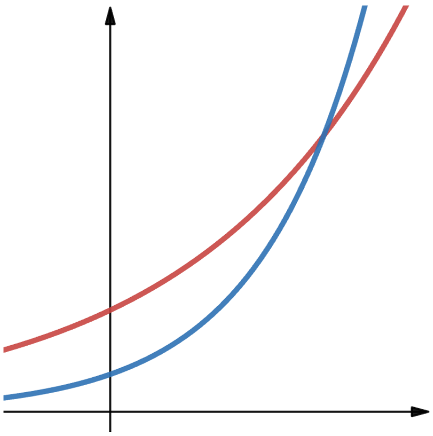
1. (a) (3 pts) Use the graphs below to shade the region bounded by $y = e^{x/2}$, $y = e^{x-1}$ and $x = 0$.



(b) (7 pts) Determine the area of this region using an appropriate integral.

2. (6 pts) Set up but do not evaluate an integral computing the arc length of the curve $y = \tan(x^2)$ between $x = -\pi/4$ to $x = \pi/4$.

3. (a) (2 pts) Sketch the region bounded by the curves $y = x^2$ and $y = 2x$.

(b) (6 pts) Use an integral to compute the volume of the solid found by rotating the region in part **a.** around the x-axis.

(c) (4 pts) Use the **shell method** to set up an integral to calculate the volume of the solid obtained by rotating the region in part **a.** around the y-axis. You do not need to evaluate the integral.

(d) (4 pts) Use the **slicing method** (disks/washers) to set up an integral to calculate the volume of the solid obtained by rotating the region in part **a.** around the y-axis. You do not need to evaluate the integral.

4. (**10 pts**) A 3-meter long whip antenna has linear density $\rho(x) = 5 - \frac{1}{x+1}$ grams per centimeter (starting at $x = 0$). Determine the mass of the antenna. Include units.

5. (**10 pts**) A 1-meter spring requires 20 J to compress the spring to a length of 0.9 meters. How much work would it take to compress the spring from 1 meter to 0.8 meters?

6. Evaluate the definite integrals. Simplify your answers

(a) (**7 pts**) $\displaystyle\int_0^{\pi/4} \tan\theta \, d\theta$

(b) (**7 pts**) $\displaystyle\int_0^{2} xe^{3x} \, dx$

7. Evaluate the indefinite integrals.

(a) (**6 pts**) $\displaystyle\int \sin^3(4x)\cos^2(4x)\,dx$

(b) (**6 pts**) $\displaystyle\int \sec^4(x)\,dx$

(c) (**6 pts**) $\displaystyle\int \arcsin(x)\,dx$

(d) (**6 pts**) $\displaystyle\int \frac{2}{(2x+1)(2x-3)}\,dx$

8. (**10 pts**) Use the method of Trigonometric Substitution to evaluate the integral $\int \frac{dx}{(4+x^2)^2}$. Your final answer must be simplified and written in terms of x.

Extra Credit. A particle moving along a straight line has a velocity of $v(t) = te^{-t}$ after t seconds where v is measured in meters per second.

(a) (**2 pts**) How far does the particle travel from time $t = 0$ seconds to time $t = T$ seconds?

(b) (**3 pts**) Use your answer from part **a.** to determine how far the particle travels in the long-term, as $T \to \infty$.

You may find the following **trigonometric formulas** useful. Other formulas, not listed here, should be in your memory, or you can derive them from the ones here.

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$$

$$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$$

$$\sin(ax)\sin(bx) = \frac{1}{2}\cos((a-b)x) - \frac{1}{2}\cos((a+b)x)$$

$$\sin(ax)\cos(bx) = \frac{1}{2}\sin((a-b)x) + \frac{1}{2}\sin((a+b)x)$$

$$\cos(ax)\cos(bx) = \frac{1}{2}\cos((a-b)x) + \frac{1}{2}\cos((a+b)x)$$