Work carefully and neatly. You must show all relevant work! You may receive no credit if there is insufficient work. Graphing calculators are not allowed!

[4] 1. Sketch the region bounded by the curves \( y = 2x \) and \( y = x^2 \). Then, using the method of cylindrical shells, set up, but do not evaluate the integral for the volume when this region is rotated about the line \( x = -1 \).

\[
\begin{align*}
\text{Vol of shell} & = 2\pi rh \Delta x \\
0 &= x^2 - 2x \\
0 &= x(x-2) \\
x &= 0, x = 2
\end{align*}
\]

\[
\begin{align*}
\gamma_1 &= 2x \quad \gamma_2 &= x^2 \\
V &= 2\pi \int (x^2 - x) \, dx
\end{align*}
\]

\[
\text{Ans} = 2\pi \int_0^2 (x^2 - x^3) \, dx
\]

[3] 2. Evaluate \( \int_1^2 t \ln t \, dt \)

\[
\begin{align*}
u &= \ln t \\
dv &= t \, dt \\
u' &= \frac{1}{t} \\
v' &= \frac{1}{2} t^2 \\
= uv - \int v \, du &= \frac{1}{2} t^2 \ln t - \frac{1}{2} \int t \, dt \\
= \frac{1}{2} t^2 \ln t - \frac{1}{4} t^2 & \bigg|_1^2 = (2\ln 2 - 1) - (0 - \frac{1}{4}) \\
&= 2\ln 2 - \frac{3}{4}
\end{align*}
\]

[3] 3. Evaluate \( \int \sin^3 x \cos^2 x \, dx \)

\[
\begin{align*}
&= \int \sin x (\sin^2 x) \cos^2 x \, dx \\
&= \int \frac{\sin x (1 - \cos^2 x)}{\cos^2 x} \, dx \\
u &= \cos x \\
du &= -\sin x \, dx \\
= - \int (1 - u^2) u^2 \, du &= -\int u^4 - u^2 \, du \\
&= -\frac{1}{5} u^5 + \frac{1}{3} u^3 \\
&= \frac{1}{5} (\cos^5 x) - \frac{1}{3} \cos^3 x + C
\end{align*}
\]