3. Find the equations of the tangent and normal to the curve $x^2 + 3xy - 11 = 0$ at the point $x = 1, y = 2$

$2x + 2y\,dy/dx + 3(x\,dy/dx + y \times 1) - 0 = 0$

$2x + 2y\,dy/dx + 3x\,dy/dx + 3y = 0$

$2y\,dy/dx + 3x\,dy/dx = -2x - 3y$

$dy/dx = \frac{-2x - 3y}{2y + 3x}$

$m = dy/dx = \frac{-(2x + 3y)}{2y + 3x}$

when $x = 1$ and $y = 2$

$m = -\frac{[2[1] + 3[2]]}{2(2) + 3(1)}$

$= -\frac{(2 + 6)}{4 + 3} = \frac{-8}{7}$

$m \ \frac{-8}{7}$

Equation of the tangent to a curve

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

$y - 2 = -8/7(x - 1)$

$y - 2 = -8x/7 + 8/7$

$7y - 14 = -8x + 8$

$8x + 7y - 14 - 8 = 0$

$8x + 7y - 22 = 0$

b. Equation of the normal to a curve

$y - y_1 = -1/m(x - x_1)$

$y - 2 = -1/-8/7\,(x - 1)$

$y - 2 = 7/8(x - 1)$

$y - 2 = 7x/8 - 7/8$

$8y - 16 = 7x - 7$

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1. Examine whether or not these pair of lines are perpendicular to each other.

$y - 3x - 2 = 0$ and $3y + x + 9 = 0$

Let $D = y - 3x - 2 - 0$

$= dy/dx - 3 - 0 = 0$

$dy/dx - 3 = 0$

$= dy/dx = 3$

Let $A = 3y + x + 9 = 0$

$3\, dy/dx + 1 + 0 = 0$

$3\, dy/dx + 1 = 0$

$dy/dx = -1/3$

$A \neq B$

i.e $y - 2x - 2 = 0$ is perpendicular to $3y + x + 9 = 0$

2. $3y - 4 = 2x + 3$ and $y - 5 = x + 6$

Let $B - 3y - 4 = 2x + 3$

$3\, dy/dx - 0 = 2 + 0$

$3\, dy/dx = 2$

$dy/dx = 2/3$

Let $C = y - 5 = x + 6$

$dy/dx - 0 = 1 + 0$

$dy/dx = 1$

$\therefore A \neq B$

i.e $3y - 4 = 2x + 3$ and $y - 5 = x + C$ is not perpendicular

$8y = 7x - 7 + 6$

$7x - 8y + 9 = 0$