

Instructions:

Please write your answers on separate paper. Please write clearly and legibly, using a large font and plenty of white space (I need room to put my comments). Staple all your pages together, with your problems in order, when you turn in your exam. Please don't write under the staple. Make clear what work goes with which problem. Put your name or initials on every page. To get credit, you must show adequate work to justify your answers. If unsure, show the work. Simplify your answers, except you may leave any number of more than three digits (like 123×456 or 15^4) unsimplified. No outside materials are permitted on this exam – no notes, papers, books, calculators, phones, smartwatches, or computers – only pens and pencils, and your coursepack. You may use any result in the coursepack (whether boxed or an exercise). However, you must cite it, and you may not use it to prove itself (or a portion/special case of itself). **CHOOSE FIVE PROBLEMS OUT OF THE FOLLOWING SIX TO COMPLETE – IF YOU TURN IN ALL SIX YOUR SCORE WILL BE FROM FIVE THAT ARE CHOSEN RANDOMLY.** Each problem is out of 10 points, 50 points maximum. You have 75 minutes.

1. Compute, with proof, $\Delta(n^{\bar{a}} + n^{\underline{a}})$, for $a \in \mathbb{N}_0$.
2. Prove the quotient rule $\Delta \frac{F(n)}{G(n)} = \frac{G(n)\Delta F(n) - F(n)\Delta G(n)}{G(n)G(n+1)}$.
3. Use the FTDC to compute $\sum_{i=10}^{20} \binom{i}{4}$.
4. Use the FTDC to find, with proof, a formula for the sum of the first k fifth powers. Simplify for 1 point of extra credit.
5. Use the FTDC to compute $\sum_{n=5}^{\infty} \frac{1}{(n-2)(n-1)n(n+1)}$.
6. Use summation by parts to compute $\sum_{n=0}^{20} n^{\bar{2}}n^{\underline{3}}$.