# WORKSHEET XI MATHEMATICAL INDUCTION

Prove the following by the principal of mathematical induction $\forall\, n \in N$

1. $1 + 3 + 5 + \ldots\ldots\ldots + (2n-1) = n^2$
2. $5 + 15 + 45 + \ldots\ldots\ldots + 5.3^{n-1} = 5/2\,(3^n - 1)$.
3. $3.6 + 6.9 + 9.12 + \ldots\ldots\ldots + 3n\,(3n+3) = 3n\,(n+1)(n+2)$
4. $1.3 + 3.5 + 5.7 + \ldots\ldots\ldots + (2n-1)(2n+1) = n\,(4n^2 + 6n - 1)/3$.

5. $\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \ldots\ldots\ldots + \frac{1}{(2n-1)(2n+1)} = \frac{n}{2n+1}$.
6. $a + (a+d) + (a+2d) + \ldots\ldots\ldots + (a+(n-1)d) = n/2\,(2a + (n-1)d)$.
7. $\frac{1}{1} + \frac{1}{1+2} + \frac{1}{1+2+3} + \ldots\ldots\ldots + \frac{1}{1+2+3+\cdots\ n} = \frac{2n}{n+1}$.
8. $X^n - Y^n$ is divisible by $x - y$
9. $4^n + 15n - 1$ is divisible by 9.
10. $3^{4n+1} + 2^{2n+2}$ is divisible by 7.

11. $11^{n+2} + 12^{2n+1}$ is divisible by 133.
12. $2.7^n + 3.5^n - 5$ is divisible by 24.
13. $n(n+1)(n+2)$ is divisible by 6.
14. $2^n < 3^n$
15. Use this inequality $2n + 7 < (n+3)^2$, $\forall\, n \in N$ and prove that $(n+3)^2 \leq 2^{n+3}$.