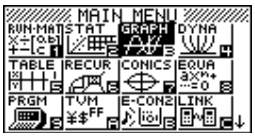
Tangents and Normals on the FX9750Gii model.

This resource was written by Derek Smith with the support of CASIO New Zealand. It may be freely distributed but remains the intellectual property of the author and CASIO.

Select **GRAPH** mode from the **Main Menu** by using the arrow keys to highlight the **GRAPH** icon or by pressing 3.



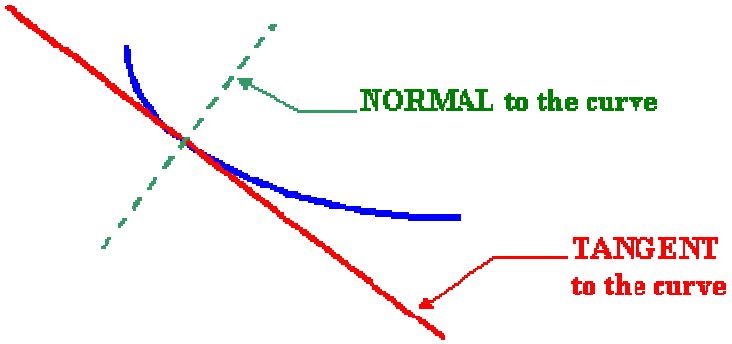
A **tangent** to a curve is a line that touches the curve at one point and has the same **slope** as the curve at that point.

If we are travelling in a car around a corner and we hit something slippery on the road (like oil, ice, water or loose gravel) and the car starts to skid, it will continue in a direction **tangent** to the curve.

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 **normal** to a curve is a line perpendicular to a **tangent** to the curve.

The spokes of a bicycle wheel are normal to the wheel rim. The spokes of a wheel are placed **normal** each point where the spoke connects to the axle (center).

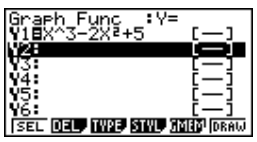


As we have discussed in previous worksheets (we can find the slope of a tangent at any point (x, y) using $^{dy}/_{dx}$ the first derivative of y.)
To find the equation of a normal, recall that the condition for two lines with slopes $\boldsymbol{m_1}$ and $\boldsymbol{m_2}$ to be perpendicular (intersect at right angles) then:

$$\boldsymbol{m_1 \times m_2 = -1} \quad \textbf{or} \quad \boldsymbol{m_1 = -1/m_2} \quad \textbf{or} \quad \boldsymbol{m_2 = -1/m_1}$$

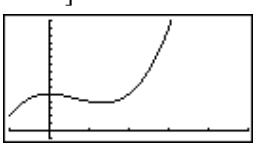
Example:
1. Find the gradient of (i) the tangent (ii) the normal to the curve $y = x^3 - 2x^2 + 5$ at the point (2, 5).
2. Find the equation of the tangent and normal.
3. Sketch the curve and the tangent and normal

Answer: $^{dy}/_{dx} = 3x^2 - 4x$
The slope of the **tangent** is $m_1 = 3(2)^2 - 4(2) = 4$
The slope of the **normal** is found using $m_1 \times m_2 = -1$, $m_2 = -¼$
We use $y - y_1 = m(x - x_1)$ with $x_1 = 2$, $y_1 = 5$, and $m = -¼$
So, $y - 5 = -¼(x - 2)$ gives $y = -¼x - 5½$ or $x + 4y - 22 = 0$
Enter into the **GRAPH** icon and enter in the equation $y = x^3 - 2x^2 + 5$ into the Y1 space.

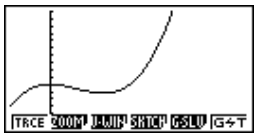


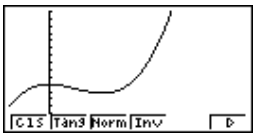
Make sure you have an appropriate V-Window. [**EXIT**]

Draw the graph of $y = x^3 - 2x^2 + 5$ [**F6**] or [**EXE**]

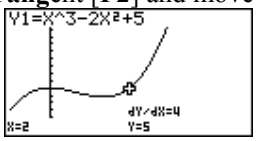


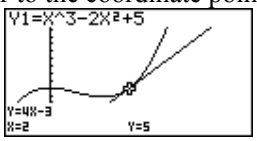
[**SHIFT**] [**F4**] for Sketch (see below)





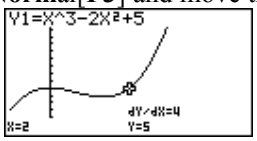
Select **Tang**ent [**F2**] and move the cursor to the coordinate point (2, 5) and press [**EXE**].

