

1) Using induction prove the following equality

$$a) \sum_{k=1}^n (5k-4) = \frac{n(5n-3)}{2}$$

$$b) \sum_{k=1}^n (2k-1) = n^2$$

$$c) \sum_{k=1}^n k^2 = \frac{n(n+1)(2n+1)}{6}$$

2) Let  $a_n = \cos\left(\frac{n\pi}{4}\right) \cdot (n^2 - 3n)$ . Determine a divergent subsequence.

3) Let  $a_n = \sin(n)$ . Determine if

- $\{a_n\}$  is bounded
- $\{a_n\}$  is monotone

•  $\exists$  a subsequence that is convergent

4) Let  $a_n = \sin\left(\frac{n\pi}{8}\right)$ . Say which of the following are true

4.1) ~~True~~ It is bounded.

4.2) It is convergent.

4.3) The sequence is constant

4.4) There exists a subsequence which is convergent

4.5)  $a_{100} = -1$

4.6)  $a_n^2$  is a constant sequence.

5) Construct a sequence which is not monotone but that is convergent.

6) Prove that  $\binom{n}{n} = 1$  and  $\binom{n+1}{k} = \binom{n}{k-1} + \binom{n}{k}$ .

7) Solve for  $n \in \mathbb{N}$   $4 \binom{n}{4} = 15 \binom{n-2}{3}$   
 $n \geq 2$ .