7. $\vec{r}(t) = \ln(t)\vec{i} + t^2\vec{j} + 5\vec{k}$, $t = 1$

$\vec{r}\,'(t) = \frac{1}{t}\vec{i} + 2t\vec{j}$ $\quad \|\vec{r}\,'(t)\| = \sqrt{\left(\frac{1}{t}\right)^2 + (2t)^2}$

$= \sqrt{\frac{1}{t^2} + 4t^2}$

$= \sqrt{\frac{4t^4+1}{t^2}}$

$= \frac{\sqrt{4t^4+1}}{t}$

$$\vec{T}(t) = \frac{\vec{r}\,'(t)}{\|\vec{r}\,'(t)\|}$$

$$= \frac{\frac{1}{t}\vec{i} + 2t\vec{j}}{\frac{\sqrt{4t^4+1}}{t}}$$

$$= \frac{t}{\sqrt{4t^4+1}} \cdot \frac{1}{t}\vec{i} + \frac{t}{\sqrt{4t^4+1}} \cdot 2t\,\vec{j}$$

$$\vec{T}(t) = (4t^4+1)^{-\frac{1}{2}}\vec{i} + \underbrace{2t^2}_{P}\,\underbrace{(4t^4+1)^{-\frac{1}{2}}}_{Q}\vec{j}$$

$$P' = 4t \qquad Q' = -\frac{1}{2}(4t^4+1)^{-\frac{3}{2}} \cdot (16t^3)$$

$$= \frac{-8t^3}{(4t^4+1)^{3/2}}$$

$P'Q + PQ'$

$$\vec{T}\,'(t) = \frac{-8t^3}{(4t^4+1)^{3/2}}\vec{i} + \left(4t(4t^4+1)^{-\frac{1}{2}} + 2t^2\left(\frac{-8t^3}{(4t^4+1)^{3/2}}\right)\right)\vec{j}$$

$$\vec{T}\,'(1) = \frac{-8}{5^{3/2}}\vec{i} + \left(4(5)^{-\frac{1}{2}} + 2\left(\frac{-8}{5^{3/2}}\right)\right)\vec{j}$$

$$= \frac{-8}{5\sqrt{5}}\vec{i} + \left(\frac{4}{5^{1/2}} - \frac{16}{5^{3/2}}\right)\vec{j}$$

$$= \frac{-8}{5\sqrt{5}}\vec{i} + \left(\frac{20}{5^{3/2}} - \frac{16}{5^{3/2}}\right)\vec{j}$$

$$\vec{T}\,'(1) = \frac{-8}{5\sqrt{5}}\vec{i} + \frac{4}{5\sqrt{5}}\vec{j}$$

$\|\vec{T}\,'(1)\|$

$= \sqrt{\left(\frac{-8}{5\sqrt{5}}\right)^2 + \left(\frac{4}{5\sqrt{5}}\right)^2}$

$= \sqrt{\frac{80}{125}}$

$= \sqrt{\frac{16}{25}} = \frac{4}{5}$

$$\vec{N}(1) = \frac{\vec{T}\,'(1)}{\|\vec{T}\,'(1)\|} = \frac{\frac{-8}{5\sqrt{5}}\vec{i} + \frac{4}{5\sqrt{5}}\vec{j}}{\frac{4}{5}} = \frac{-2}{\sqrt{5}}\vec{i} + \frac{1}{\sqrt{5}}\vec{j} = \frac{-2\sqrt{5}}{5}\vec{i} + \frac{\sqrt{5}}{5}\vec{j}$$