**Solutions to: 3.3: 9-14**

(9) Let's say that Curve 1 is $x^2+xy+y^2=1$ and Curve 2 is $x^2-xy+y^2=1$. To find $\frac{dy}{dx}$ for Curve 1, we differentiate both sides: $2x+xy'+y+2yy'=0$ and solve for $y'$ to get $y'=-\frac{2x+y}{x+2y}$. For Curve 2, using the same method, we get that $y'=\frac{-2x+y}{-x+2y}$.

(10) Looking at the picture of both curves, we notice that one of them will have a tangent line with positive slope at $(0,1)$ while the other will have a tangent line with the negative slope at $(0,1)$. Evaluating $y'$ of both curves at this point we can figure out which one is which.

(12) The curve $x^2+xy+y^2=1$ has $y'=0$ if and only if $2x+y=0$. This line, $y=-2x$ intersects the curve at the point $(1/\sqrt{3},-2/\sqrt{3})$. By symmetry, the other points with horizontal tangent lines are $(-1/\sqrt{3},2/\sqrt{3})$, $(1/\sqrt{3},2/\sqrt{3})$, and $(-1/\sqrt{3},-2/\sqrt{3})$.

(13) For the curve $x^2+xy+y^2=1$, the tangent line is vertical wherever $y'$ is undefined. From the equation of $y'$ we see that this is precisely when $y=-x/2$. Thus the curve is vertical at the points $(2,\sqrt{3},-1/\sqrt{3})$ and $(-2/\sqrt{3},1/\sqrt{3})$. For the other curve, those points are $(2/\sqrt{3},1/\sqrt{3})$ and $(-2/\sqrt{3},-1/\sqrt{3})$.

(14) The formulas for $y'$ show that if $y=x$, then $y'=-1$ for both curves. Since the line $y=x$ has slope 1, it follows that the line $y=x$ is perpendicular to both curves at the points of intersection.