Math 1432

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Class webpage:
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\[ \int \sec^3(x) \, dx \]
To summarize trig sub:

**Given:**

\[ \sqrt{a^2 + x^2} \]

\[ \sqrt{a^2 - x^2} \]

**Use:**

\[ \sqrt{x^2 - a^2} \]
Examples:

\[ \int \sqrt{16-x^2} \, dx \]
\[ \int \frac{1}{x^2 \sqrt{49 + x^2}} \, dx \]
\[ \int_{0}^{1/2} \frac{x^2}{\left(1 - x^2\right)^{3/2}} dx \]
\[ \int \sqrt{2 - x^2 + 4x} \, dx \]
1. \[ \int \frac{x^2 + 1}{x^3 + 3x - 4} \, dx \]

2. \[ \int \frac{x^3 - 5}{x} \, dx \]
Rational Functions and Partial Fraction Decomposition

Rational functions are defined as functions in the form \( R(x) = \frac{F(x)}{G(x)} \), where \( F(x) \) and \( G(x) \) are polynomials.

Rational functions are said to be proper if the degree of the numerator is less than the degree of the denominator (otherwise they are improper).

**Theorem:**

If \( F(x) \) and \( G(x) \) are polynomials and the degree of \( F(x) \) is larger than or equal to the degree of \( G(x) \), then there are polynomials \( q(x) \) (quotient) and \( r(x) \) (remainder) such that

\[
\frac{F(x)}{G(x)} = q(x) + \frac{r(x)}{G(x)}
\]

where the degree of \( r(x) \) is smaller than the degree of \( G(x) \).
Example:

Write \( \frac{x^5 + 1}{x^3 - x^2 - 2x} \) in terms of its quotient and remainder.
Write $\frac{x^2 + x - 1}{x^2 + 1}$ in terms of its quotient and remainder.

Compute: $\int \frac{x^2 + x - 1}{x^2 + 1} \, dx$
Compute: \[ \int \frac{3x^3 - 2}{x^2 + 4} \, dx \]
3. \[ \int \tan^2(x) \, dx = \]

4. \[ \int x \sin(x) \, dx = \]

5. If you have an integral with the substitution \( x = 2 \sin(\theta) \) and after integration get the answer \( \frac{1}{2} \theta - 4 \cos(\theta) + C \), what is the answer in terms of \( x \)?