This exam contains 4 numbered problems on 6 pages of paper. Check to see if any pages are missing.

A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit; an incorrect answer supported by substantially correct calculations and explanations will receive partial credit. NO CALCULATORS are permitted. good luck.

You may like to use the following trigonometric identities:

\[
\sin(A + B) = \sin A \cos B + \cos A \sin B
\]
\[
\cos(A + B) = \cos A \sin B - \sin A \cos B
\]
\[
\sin^2(A/2) = (1 - \cos A)/2
\]
\[
\cos^2(A/2) = (1 + \cos A)/2
\]
\[
\sin A \cos B = \frac{1}{2} [\sin(A - B) + \sin(A + B)]
\]
\[
\sin A \sin B = \frac{1}{2} [\cos(A - B) - \cos(A + B)]
\]
\[
\cos A \cos B = \frac{1}{2} [\cos(A - B) + \cos(A + B)]
\]

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1. (25 points) What is the distance traveled along the path $x(t) = t^4 + \sin t$, $y(t) = t^7 + 1$ from $t = 1$ to $t = 4$? Write your answer as an integral. Show any general formulas you are using.
2. (25 points) What is the solution of \( x^2y' = y - y' \) with \( y(0) = -2 \)? Write the answer as a function of \( x \). Show your work.
3. (25 points) What is the centroid of the region lying between \( f(x) = x^2 + 6x - 5 \) and \( g(x) = 2x^2 \)?

You can write your answer in terms of integrals. Write down any formulas you are using.
4. (25 points) Find the area of the region that lies inside $r = 1 - \sin \theta$ and outside $r = 1$. Make a sketch of both curves on the graph provided below. Show any formulas you are using.