Template for Proofs by Mathematical Induction

1. Express the statement that is to be proved in the form "for all n ≥ b, P(n)" for a fixed integer b.
2. Write out the words "Basic Step." Then show that P(b) is true, taking care that the correct value b is used. This completes the first part of the proof.
3. Write out the words "Inductive step."
4. State, and clearly identify, the inductive hypotheses, in the form "assume that P(k) is true for an arbitrary fixed integer k ≥ b."
5. State what needs to be proved under the assumption that the inductive hypothesis is true. That is, write out what P(k+1) says.
6. Prove the statement P(k+1) making use of the assumption P(k). Be sure that your proof is valid for all integers with k ≥ b, taking care that the proof for small values of k, including k=b.
7. Clearly identify the conclusion of the inductive step, such as "this completes the inductive step."
8. After completing the basic and inductive steps, state the conclusion, namely that by mathematical induction, P(n) is true for all integers n ≥ b.

Sequences and summations:

1) Arithmetic sequence: 2, 5, 8, 11, …
a_0 initial term/value, $a_0 = 2$;
d is common difference, d = 3
$a_n = a_0 + d \cdot n$ is n^{th} term

2) Geometric sequence: 2, 6, 18, 54, ...
a_0 is initial term/value, $a_0 = 2$
r is common ratio, r = 3
$a_n = a_0 \cdot r^n$ is n^{th} term

Partial sums:

$$S_n = \sum_{i=0}^{n-1} a_i = \frac{(a_0 + a_{n-1})n}{2}$$

$$S_{k-s+1} = \sum_{i=s}^{k} a_i = \frac{(a_s + a_k)(k-s+1)}{2} = \frac{(first + last)\, numberOfValues}{2}$$

$$S_n = \sum_{i=0}^{n-1} (c+di) = (c) + (c+d) + (c+2d) + \ldots + (c+(n-1)d) = nc + d\frac{(n-1)n}{2}$$

$$S_n = a_0 + a_0 r + a_0 r^2 + \ldots + a_o r^{n-1} = \sum_{i=0}^{n-1} a_0 r^i = \frac{a_0(r^n - 1)}{r-1}$$

$$S_n = a_0 + a_0 r + a_0 r^2 + \ldots + a_o r^n = \frac{a_0(r^{n+1} - 1)}{r-1}$$

Other useful summation formulas:

$$\sum_{i=0}^{n-1} C = \sum_{i=1}^{n} C = nC$$, where C is a constant

$$1 + 2 + \ldots + n = \sum_{i=1}^{n} i = \frac{(1+n)n}{2} = \frac{(first + last)\, numberOfValues}{2}$$