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Mathematical Solution
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PROBLEM

integrate x^2 * ln(x)

We need to find the indefinite integral of the function $x^{2} \cdot \ln(x)$. This involves using integration by parts, a technique that allows us to differentiate one part of the function and integrate the other.

✅ **VERIFIED ANSWER**

$$\frac{x^3 \cdot (3\ln(x) - 1)}{9} + C$$

📚 Step-by-Step Solution

1 Choose u and dv

Let's choose $u = \ln(x)$ and $dv = x^2 dx$. This means we'll differentiate u and integrate dv.

2 Differentiate u and Integrate dv

Differentiating $u = \ln(x)$ gives us $\frac{du}{dx} = \frac{1}{x}$, and integrating $dv = x^2 dx$ gives us $v = \frac{x^3}{3}$.

3 Apply Integration by Parts Formula

The integration by parts formula is $\int u \cdot dv = u \cdot v - \int v \cdot \frac{du}{dx}$. Plugging in our values, we get:

$$\int x^2 \cdot \ln(x) dx = \ln(x) \cdot \frac{x^3}{3} - \int \frac{x^3}{3} \cdot \frac{1}{x} dx$$

4 **Simplify the Integral**

Simplifying the integral on the right-hand side, we get:

$$\int x^2 \cdot \ln(x) dx = \frac{x^3 \ln(x)}{3} - \int \frac{x^2}{3} dx$$

5 **Integrate the Remaining Term**

Integrating the remaining term, we get:

$$\int x^2 \cdot \ln(x) dx = \frac{x^3 \ln(x)}{3} - \frac{x^3}{9} + C$$

6 **Combine the Terms**

Combining the terms, we get:

$$\int x^2 \cdot \ln(x) dx = \frac{x^3 \ln(x)}{3} - \frac{x^3}{9} + C$$

7 **Factor Out the Common Term**

Factoring out the common term, we get:

$$\int x^2 \cdot \ln(x) dx = \frac{x^3}{9} (3 \ln(x) - 1) + C$$

Therefore, the answer is:

$$\frac{x^3 \cdot (3 \ln(x) - 1)}{9} + C$$

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