k+2)}\left(\frac{k}{2}+\frac{1}{3 k+5}\right)} \\ {=\frac{1}{(3 k+2)}\left(\frac{k(3 k+5)+2}{2(3 k+5)}\right)}\end{array}\) \(\begin{array}{l}{=\frac{1}{(3 k+2)}\left(\frac{3 k^{2}+5 k+2}{2(3 k+5)}\right)} \\ {=\frac{1}{(3 k+2)}\left(\frac{(3 k+2)(k+1)}{2(3 k+5)}\right)} \\ {=\frac{(k+1)}{6 k+10}} \\
{=\frac{(k+1)}{6(k+1)+4}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 18 Search More Ncert Solutions Q11. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{1.2.3}+\frac{1}
{2.3.4}+\frac{1}{3.4.5}+\ldots+\frac{1}{n(n+1)(n+2)}=\frac{n(n+3)}{4(n+1)(n+2)}\) Answer. Let the given statement be P(n),i.e., P(n): \(\frac{1}{1.2.3}+\frac{1}{2.3.4}+\frac{1}{3.4.5}+\ldots+\frac{1}{n(n+1)(n+2)}=\frac{n(n+3)}{4(n+1)(n+2)}\) For n = 1, we have \(P(1) : \frac{1}{1 \cdot 2 \cdot 3}=\frac{1 \cdot(1+3)}{4(1+1)(1+2)}=\frac{1 \cdot 4}{4
\cdot 2 \cdot 3}=\frac{1}{1 \cdot 2 \cdot 3}\), which is true Let P(k) be true for some positive integer k, i.e., \(\frac{1}{1 \cdot 2 \cdot 3}+\frac{1}{2 \cdot 3 \cdot 4}+\frac{1}{3 \cdot 4 \cdot 5}+\ldots+\frac{1}{k(k+1)(k+2)}=\frac{k(k+3)}{4(k+1)(k+2)}\) …..(i) We shall now prove that P(k + 1) is true. Consider \(\left[\frac{1}{1 \cdot 2 \cdot 3}+\frac{1}{2
\cdot 3 \cdot 4}+\frac{1}{3 \cdot 4 \cdot 5}+\ldots+\frac{1}{k(k+1)(k+2)}\right]+\frac{1}{(k+1)(k+2)(k+3)}\) \(=\frac{k(k+3)}{4(k+1)(k+2)}+\frac{1}{(k+1)(k+2)(k+3)} \quad[\text { Using }(\mathrm{i})]\) \(\begin{array}{l}{=\frac{1}{(k+1)(k+2)}\left\{\frac{k(k+3)}{4}+\frac{1}{k+3}\right\}} \\ {=\frac{1}{(k+1)(k+2)}\left\{\frac{k(k+3)^{2}+4}{4(k+3)}\right\}} \\
{=\frac{1}{(k+1)(k+2)}\left\{\frac{k\left(k^{2}+6 k+9\right)+4}{4(k+3)}\right\}}\end{array}\) \(\begin{array}{l}{=\frac{1}{(k+1)(k+2)}\left\{\frac{k^{3}+6 k^{2}+9 k+4}{4(k+3)}\right\}} \\ {=\frac{1}{(k+1)(k+2)}\left\{\frac{k^{3}+2 k^{2}+k+4 k^{2}+8 k+4}{4(k+3)}\right\}} \\ {=\frac{1}{(k+1)(k+2)}\left\{\frac{k\left(k^{2}+2 k+1\right)+4\left(k^{2}+2 k+1\right)}
{4(k+3)}\right\}}\end{array}\) \(\begin{array}{l}{=\frac{1}{(k+1)(k+2)}\left\{\frac{k(k+1)^{2}+4(k+1)^{2}}{4(k+3)}\right\}} \\ {=\frac{(k+1)^{2}(k+4)}{4(k+1)(k+2)(k+3)}} \\ {=\frac{(k+1)\{(k+1)+3\}}{4\{(k+1)+1\}\{(k+1)+2\}}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true
for all natural numbers i.e., n. Page 19 Search More Ncert Solutions Q12. Prove the following by using the principle of mathematical induction for all n ∈ N: \(a+a r+a r^{2}+\ldots+a r^{n-1}=\frac{a\left(r^{n}-1\right)}{r-1}\) Answer. Let the given statement be P(n), i.e., P(n): \(a+a r+a r^{2}+\ldots+a r^{n-1}=\frac{a\left(r^{n}-1\right)}{r-1}\) For n
= 1, we have \(\mathrm{P}(1) : a=\frac{a\left(r^{1}-1\right)}{(r-1)}=a\), which is true. Let P(k) be true for some positive integer k, i.e., \(a+a r+a r^{2}+\ldots \ldots .+a r^{k-1}=\frac{a\left(r^{k}-1\right)}{r-1}\) …….(i) We shall now prove that P(k + 1) is true. Consider \(\begin{array}{l}{\left\{a+a r+a r^{2}+\ldots \ldots+a r^{k-1}\right\}+a r^{(k+1)-1}} \\
{=\frac{a\left(r^{k}-1\right)}{r-1}+a r^{k}}\end{array}\) [Using(i)] \(\begin{aligned} &=\frac{a\left(r^{k}-1\right)+a r^{k}(r-1)}{r-1} \\ &=\frac{a\left(r^{k}-1\right)+a r^{k+1}-a r^{k}}{r-1} \end{aligned}\) \(\begin{array}{l}{=\frac{a r^{k}-a+a r^{k+1}-a r^{k}}{r-1}} \\ {=\frac{a r^{k+1}-a}{r-1}} \\ {=\frac{a\left(r^{k+1}-1\right)}{r-1}}\end{array}\) Thus, P(k + 1) is
