1. Evaluate the following integrals:

   (a) \( \int_{0}^{\infty} x^2 e^{-x} \, dx \)

   (b) \( \int_{0}^{1} \frac{x^3}{\sqrt{1-x^2}} \, dx \)
2. In each case, find the limit of the sequence \( \{a_n\} \):

(a) \( a_n = \frac{\sin(n)}{n^2} + \frac{4^n + 2^n}{4^n + e^n} \)

(b) \( a_n = n^2 e^{-n} + \frac{n^2 - 3}{n^2 + 4} \)

3. For \( n \geq 1 \), let \( A_n \) count the number of ways to write the number \( n \) as a sum of 1s, 2s, or 3s, where order matters. In other words, 1 + 1 + 2, 1 + 2 + 1, 2 + 1 + 1, 1 + 3, and 3 + 1 are distinct.

(a) Find \( A_1 \), \( A_2 \), and \( A_3 \) by inspection.

(b) Find a recursive formula for \( A_n \).

(c) Use your recursive formula to find \( A_{10} \).