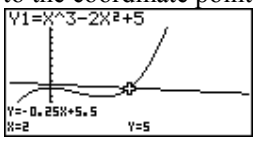




$^{dy}/_{dx} = 4$ at (2, 5) and the equation is $y = 4x - 3$

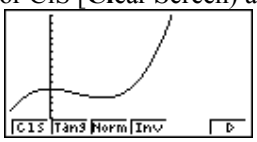
Select **Norm**al[**F3**] and move the cursor to the coordinate point (2, 5) and press [**EXE**].





$^{dy}/_{dx} = 4$ at (2, 5) and the equation is $y = -¼x - 5½$

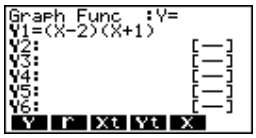
To clear the screen:[**SHIFT**] [**F4**] [**F1**] for ClS [**Cl**ear **S**creen) and the calculator will redraw the function.

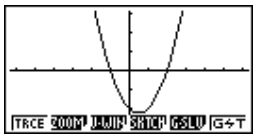


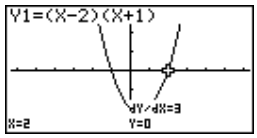
Try this one!

1. Find the gradient of (i) the tangent (ii) the normal to the curve $y = (x - 2)(x + 1)$ at the point (2, 0).
2. Find the equation of the tangent and normal.
3. Sketch the curve and the tangent and normal

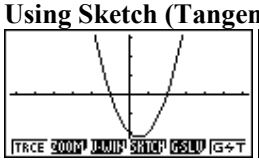
Answer:

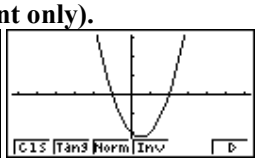


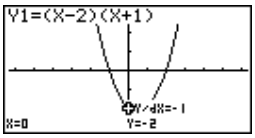


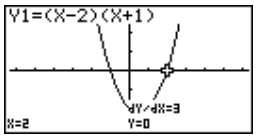


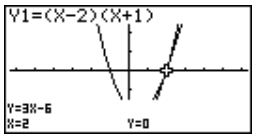
Using Sketch (Tangent only).



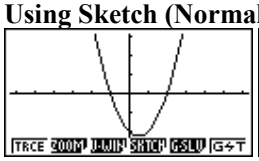


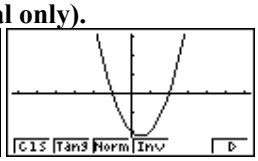


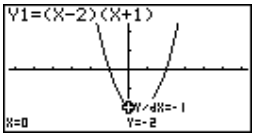


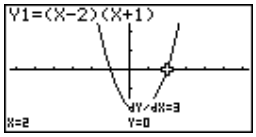


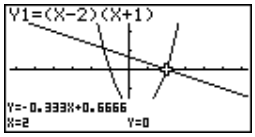
Using Sketch (Normal only).



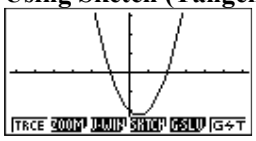


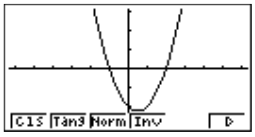


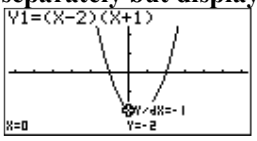


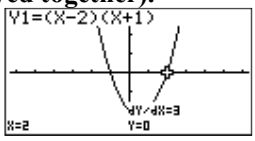


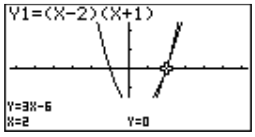
Using Sketch (Tangent and Normal drawn separately but displayed together).

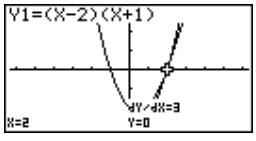


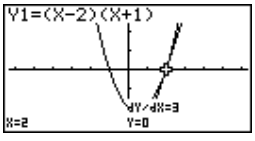


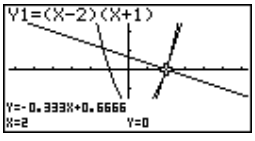












What a great new feature! Enjoy!