true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 20 Search More Ncert Solutions Q13. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right)
\dots\left(1+\frac{(2 n+1)}{n^{2}}\right)=(n+1)^{2}\) Answer. Let the given statement be P(n), i.e., \(\mathrm{P}(n) :\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right) \dots\left(1+\frac{(2 n+1)}{n^{2}}\right)=(n+1)^{2}\) For n = 1, we have \(\mathrm{P}(1) :\left(1+\frac{3}{1}\right)=4=(1+1)^{2}=2^{2}=4,\) Let P(k) be true for
some positive integer k, i.e., \(\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right) \dots\left(1+\frac{(2 k+1)}{k^{2}}\right)=(k+1)^{2}\) ……(1) We shall now prove that P(k + 1) is true. Consider \(\left[\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right) \dots\left(1+\frac{(2 k+1)}{k^{2}}\right)\right]\left\{1+\frac{\
{2(k+1)+1\}}{(k+1)^{2}}\right\}\) \(=(k+1)^{2}\left(1+\frac{2(k+1)+1}{(k+1)^{2}}\right)\) [(Using (1)] \(\begin{array}{l}{=(k+1)^{2}\left[\frac{(k+1)^{2}+2(k+1)+1}{(k+1)^{2}}\right]} \\ {=(k+1)^{2}+2(k+1)+1} \\ {=\{(k+1)+1\}^{2}}\end{array}\) Thus, P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n)
is true for all natural numbers i.e., n. Page 21 Search More Ncert Solutions Q14. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right) \dots\left(1+\frac{1}{n}\right)=(n+1)\) Answer. Let the given statement be P(n), i.e., P(n): \(\left(1+\frac{1}
{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right) \dots\left(1+\frac{1}{n}\right)=(n+1)\) For n = 1, we have \(\mathrm{P}(1) :\left(1+\frac{1}{1}\right)=2=(1+1)\), which is true Let P(k) be true for some positive integer k, i.e., \(\mathrm{P}(k) :\left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right) \dots\left(1+\frac{1}{k}\right)=
(k+1)\) ……….(1) We shall now prove that P(k + 1) is true. Consider \(\left[\left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right) \dots\left(1+\frac{1}{k}\right)\right]\left(1+\frac{1}{k+1}\right)\) \(=(k+1)\left(1+\frac{1}{k+1}\right)\) [Using(1)] \(\begin{array}{l}{=(k+1)\left(\frac{(k+1)+1}{(k+1)}\right)} \\ {=(k+1)+1}\end{array}\) Thus,
P(k + 1) is true whenever P(k) is true. Hence, by the principle of mathematical induction, statement P(n) is true for all natural numbers i.e., n. Page 22 Search More Ncert Solutions Q1. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1+3+3^{2}+\ldots+3^{a-1}=\frac{\left(3^{n}-1\right)}{2}\) Answer. \
(\begin{array}{l}{\text { Let the given statement be } P(n), \text { i.e., }} \\ {P(n) : 1+3+3^{2}+\ldots+3^{n-1}=\frac{\left(3^{n}-1\right)}{2}} \\ {\text { For } n=1, \text { we have }} \\ {P(1) : 1=\frac{\left(3^{\prime}-1\right)}{2}=\frac{3-1}{2}=\frac{2}{2}=1}\end{array}\) , which is true \(\begin{array}{l}{\text { Let } P(k) \text { be true for some positive
integer } k, \text { i.e., }} \\ {1+3+3^{2}+\ldots+3^{k-1}=\frac{\left(3^{k}-1\right)}{2}} \\ {\text { We shall now prove that } P(k+1) \text { is true. }} \\ {\text { Consider }} \\ {1+3+3^{2}+\ldots+3^{k-1}+3^{(k+1)-1}} \\ {=\left(1+3+3^{2}+\ldots+3^{k-1}\right)+3^{k}}\end{array}\) \(\begin{array}{l}{=\frac{\left(3^{t}-1\right)}{2}+3^{k}} \\ {=\frac{\left(3^{t}-
1\right)+2.3^{k}}{2}}\end{array}\) [using (i)] \(=\frac{(1+2) 3^{k}-1}{2}\) \(\begin{aligned} &=\frac{3.3^{k}-1}{2} \\ &=\frac{3^{k+1}-1}{2} \end{aligned}\) \(\begin{array}{l}{\text { Thus, } P(k+1) \text { is true whenever } P(k) \text { is true. }} \\ {\text { Hence, by the principle of mathematical induction, statement } P(n) \text { is true for all natural }} \\
