**CALCULUS REFRESHER:**
**INTEGRATION BY SUBSTITUTION**

The following guideline summarizes the steps involved in u-substitution method:

**INTEGRATION BY SUBSTITUTION**

Choose a new variable $u$. Usually try choosing $u$ to be some complicated part of the integrand whose derivative is also in the integrand.

Compute $du$.

Replace all terms in the original integrand with expressions involving $u$ and $du$.

Evaluate the resulting $u$ integrand. (If you can’t, you may need to try a different $u$ or a different method of integration.)

Replace $u$ with the corresponding expression in $x$.

**Example:** Evaluate $\int \frac{x}{x^2 + 2} \, dx$

We would choose $u = x^2 + 2$ since its derivative is $2x$ and we can write the entire expression in terms of $u$ and $du$.

\[
\begin{align*}
  u &= x^2 + 2 \\
  du &= 2x \, dx \\
  \frac{du}{2} &= x \, dx
\end{align*}
\]

When substituting we should get the entire expression in terms of $u$ and $du$.

\[
\begin{align*}
  \int \frac{x}{x^2 + 2} \, dx &= \int \frac{du}{u} \\
  &= \frac{1}{2} \ln |u| + C \\
  &= \frac{1}{2} \ln (x^2 + 2) + C
\end{align*}
\]

**Now you try it!**

Evaluate:

\[
\int x^3 \sqrt{x^4 + 5} \, dx
\]

**Answer:** $\frac{(x^4 + 5)^{3/2}}{6} + C$