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Examine if each of the lines are perpendicular to each other

1 $y-3x-2=0$ and $3y+x+9=0$

$y-3x-2=0$

$y=3x+2$

$y=m_1x+c$

$m_1=3$

$3y+x+9=0$

$3y=-x-9$

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

$y=m_2x+c$

$m_2=-\frac{1}{3}$

$m_1m_2=3x-\frac{1}{3}$

$m_1m_2=-1$

∴ The lines $y-3x-2=0$ and $3y+9=0$ are perpendicular to each other

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

$3y-4=2x+3$

$3y=2x+7$

$y=2/3x+7/3$

$y=m_1x+c$

$m_1=2/3$

$y-5=x+6$

$y=x+6+5$

$y=x+11$

$y=m_2x+c$

$m_2=1$

For 2 lines to be perpendicular.

$m_1m_2=-1$

$m_1m_2=\frac{2}{3}\times 1$

$m_1m_2=\frac{2}{3}$

$\therefore m_1m_2\neq 1$

∴ the lines $3y-4=2x+13$ and $y-5=x+6$ are not perpendicular to each other.

3 Find the equations of the tangent and normal to the line $x^2+y^2+3xy-11=0$, at the point $x_1=1$ and $y=2$

$x^2+y^2+3xy-11=0$

$\frac{d}{dx}\left(x^2+y^2+3xy-11\right)=0$

$2x+2y\frac{dy}{dx}+3\left(y+x\frac{dy}{dx}\right)-0=0$

$2x+2y\frac{dy}{dx}3y+3x\frac{dy}{dx}=0$

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

$$m = \left.\frac{dy}{dx}\right|_{x=1,\,y=2}$$

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

$$m = \frac{-2-6}{4+3} \qquad m = \frac{-8}{7}$$

a Equation of the tangent

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

$$y - 2 = \frac{-8}{7}(x-1)$$

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

$$7y - 14 = -8x + 2$$

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

$$7y = -8x + 22 \quad \text{or} \quad 7y + 8x - 22 = 0$$

b The Equation of the normal

$$y - y_1 = -\frac{1}{m}(x - x_1)$$

$$y - 2 = \frac{7}{8}(x-1)$$

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

$$8y - 16 = 7x - 7$$

$$8y = 7x + 9 \quad \text{or} \quad 8y - 7x - 9 = 0$$