In-Class Assignment 5: Integration by Parts

**Directions:** Work neatly on a separate sheet of paper. Your group will hand in one write-up with everyone’s name on it. **DO NOT** fold the corner over to hold everything together!

Work together on each problem; do not delegate different problems to different people.

On this worksheet, we will develop a way to “undo” the product rule. The technique is called integration by parts.

1. Recall the **Product Rule**: \[ \frac{d}{dx} (f(x)g(x)) = f'(x)g(x) + g'(x)f(x) \]. What is \( \int (f'(x)g(x) + g'(x)f(x)) \, dx \)?

2. To simplify the notation, let \( u = f(x) \) and \( v = g(x) \). Translate your work from Problem 1 into terms of \( u \) and \( v \). If you see \( u' \, dx \), rewrite it as \( du \); if you see \( v' \, dx \), rewrite it as \( dv \).

3. Suppose you encounter an integral of the form \( \int uv' \, dx = \int udv \). Using your work from Problem 1, find another expression for this integral. This is the Integration by Parts formula.

4. Apply the integration by parts formula to integrate.
   - (a) \( \int 2xe^x \, dx \). (Which factor plays the role of \( u \)? Which factor plays the role of \( dv = v' \, dx \)?)
   - (b) \( \int_0^{\pi/2} t \cos t \, dt \)
   - (c) \( \int x \ln x \, dx \)
   - (d) \( \int \ln x \, dx \)
   - (e) \( \int 6x^2 \cos x \, dx \)
   - (f) \( \int e^x \sin x \, dx \)