4. [9 points] We can define the Bessel function of order one by its Taylor series about \( x = 0 \),
\[
J_1(x) = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{n!(n+1)!2^{n+1}}.
\]

a. [3 points] Compute \( J_1^{(2015)}(0) \). Write your answer in exact form and do not try evaluate
using a calculator.

\[
J_1^{(2015)}(0) = \underline{\phantom{0000}}
\]

b. [4 points] Find \( P_5(x) \), the Taylor polynomial of degree 5 that approximates \( J_1(x) \) near
\( x = 0 \).

\[
P_5(x) = \underline{\phantom{0000}}
\]

c. [2 points] Use the Taylor polynomial from the previous part to compute
\[
\lim_{x \to 0} \frac{J_1(x) - \frac{1}{2}x}{x^3}.
\]

\[
\lim_{x \to 0} \frac{J_1(x) - \frac{1}{2}x}{x^3} = \underline{\phantom{0000}}
\]