

1. Sketch the region bounded by

$$z = 3x^2 + y^2$$

and

$$z = 6 - 3x^2 - y^2$$

and find parametric equations for the intersection of the two surfaces. (3+6 points)

2. For the curve given by

$$\vec{r}(t) = \langle 4 \sin t, 3t, 4 \cos t \rangle$$

(a) Find the unit tangent vector $\vec{T}(t)$. (3 points)

(b) Find the unit normal vector $\vec{N}(t)$. (3 points)

(c) Find parametric equations for the tangent line to the curve at the point $(2, \frac{\pi}{2}, 2\sqrt{3})$. (3 points)

(d) Find the equation of the normal plane to the curve at the point $(2, \frac{\pi}{2}, 2\sqrt{3})$. (3 points)

4. (a) Match the following polar curves with their graphs. (1 point each)

$$r^2 = \sin(2\theta)$$

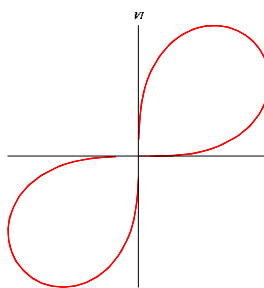
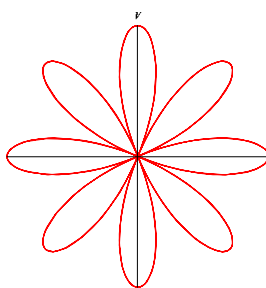
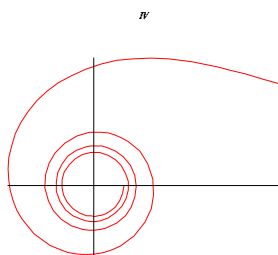
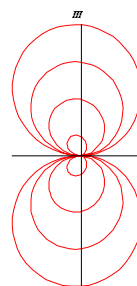
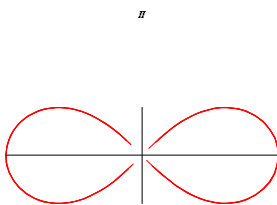
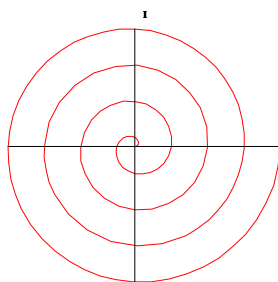
$$r = \theta$$

$$r = \cos(4\theta)$$

$$r = \frac{1}{\sqrt{\theta}}$$

$$r^2 = \cos(2\theta)$$

$$r = \theta \sin(\theta)$$



- (b) Find the equation of the tangent line to $r = \theta \sin(\theta)$ at the point $(\frac{\pi}{2}, \frac{\pi}{2})$. (4 points)