

A **normal** to a curve is a line which is perpendicular to the tangent at the point of contact.

The slope of the normal is the *negative reciprocal* of the slope of the curve at that point.

To find the equation of the normal to the curve at a given point:

\*Find the slope of the curve at that point

(use the derivative)

\*Find the slope perpendicular (take the negative reciprocal)

\*Plug the perpendicular slope and the original point into point-slope form:

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

Find the equation of the normal to  $f(x) = x^2 - 4x + 3$  at the point where  $x = 4$ .

$$f'(x) = 2x - 4$$

$$f'(4) = 2(4) - 4$$
$$= 4$$

$$\perp m = -\frac{1}{4}$$

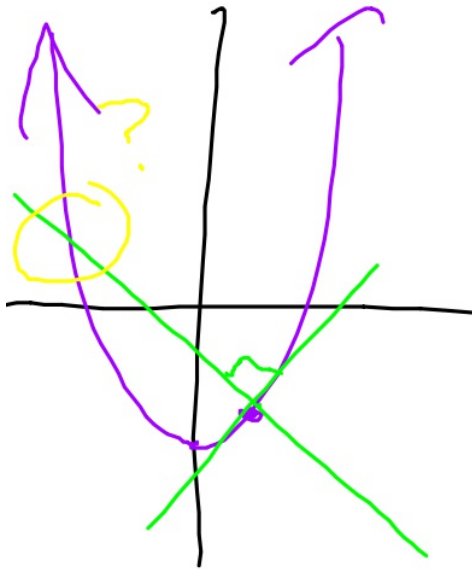
$$y - 3 = -\frac{1}{4}(x - 4)$$

$$(4, 3)$$

$$y - 3 = -\frac{1}{4}x + 1$$
$$+3$$

$$y = -\frac{1}{4}x + 4$$

Find the coordinates of the point where the normal to  $y = x^2 - 3$  at  $(1, -2)$  meets the curve again.



$$f(x) = x^2 - 3$$

$$f'(x) = 2x$$

$$= 2(1)$$

$$m = 2$$

$$\frac{1}{m} = -\frac{1}{2}$$

Put in calculator

$$(-1.5, -0.75)$$

$$y - (-2) = -\frac{1}{2}(x - 1)$$

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

$$y = -\frac{1}{2}x - \frac{3}{2}$$

## Applications

### Tangent:

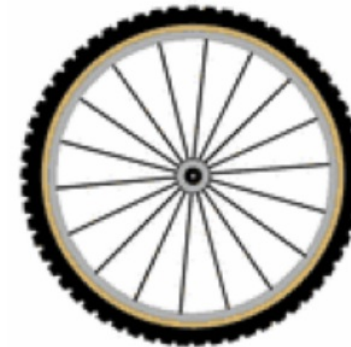
1. If we are traveling in a car around a corner and we hit something slippery on the road (like oil, ice, water or loose gravel) and our car starts to skid, it will continue in a direction **tangent** to the curve.
2. Likewise, if we hold a ball and swing it around in a circular motion then let go, it will fly off in a **tangent** to the circle of motion.



A car has skidded while rounding a corner, **tangent** to the double yellow lines curve.

## Normal:

1. When you are going fast around a circular track in a car, the force that you feel pushing you outwards is **normal** to the curve of the road. Interestingly, the force that is making you go around that corner is actually directed towards the **center** of the circle, normal to the circle.
2. The spokes of a wheel are placed **normal** to the circular shape of the wheel at each point where the spoke connects with the center.



The spokes of a bicycle wheel are **normal** to the rim.

Assignment:

Review Set 20C