1. Find the following. [See Review for Exam II for integration tips and strategies.]

(a) \( \int 12x^2 \cos(x^3) \, dx \)

(b) \( \int_0^\infty xe^{-3x} \, dx \)

(c) \( \int_0^6 \frac{dx}{(x-4)^2} \)

(d) \( \int \frac{3x^2 + 2x - 5}{(x^2 + 1)(x - 4)} \, dx \)

(e) \( \int_0^{\pi/3} \tan^3 x \sec^5 x \, dx \)
(f) \( \int \sqrt{25-x^2} \, dx \)

2. Find the best possible left, right, midpoint, trapezoidal, and Simpson’s approximations to \( \int_{-2}^{0} f(x) \, dx \) given the data in the table below.

<table>
<thead>
<tr>
<th>x</th>
<th>-2</th>
<th>-1.5</th>
<th>-1</th>
<th>-0.5</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

3. If you use numerical integration to estimate \( \int_{a}^{b} \ln x \, dx \), how would the following be ordered from least to greatest? \( L_{100}, R_{100}, M_{100}, T_{100}, S_{200} \).

What can you say with certainty about where \( \int_{a}^{b} \ln x \, dx \) would fit into your ordering?
4. Find bounds for each of the following errors if \( I = \int_0^2 e^{-5x} \, dx \).

(a) \( |I - R_{100}| \)

(b) \( |I - T_{100}| \)

(c) \( |I - M_{100}| \)

5. If \( I = \int_0^2 e^{-5x} \, dx \), how many subdivisions are required to obtain a midpoint sum approximation with error of at most 1/1,000,000?

6. Use Euler’s Method with 3 steps to estimate \( y(3/4) \) if \( dy/dx = y - 3 \) and \( y(0) = 1 \).

7. Write an integral equal to the area between \( y = 2x + 3 \) and \( y = x^2 + 7x - 3 \).

8. Compute the arc length of \( y = \sqrt{1 - x^2} \) from \( x = 0 \) to \( x = 1/2 \).
9. Consider the region bounded by \( y = 0 \), \( x = 2 \), and \( y = x^2 \). Write an integral equal to the volume of the object created when the region is revolved about

(a) the \( x \)-axis

(b) the line \( x = 5 \)

10. Find the solution to \( \frac{dy}{dx} = \frac{\cos x}{y^2} \) that passes through \((0, 2)\).

11. The probability density function (pdf) of the weights of newborn toads in a certain pond is given by \( f(x) = \frac{k}{(x+1)^2} \), where \( x \) is the weight (in ounces). Note that the domain is \( x \geq 0 \) since no toad can have a negative weight.

(a) What must be the value of \( k \)?

(b) What fraction of the newborn toads weigh more than one ounce?