{\text { numbers I.e., }}\end{array}\) Page 23 Search More Ncert Solutions Q2. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1^{3}+2^{3}+3^{3}+\ldots+n^{3}=\left(\frac{n(n+1)}{2}\right)^{2}\) Answer. \(\begin{array}{l}{\text { Let the given statement be } P(n), \text { i.e., }} \\ {\quad
1^{3}+2^{3}+3^{3}+\ldots+n^{3}=\left(\frac{n(n+1)}{2}\right)^{2}} \\ {\text { For } n=1, \text { we have }} \\ {\text { For } n=1, \text { we have }} \\ {P(1) : 1^{3}=1=\left(\begin{array}{c}{1(1+1)} \\ \hline\end{array}\right.^{2}=\left(\frac{1.2}{2}\right)^{2}=1^{2}=1}\end{array}\) , which is true. \(\begin{array}{l}{\text { Let } P(k) \text { be true for some
positive integer } k, \text { I.e., }} \\ {1^{3}+2^{3}+3^{3}+\ldots \ldots+k^{3}=\left(\frac{k(k+1)}{2}\right)^{2}} \\ {\text { We shall now prove that } P(k+1) \text { is true. }} \\ {\text { Consider }} \\ {1^{3}+2^{3}+3^{3}+\ldots+k^{3}+(k+1)^{3}}\end{array}\) \(=\left(\frac{k(k+1)}{2}\right)^{2}+(k+1)^{3} \quad[\text { Using }(i)]\) \(\begin{aligned} &=\frac{k^{2}
(k+1)^{2}}{4}+(k+1)^{3} \\ &=\frac{k^{2}(k+1)^{2}+4(k+1)^{3}}{4} \\ &=\frac{(k+1)^{2}\left\{k^{2}+4(k+1)\right\}}{4} \end{aligned}\) \(\begin{array}{l}{=\frac{(k+1)^{2}\left\{k^{2}+4 k+4\right\}}{4}} \\ {=\frac{(k+1)^{2}(k+2)^{2}}{4}} \\ {=\frac{(k+1)^{2}(k+1+1)^{2}}{4}}\end{array}\) \(=\left(1^{3}+2^{3}+3^{3}+\ldots .+k^{3}\right)+(k+1)^{3}=\left(\frac{(k+1)
(k+1+1)}{2}\right)^{2}\) \(\begin{array}{l}{\text { Thus, } P(k+1) \text { is true whenever } P(k) \text { is true. }} \\ {\text { Hence, by the principle of mathematical induction, statement } P(n) \text { is true for all natural }} \\ {\text { numbers I.e., }}\end{array}\) Page 24 Search More Ncert Solutions Q3. Prove the following by using the principle of
mathematical induction for all n ∈ N: \(1+\frac{1}{(1+2)}+\frac{1}{(1+2+3)}+\ldots+\frac{1}{(1+2+3+\ldots n)}=\frac{2 n}{(n+1)}\) Answer. \(\begin{array}{l}{\text { Let the given statement be } P(n), \text { i.e., }} \\ {\text { P(n): } 1+\frac{1}{1+2}+\frac{1}{1+2+3}+\ldots+\frac{1}{1+2+3+\ldots n}=\frac{2 n}{n+1}} \\ {\text { For } n=1, \text { we have }}
\\ {P(1) : 1=\frac{2.1}{1+1}=\frac{2}{2}=1} \\ {\text { Let } P(k) \text { be true for some positive integer } k, \text { i.e., }}\end{array}\) \(1+\frac{1}{1+2}+\ldots+\frac{1}{1+2+3}+\ldots+\frac{1}{1+2+3+\ldots+k}=\frac{2 k}{k+1}\)............(i) \(\begin{array}{l}{\text { We shall now prove that } \mathrm{P}(k+1) \text { is true. }} \\ {\text { Consider }} \\
{1+\frac{1}{1+2}+\frac{1}{1+2+3}+\ldots+\frac{1}{1+2+3+\ldots+k}+\frac{1}{1+2+2+k+(k+1)}}\end{array}\) \(\begin{array}{l}{=\left(1+\frac{1}{1+2}+\frac{1}{1+2+3}+\ldots+\frac{1}{1+2+3+. k}\right)+\frac{1}{1+2+3+\ldots+k+(k+1)}} \\ {=\frac{2 k}{k+1}+\frac{1}{1+2+3+\ldots+k+(k+1)}} \quad \quad[\text { Using (i) }]}\end{array}\) \(=\frac{2 k}
{k+1}+\frac{1}{\left(\frac{(k+1)(k+1+1)}{2}\right)}\) \(\left[1+2+3+\ldots+n=\frac{n(n+1)}{2}\right]\) \(\begin{array}{l}{=\frac{2 k}{(k+1)}+\frac{2}{(k+1)(k+2)}} \\ {=\frac{2}{(k+1)}\left(k+\frac{1}{k+2}\right)}\end{array}\) Page 25 Q1. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1+3+3^{2}+\ldots+3^{a-
