

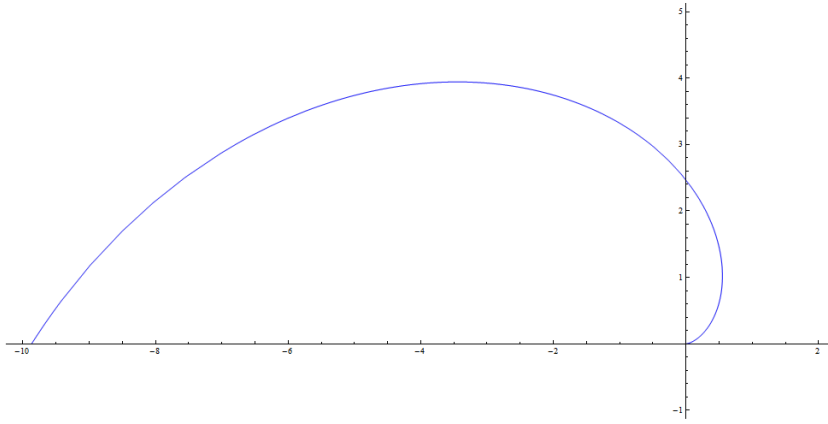
YOUR NAME: \_\_\_\_\_

George Voutsadakis

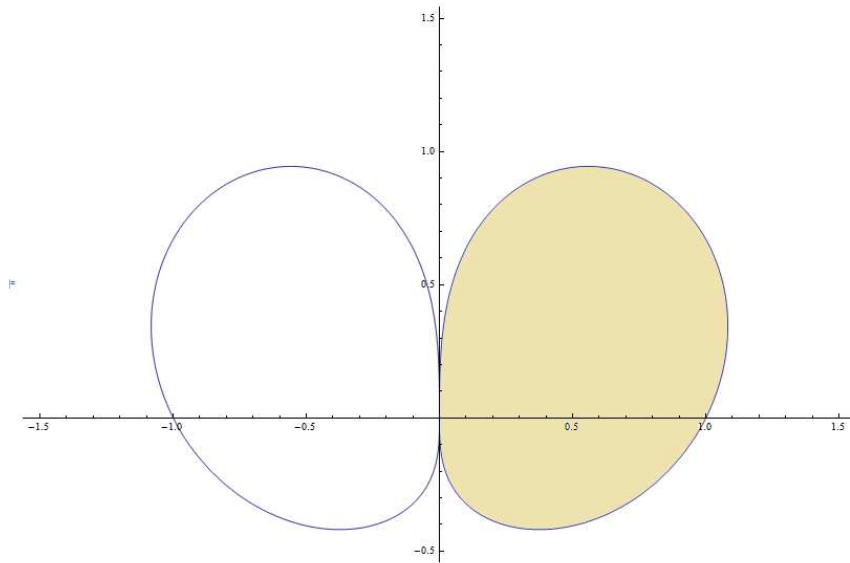
Read each problem **very carefully** before starting to solve it. Each problem is worth 10 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. Consider the parametric curve  $\begin{cases} x = \ln t \\ y = 3t^2 - t \end{cases}$ . Find an equation for the tangent line to the curve at the point  $P = (0, 2)$ .

2. Calculate the length of the portion of the polar curve  $r = \theta^2$  shown in the figure:



3. Calculate the shaded area in the figure, where the polar curve is given by  $r^2 = \cos \theta e^{\sin \theta}$ .



4. A hyperbola has vertices  $(-1, 5)$  and  $(3, 5)$  and one of its asymptotes is given by  $y - 5 = \frac{5}{2}(x - 1)$ .

(a) Find an equation for the hyperbola.

(b) Locate its foci.

5. (a) Find an equation in symmetric form for the line that passes through the points  $P = (-2, 0, 2)$  and  $Q = (4, 3, 7)$ .

(b) Determine whether the lines  $\mathbf{r}_1(t) = \langle 2, 1, 1 \rangle + t\langle -4, 0, 1 \rangle$  and  $\mathbf{r}_2(t) = \langle -4, 1, 5 \rangle + t\langle 2, 1, -2 \rangle$  intersect and, if yes, find the point of intersection.