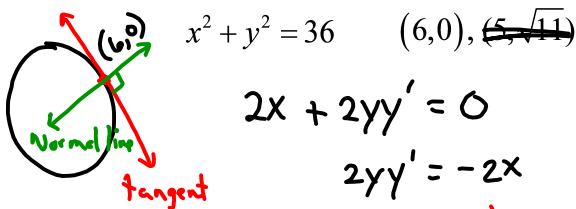


Find equations for the **tangent line** and the **normal line** to the circle at each point. (*Normal line at a point is perpendicular to the tangent line at the point*).

$$y - y_1 = m(x - x_1)$$

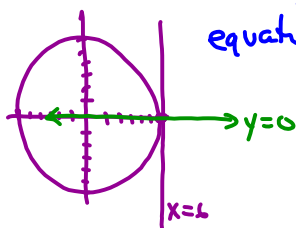


$$x^2 + y^2 = 36 \quad (6, 0), (\cancel{5}, \sqrt{11})$$

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

$$2yy' = -2x$$

$$y' = \frac{-2x}{2y} = -\frac{6}{0} \text{ undefined means vertical}$$



tangent equation of line: $y - 0 = \frac{0}{6}(x - 6)$

$$0 = -6x + 36$$

$$6x = 36$$

$$x = 6$$

equation of normal line: $m \perp$ to tangent $m = \frac{0}{6} = 0$

$$y - 0 = 0(x - 6)$$

$$y = 0$$

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Find the points at which the graph of the equation has a vertical or horizontal tangent line.

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

vertical $m = \frac{1}{0}$

horizontal $m = 0$

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

$$y'(2y + 4) = 8 - 8x$$

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

vertical $m \Rightarrow \frac{1}{0} = \frac{8 - 8x}{2y + 4}$

$$0 = 2y + 4$$

$$-2y = 4$$

$$y = -2$$

$4x^2 + (y^2 - 8x + 4y) + 4 = 0$
 $4x^2 - 8x = 0 \Rightarrow x = 0, 2$
 $4x(x - 2) = 0$
 pt where graph has a vertical tangent line
 $(0, -2)$
 $(2, -2)$

horizontal $m \Rightarrow \frac{0}{1} = \frac{8 - 8x}{2y + 4}$

$$8 - 8x = 0$$

$$x = 1$$

$$(1, 0)$$

$4(1) + y^2 - 8(1) + 4y + 4 = 0$
 $y^2 + 4y = 0$
 $y(y + 4) = 0$
 $y = 0, -4$

$$(1, -4)$$

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2.10 Tangents, Normals, and Continuity (Revisited)

491. Find the equation of the tangent line to the curve $y = \sqrt{x^2 - 3}$ at the point $(2, 1)$.
492. Find the equation of the normal line to the curve $y = (3x - 1)^2(x - 1)^3$ at $x = 0$.
493. Find the equation of the tangent line to the curve $y = \sqrt{3x - 1}$ that is perpendicular to the line $3y + 2x = 3$.
494. Find the equation of the normal line to the curve $y = x\sqrt{25 + x^2}$ at $x = 0$.
495. Find the equation of the tangent line to the curve $y = \frac{2 - x}{5 + x}$ at $x = 1$.
496. Find the equation of the normal line to the curve $y = \frac{5}{(5 - 2x)^2}$ at $x = 0$.
497. Find the equation of the tangent line to the curve $y = 3x^4 - 2x + 1$ that is parallel to the line $y - 10x - 3 = 0$.
498. The point $P(3, -2)$ is not on the graph of $y = x^2 - 7$. Find the equation of each line tangent to $y = x^2 - 7$ that passes through P .

Sep 28-9:21 AM