1. [10 points] Rewrite the following sum as indicated.

\[ \sum_{k=4}^{101} (k^3 - 1)^2 = \sum_{j=9}^{?} \]

2. [15 points] Find the derivative of \( G(x) = \int_{3x}^{5x} \sin (t^2) \, dt \) using part 1 of the Fundamental Theorem of Calculus.

3. [15 points] Do one (1) of the following. Do not use your calculator.

1. (a) Evaluate \( \int (2t^2 + 1 - 3t\sqrt{2} + 5\sec^2(t) + 6\sec(t)\tan(t) + \frac{4}{1 + t^2}) \, dt \)

(b) Verify the formula \( \int \arcsin(ax) \, dx = x\arcsin(ax) + \frac{1}{a}\sqrt{1 - a^2x^2} + C \) where \( a \) is a constant by differentiating the right hand side.

4. [5, 5, 10 points] If we use the partition points \( x_0 < x_1 < x_2 < \cdots < x_n \) to partition the interval \([2, 5]\) into \( n \) subintervals of equal length

1. (a) What is the value of \( \Delta x \) in terms of the letter \( n \)?

(b) Write the values of \( x_0, x_1, x_2, \ldots, x_n \) in terms of the letter \( n \).

(c) Use sigma notation to write, in terms of the letter \( n \), the Riemann sum for the function \( f(x) = x + x^2 \) that uses the \textbf{left} endpoint of each subinterval as the value of \( c_k \). \textbf{Do not simplify this Riemann Sum.}

5. [10 points each] Do both of the following. Do not use your calculator. [Useful information: \( \cos(\pi/3) = 1/2 \) and \( \cos(\pi/4) = 1/\sqrt{2} \).

1. (a) Evaluate \( \int \frac{\sqrt{\arcsin(x)}}{\sqrt{1-x}} \, dx \)

(b) Evaluate \( \int_{2/\sqrt[3]{3}}^{3/\sqrt[3]{3}} \frac{dy}{|y/\sqrt{y^2-1}|} \)

6. [10 points each] Write out definite integrals that give the volumes of both of the following. \textbf{Do not evaluate the integrals.}

1. (a) The solid:
   i. with base the region in the \( xy \)-plane between the curve \( y = 4\sin(x) \) and the interval \([0, \pi]\) on the \( x \)-axis
   ii. with cross-sections perpendicular to the \( x \)-axis that are squares with one side running from the \( x \)-axis to the curve.

(b) The solid obtained by revolving the region in the first quadrant bounded by \( y = x^2 \) and \( y = 2x \) about the vertical line \( x = 3 \).