

1. The limit is equal to 0.
2. The limit is equal to 1.
3. $x + y + z = 0$
4. $x - 2y + z = 5$
5. $\frac{\partial P}{\partial x} = \frac{ue^y + vye^x + we^{xy}}{\sqrt{u^2 + v^2 + w^2}}$ and $\frac{\partial P}{\partial y} = \frac{uxe^y + ve^x + wx e^{xy}}{\sqrt{u^2 + v^2 + w^2}}$
6. $\frac{\partial N}{\partial u} = \frac{(q-r)(p-1)}{(p+r)^2} + \frac{v+w}{p+r} - \frac{(p+q)(w+v)}{(p+r)^2}$ and $\frac{\partial N}{\partial v} = \frac{(q-r)(p-1)(u+w)}{(p+r)^2} + \frac{1}{p+r} - \frac{(p+q)(w+u)}{(p+r)^2}$ and $\frac{\partial N}{\partial w} = \frac{(q-r)(p-1)(u+v)}{(p+r)^2} + \frac{v+u}{p+r} - \frac{p+q}{(p+r)^2}$
7. $\left. \frac{dz}{dt} \right|_{t=4} = 23$
8. $\left. \frac{dz}{dt} \right|_{t=\pi} = 20$
9. $D_{\mathbf{u}} = \frac{-3 - 4\sqrt{3}}{10}$
10. $D_{\mathbf{u}} = \frac{48}{\sqrt{53}}$
11. $(0, 0)$ is a minimum and $(\pm 1, \pm 1)$ are maximums
12. $(\pm 2, 0)$ are minimums and $(0, \pm 1)$ are maximums
13. From the chain rule $z_x = f'(t)$ and $z_y = -f'(t)$, so the identity follows.