1. Find $\frac{dy}{dx}$ for $x^2 - y^2 = 16$ at $(5,-3)$.

$2x - 2yy' = 0$

$y' = \frac{x}{y}$

$y'|_{(5,-3)} = \frac{-5}{3}$

2. Find $\frac{dy}{dx}$ given $xy + y = 8$.

$xy' + y + y' = 0$

$y'(x+1) = -y$

$y' = \frac{-y}{x+1}$

3. Find $\frac{dy}{dx}$ for $\sin(xy) = 1$.

$\cos(xy)(y + xy') = 0$

$y\cos(xy) + xy'\cos(xy) = 0$

$y' = -\frac{y\cos(xy)}{x\cos(xy)}$

$y' = -\frac{y}{x}$

4. Find $\frac{d^2y}{dx^2}$ given $x^2 + y^2 = 100$.

$2x + 2yy' = 0$

$y' = -\frac{x}{y}$

$y'' = \frac{-y + xy'}{y^2}$

$y'' = \frac{-y + x\left(-\frac{x}{y}\right)}{y^2}$

$y'' = \frac{-y^2 - x^2}{y^3} = \frac{-100}{y^3}$

5. Find $\frac{dy}{dx}$ given $x^2y + xy^2 = 2x$.

$2xy + x^2y' + y^2 + 2xyy' = 2$

$y'(x^2 + 2xy) = 2 - 2xy - y^2$

$y' = \frac{2 - 2xy - y^2}{x^2 + 2xy}$

6. Find $\frac{dy}{dx}$ for $(x+y)^2 + y = 2$ at $(0,1)$.

$2(x+y)(1+y') + y' = 0$

$(2x+2y)(1+y') + y' = 0$

$2x + 2xy' + 2y + 2yy' + y' = 0$

$y' = \frac{-2x - 2y}{2x + 2y + 1}$

$y'|_{(0,1)} = \frac{-2}{3}$

7. Find the points where the curve $x^2 + 4y^2 - 4x + 16y + 4 = 0$ has horizontal and vertical tangent lines.

$2x + 8yy' - 4 + 16y' = 0$

$y' = \frac{4 - 2x}{8y + 16} = \frac{2 - x}{4y + 8}$

Horizontal: $2 - x = 0$, $x = 2$

$4 + 4y^2 - 8 + 16y + 4 = 0$

$4y^2 + 16y = 0$

$4y(y+4) = 0$

$y = 0, -4$

Vertical: $4y + 8 = 0$, $y = -2$

$x^2 - 4x - 12 = 0$

$(x-6)(x+2) = 0$

$x = 6, -2$

Horizontal:	Vertical:
(2,0)	(6,-2)
(2,-4)	(-2,-2)

8. Find the equation of the tangent line to the curve $\sqrt{x} + \sqrt{y} - 1 = y$ at $(9,4)$.

$\frac{1}{2\sqrt{x}} + \frac{1}{2\sqrt{y}}y' = y'$

$y'\left(\frac{1}{2\sqrt{y}} - 1\right) = -\frac{1}{2\sqrt{x}}$

$y' = \frac{-1}{2\sqrt{x}\left(\frac{1}{2\sqrt{y}} - 1\right)}$

$y'|_{(9,4)} = \frac{-1}{6\left(\frac{1}{4} - 1\right)} = \frac{-1}{\frac{-9}{2}} = \frac{2}{9}$

$y - 4 = \frac{2}{9}(x - 9)$