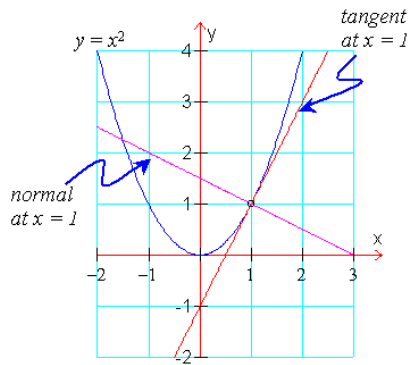


# TANGENTS AND NORMALS

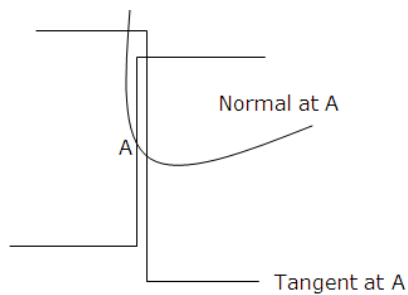
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## Slope of Tangent and Normal



### Slope of a tangent

Slope of a tangent to the curve  $y = f(x)$  is given by  $dy / dx$



### Slope of a normal

Slope of the normal to the curve  $y = f(x)$  is given by  $-1 / (dy/dx)$

# Equation of Tangent and Normal

## Equation of tangent at $(x_0, y_0)$

[Equation](#) of the tangent at the point  $(x_0, y_0)$  is given by

$$(y - y_0) = \frac{dy}{dx} (x - x_0)$$

OR

$$(y - y_0) = f'(x) (x - x_0)$$

## Equation of normal at $(x_0, y_0)$

Equation of the normal at the point  $(x_0, y_0)$  is given by

$$(y - y_0) = -1 / \left( \frac{dy}{dx} \right) (x - x_0)$$

OR

$$(y - y_0) = [-1 / f'(x_0)] (x - x_0)$$

## Condition for perpendicularity and parallelism

- If the lines are [parallel](#) then the slopes are equal
- If the lines are [perpendicular](#) the product of their slopes is -1
- If the tangent is parallel to x-axis then  $\frac{dy}{dx} = 0$
- If the tangent is parallel to y-axis then  $\frac{dy}{dx} = 1 / 0$
- Slope of the line segment joining two points  $(x_1, y_1)$  and  $(x_2, y_2)$  is given by  $(y_2 - y_1) / (x_2 - x_1)$

The following examples will help us to understand the concept more thoroughly:

Example 1: Find the point on the curve  $y = x^3 - 11x + 5$  at which tangent is  $y = x - 11$

Solution: Slope of the tangent to the curve,  $\frac{dy}{dx} = 3x^2 - 11$

Since  $y = x - 11$ ,  $\frac{dy}{dx} = 1$

$$3x^2 - 11 = 1$$

$$x^2 = 4$$

$$x = 2$$

When  $x = 2$ ,  $y = 2^3 - 11 \times 2 + 5 = 8 - 22 + 5 = -9$ , so the point is  $(2, -9)$

Example 2: Find the equation of the tangent line to the curve  $y = x^2 - 2x + 7$  which is parallel to the line  $2x - y + 9 = 0$

Solution: Slope of the tangent  $= 2x - 2$

Slope of the line  $= 2$

Since they are parallel,  $2x - 2 = 2$

$$x = 2$$

When  $x = 2$ ,  $y = 4 - 4 + 7 = 7$

So the point is  $(2, 7)$

Equation of the tangent is,  $y - 7 = 2(x - 2)$

$$y = 2x + 3$$

Now try it yourself! Should you still need any help, [click here](#) to schedule live online session with e Tutor!

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## Reference Links:

- <http://en.wikipedia.org/wiki/Slope>
- <http://en.wikipedia.org/wiki/Tangent>
- <http://ref.subwiki.org/wiki/Normal> (mathematics)
- <http://en.wikipedia.org/wiki/Equation>
- <http://en.wikipedia.org/wiki/Parallel> (geometry)
- <http://en.wikipedia.org/wiki/Perpendicular>

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