Induction Problems - Assignment #1a

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Instructions. Prove the following by Mathematical Induction:

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

   i.e. $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$

2. $1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$

   i.e. $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$

3. $1 + x + x^2 + x^3 + \ldots + x^n = \frac{x^{n+1}-1}{x-1}$; where $x \neq 1$.

   i.e. $\sum_{i=0}^{n} x^i = \frac{x^{n+1}-1}{x-1}$; where $x \neq 1$.

4. $1 + 3 + 5 + \ldots + (2n-1) = n^2$

   i.e. $\sum_{i=1}^{n} (2i-1) = n^2$

5. $2 + 4 + 6 + \ldots + 2n = n^2 + n$

   i.e. $\sum_{i=1}^{n} 2i = n^2 + n$

6. $1 + 5 + 9 + \ldots + (4n-3) = 2n^2 - n$

   i.e., $\sum_{i=1}^{n} (4i-3) = 2n^2 - n$

7. $3 + 7 + 11 + \ldots + (4n-1) = 2n^2 + n$

   i.e., $\sum_{i=1}^{n} (4i-1) = 2n^2 + n$

8. $2 + 6 + 10 + \ldots + (4n-2) = 2n^2$

   i.e., $\sum_{i=1}^{n} (4i-2) = 2n^2$

9. $1^3 + 2^3 + 3^3 + \ldots + n^3 = \frac{n^2(n+1)^2}{4}$

   i.e. $\sum_{i=1}^{n} i^3 = \frac{n^2(n+1)^2}{4}$