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1. Find the first three non-zero terms, and the general term, of the Taylor series of  $f(x) = \frac{1}{1+3x}$  around  $x = 1$  (*not around*  $x = 0$ ). (3 points)

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2. Recall that  $\frac{d}{dx} \arctan(x) = \frac{1}{1+x^2}$ . Use the Taylor series for  $\frac{1}{1-x}$  (around  $x = 0$ ) to find the Taylor series for  $\arctan(x)$ . Without calculating it, what would you expect the radius of convergence of your new series to be? (4 points)

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3. For what values of  $n$ , if any, is  $y = x^n$  a solution to the differential equation  $x^2 \frac{d^2 y}{dx^2} - 2y = 0$ ? (3 points)