13.7 #9

$z = x\cos(x+y) \iff x\cos(x+y) - z = 0$

$f(x,y,z) = x\cos(x+y) - z$

$f_x(x,y,z) = x(-\sin(x+y)) + \cos(x+y)$

$f_x\left(\frac{\pi}{2}, \frac{\pi}{3}, -\frac{\sqrt{3}\pi}{4}\right) = \left(\frac{\pi}{2}\right)\left(-\sin\frac{5\pi}{6}\right) + \cos\left(\frac{5\pi}{6}\right) = -\frac{\pi}{4} - \frac{\sqrt{3}}{2}$

$f_y(x,y,z) = -x\sin(x+y) \Longrightarrow f_y\left(\frac{\pi}{2}, \frac{\pi}{3}, -\frac{\sqrt{3}\pi}{4}\right) = -\frac{\pi}{4}$

$f_z(x,y,z) = -1 \Longrightarrow f_z\left(\frac{\pi}{2}, \frac{\pi}{3}, -\frac{\sqrt{3}\pi}{4}\right) = -1$

So $\nabla f\left(\frac{\pi}{2}, \frac{\pi}{3}, -\frac{\sqrt{3}\pi}{4}\right) = \left\langle -\frac{\pi}{4} - \frac{\sqrt{3}}{2}, -\frac{\pi}{4}, -1 \right\rangle$

Any scalar multiple will suffice, e.g. $\langle \pi + 2\sqrt{3}, \pi, 4 \rangle$

Tangent Plane: $(\pi + 2\sqrt{3})\left(x - \frac{\pi}{2}\right) + \pi\left(y - \frac{\pi}{3}\right) + 4\left(z + \frac{\sqrt{3}}{4}\pi\right) = 0$

Normal Line: $\begin{cases} x = \frac{\pi}{2} + (\pi + 2\sqrt{3})t \\ y = \frac{\pi}{3} + \pi t \\ z = -\frac{\sqrt{3}\pi}{4} + 4t \end{cases}$