Problem 1. \( \pi/4 \)

Problem 2. \( \frac{\pi}{6}(5\sqrt{5} - 1) \)

Problem 3. \( \left\{ \frac{3}{4}, \frac{9}{10} \right\} \)

Problem 4. 
\[ y = -\frac{1}{2} \ln(e^{-2} - x^2) \]

Problem 5. 
\[ y(t) = 200(1 - e^{-t/500}) \]

Problem 6. 
(1) \( m(100) = 200 \cdot 2^{-5/8} \)
(2) \( t = 160 \ln 40 \)

Problem 7. 
\[ x = -\frac{y^2}{4} + 2, \quad 0 \leq y \leq 2. \]

The graph is the piece of the parabola with vertex \((2, 0)\), opening to the left, enclosed between \(y = 0\) and \(y = 2\). The direction of increasing \(t\) should be indicated in both ways along the curve.

\[ t = 0, \quad x = 2, \quad y = 0; \]
\[ t = \pi/2, \quad x = 1, \quad y = 2; \]
\[ t = \pi, \quad x = 2, \quad y = 0. \]

Problem 8. 
\[ y = 4(x - 5) \]

The tangent is horizontal at \( t = 0 \) and \( t = \pm \sqrt{2} \). The second derivative is \( 3t^2 - 2 \), while its value at \( t = 2 \) is 10.

Problem 9. 
\[ \frac{\pi^2}{2} \]

Problem 10. It is the circle of radius \( 3/2 \) centered at \((3/2, 0)\), i.e., the one given by the equation
\[ (x - \frac{3}{2})^2 + y^2 = \frac{9}{4}. \]
The integral for the arclength is as follows:

\[
\int_{0}^{\pi/2} \sqrt{9 \cos^2 \theta + 9 \sin^2 \theta} \, d\theta = \frac{9}{2} \pi.
\]

**Problem 11.**

\[
\int_{\cos^{-1}(1/3)}^{\cos^{-1}(1/3)} \frac{1}{2} (1 - 3 \cos \theta)^2 \, d\theta
\]

**Problem 12.** The vertices: \((\pm 1, 0)\), the foci: \((\pm \sqrt{2}, 0)\), the asymptotes: \(y = \pm x\).

**Problem 13.**

\[
\lim_{n \to \infty} \left\{ \sqrt{n + 2} - \sqrt{n} \right\} = 0
\]