1}=\frac{\left(3^{n}-1\right)}{2}\) Q2. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1^{3}+2^{3}+3^{3}+\ldots+n^{3}=\left(\frac{n(n+1)}{2}\right)^{2}\) Q3. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1+\frac{1}{(1+2)}+\frac{1}{(1+2+3)}+\ldots+\frac{1}{(1+2+3+\ldots
n)}=\frac{2 n}{(n+1)}\) Q4. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.2.3+2.3 .4+\ldots+n(n+1)(n+2)=\frac{n(n+1)(n+2)(n+3)}{4}\) Q5. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.3+2.3^{2}+3.3^{3}+\ldots+n 3^{n}=\frac{(2 n-1) 3^{n+1}+3}{4}\) Q6. Prove the
following by using the principle of mathematical induction for all n ∈ N: \(1.2+2.3+3.4+\ldots+n .(n+1)=\left[\frac{n(n+1)(n+2)}{3}\right]\) Q7. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1.3+3.5+5.7+\ldots+(2 n-1)(2 n+1)=\frac{n\left(4 n^{2}+6 n-1\right)}{3}\) Q8. Prove the following by using the principle
of mathematical induction for all n ∈ N: \(1.2+2.2^{2}+3.2^{3}+\ldots+n .2^{\circ}=(n-1) 2^{n+1}+2\) Q9. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots+\frac{1}{2^{n}}=1-\frac{1}{2^{n}}\) Q10. Prove the following by using the principle of mathematical induction for all
n ∈ N: \(\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots+\frac{1}{(3 n-1)(3 n+2)}=\frac{n}{(6 n+4)}\) Q11. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{1.2.3}+\frac{1}{2.3.4}+\frac{1}{3.4.5}+\ldots+\frac{1}{n(n+1)(n+2)}=\frac{n(n+3)}{4(n+1)(n+2)}\) Q12. Prove the following by using the principle of
mathematical induction for all n ∈ N: \(a+a r+a r^{2}+\ldots+a r^{n-1}=\frac{a\left(r^{n}-1\right)}{r-1}\) Q13. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right) \dots\left(1+\frac{(2 n+1)}{n^{2}}\right)=(n+1)^{2}\) Q14. Prove the following by
using the principle of mathematical induction for all n ∈ N: \(\left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right) \dots\left(1+\frac{1}{n}\right)=(n+1)\) Q15. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1^{2}+3^{2}+5^{2}+\ldots+(2 n-1)^{2}=\frac{n(2 n-1)(2 n+1)}{3}\) Q16. Prove the
following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+\ldots+\frac{1}{(3 n-2)(3 n+1)}=\frac{n}{(3 n+1)}\) Q17. Prove the following by using the principle of mathematical induction for all n ∈ N: \(\frac{1}{3.5}+\frac{1}{5.7}+\frac{1}{7.9}+\ldots+\frac{1}{(2 n+1)(2 n+3)}=\frac{n}{3(2
n+3)}\) Q18. Prove the following by using the principle of mathematical induction for all n ∈ N: \(1+2+3+\ldots+n Q19. Prove the following by using the principle of mathematical induction for all n ∈ N: \(n(n+1)(n+5) \text { is a multiple of } 3\) Q20. Prove the following by using the principle of mathematical induction for all n ∈ N: \(10^{1 n-
1}+1 \text { is divisible by } 11\) Q21. Prove the following by using the principle of mathematical induction for all n ∈ N: \(x^{2 x}-y^{3 n} \text { is divisible by } x+y\) Q22. Prove the following by using the principle of mathematical induction for all n ∈ N: \(3^{2 n+2}-8 n-9 \text { is divisible by } 8\) Q23. Prove the following by using the principle
of mathematical induction for all n ∈ N: \(41^{n}-14^{n} \text { is a multiple of } 27\) Q24. Prove the following by using the principle of mathematical induction for all n ∈ N: \((2 n+7) class 11 principle of mathematical induction exercise 4.1

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