

TRANSITION TO MATHEMATICAL PROOFS

CHAPTER 6 - INDUCTION ASSIGNMENT

INSTRUCTIONS: For the below questions, show all of your work. For the proofs, be sure that you

- (i) write a complete proof in full English sentences;
- (ii) if hand-writing, write legibly and clearly.

Question 1. Let $r \neq 1$ be a real number. Use mathematical induction to show that

$$\sum_{j=0}^n r^j = \frac{1 - r^{n+1}}{1 - r}.$$

Question 2. Consider the function $f(x) = \frac{1}{1-x}$.

- (a) Compute the first several derivatives of f and use them to conjecture a pattern for $f^{(n)}(x)$.
- (b) Prove that your conjectured pattern for $f^{(n)}(x)$ is indeed true by using a proof by induction.

Question 3. Let $x > -1$. Use mathematical induction to prove that

$$(1+x)^n \geq 1+nx$$

for all integers $n \geq 1$.