1. (7 points each) Evaluate the following integrals. Simplify your answer in parts (a)–(d).

(a) \[ \int_0^1 16x \left( x^2 + 1 \right)^3 \, dx \]

(b) \[ \int_0^1 xe^{-x} \, dx \]
(c) \[ \int_1^3 \frac{2x}{x^2 + 1} \, dx \]

(d) \[ \int_{\pi/6}^{\pi/3} 12 \sin x \cos x \, dx \]
(e) \[ \int \frac{e^x}{\sqrt{1 + e^x}} \, dx \]

(f) \[ \int \sqrt{x} \ln x \, dx \]
(g) $\int e^{2x} \cos x \, dx$

(h) $\int \tan x \sec^3 x \, dx$
(i) \[ \int \frac{15}{9x^2 + 1} \, dx \]

(j) \[ \int x^3 e^x \, dx \]
2. (5 points each) Set up, but do not evaluate, integrals for each of the following quantities.

(a) The area of the region on the interval \([1, 2]\) which is bounded below by the \(x\)-axis and above by the graph of \(y = x + e^x\).

(b) The volume obtained when the region in part (a) is revolved around the \(y\)-axis.

3. (5 points each) Let \(R\) denote the region between the graph of \(y = \sin x\) and the \(x\)-axis on the interval \([0, \pi]\). Set up, but do not evaluate, definite integrals which represent the volumes of the following solids.

(a) The solid generated when the region \(R\) is revolved around the \(x\)-axis.

(b) The solid generated when the region \(R\) is revolved around the horizontal line \(y = 2\).

4. (5 points each) Set up, but do not evaluate, integrals for each of the following quantities.

(a) The length of the curve \(f(x) = x^2\) from \(x = 0\) to \(x = 1/2\).

(b) The average value of the function \(f(x) = \tan^{-1} x\) over the interval \([0, 1]\).
Bonus problems – 2 points each

Evaluate the following integrals.

- \( \int xe^{\sqrt{x}} \, dx \)
- \( \int x^2 \tan^{-1} x \, dx \)