

**AP Calculus BC – McGlone**  
**Chapter 10 Test #2 Review Outline**

1. Polar Coordinates (Anton handout)
  - a. Graph a point in polar
  - b. Rewrite a point in polar with other polar coordinates (negative radius, negative angle, etc.)
  - c. Given a point in polar, find Cartesian coordinates, or vice versa (with possible restrictions)
  - d. Given an equation in polar, find the Cartesian equation, or vice versa
  - e. Conversion Formulas:
    - i.  $x = r \cos \theta$
    - ii.  $y = r \sin \theta$
    - iii.  $x^2 + y^2 = r^2$
    - iv.  $\theta = \tan^{-1} \frac{y}{x}$
2. Graphing in polar
  - a. Lines (horizontal, vertical, through origin)
  - b. Circles
    - i. Centered at origin:  $r = a$
    - ii. Centered on an axis, through the origin:  $r = 2a \sin \theta, r = 2a \cos \theta$
  - c. Cardioids ( $r = a \pm a \sin \theta$  or  $r = a \pm a \cos \theta$ )
  - d. Limaçons ( $r = a \pm b \sin \theta$  or  $r = a \pm b \cos \theta$ )
    - i. Inner loop:  $\left| \frac{a}{b} \right| < 1$
    - ii. Dimpled:  $1 < \left| \frac{a}{b} \right| < 2$
    - iii. Convex:  $\left| \frac{a}{b} \right| \geq 2$
  - e. Lemniscates: On an axis:  $r^2 = \pm a^2 \cos(2\theta)$ ; on a diagonal:  $r^2 = \pm a^2 \sin(2\theta)$
  - f. Roses ( $r = a \sin(n\theta)$  or  $r = a \cos(n\theta)$ )
    - i. Find the radius and # of petals ( $n$  if  $n$  is odd,  $2n$  if  $n$  is even)
    - ii. Graph with petals in correct locations (plot some points or solve an equation)
  - g. Spirals
3. Finding Area in polar:  $A = \frac{1}{2} \int_{\theta_1}^{\theta_2} r^2 d\theta$ 
  - a. Area between curves:  $A = \frac{1}{2} \int_{\theta_{-1}}^{\theta_2} R^2 - r^2 d\theta$
  - b. Area shared by curves: typically must add two or more areas.
4. Finding tangents in polar
  - a.  $\frac{dy}{dx} = \frac{\frac{d}{d\theta}(r \sin \theta)}{\frac{d}{d\theta}(r \cos \theta)}$
  - b. Horizontal tangents:  $\frac{dy}{d\theta} = 0$ , but  $\frac{dx}{d\theta} \neq 0$
  - c. Vertical tangents:  $\frac{dx}{d\theta} = 0$ , but  $\frac{dy}{d\theta} \neq 0$
  - d. Tangents at pole (origin,  $r = 0$ ):  $\frac{dy}{dx} = \tan \theta$
5. Arc Length:  $L = \int_{\theta_1}^{\theta_2} \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2} d\theta$