

$$10. \vec{r}(t) = e^t \vec{i} + e^{-t} \vec{j}, \quad t=0 \quad (1, 1)$$

$$\vec{v}(t) = \vec{r}'(t) = e^t \vec{i} - e^{-t} \vec{j} \quad \vec{v}'(0) = e^0 \vec{i} - e^{-0} \vec{j} = \vec{i} - \vec{j}$$

$$\vec{a}(t) = \vec{r}''(t) = e^t \vec{i} + e^{-t} \vec{j} \quad \vec{a}(0) = e^0 \vec{i} + e^{-0} \vec{j} = \vec{i} + \vec{j}$$

$$\|\vec{v}'(0)\| = \sqrt{1^2 + (-1)^2} = \sqrt{2} \quad \|\vec{a}(0)\| = \sqrt{1^2 + 1^2} = \sqrt{2}$$

$$\hat{T}(0) = \frac{\vec{v}'(0)}{\|\vec{v}'(0)\|} = \frac{\vec{i} - \vec{j}}{\sqrt{2}} = \frac{\sqrt{2}}{2} \vec{i} - \frac{\sqrt{2}}{2} \vec{j}$$

$$\hat{N}(0) = \frac{\sqrt{2}}{2} \vec{i} + \frac{\sqrt{2}}{2} \vec{j}$$

$$a_T = \vec{a}(0) \cdot \hat{T}(0) = (\vec{i} + \vec{j}) \cdot \left(\frac{\sqrt{2}}{2} \vec{i} - \frac{\sqrt{2}}{2} \vec{j}\right) = \frac{\sqrt{2}}{2} + -\frac{\sqrt{2}}{2} = 0$$

$$a_N = \sqrt{\|\vec{a}(0)\|^2 - a_T^2} = \sqrt{(\sqrt{2})^2 - 0^2} = \sqrt{2}$$

$$11. \vec{r}(t) = 5t^2 \vec{i} + 5t \vec{j}, \quad t_0 = \frac{1}{5} \quad \left(\frac{1}{5}, 1\right)$$

$$\vec{r}'(t) = 10t \vec{i} + 5 \vec{j}$$

$$\vec{r}'\left(\frac{1}{5}\right) = 10\left(\frac{1}{5}\right) \vec{i} + 5 \vec{j} = 2 \vec{i} + 5 \vec{j}$$

$$\|\vec{r}'\left(\frac{1}{5}\right)\| = \sqrt{2^2 + 5^2} = \sqrt{29}$$

$$\hat{T}\left(\frac{1}{5}\right) = \frac{\vec{r}'\left(\frac{1}{5}\right)}{\|\vec{r}'\left(\frac{1}{5}\right)\|} = \frac{2 \vec{i} + 5 \vec{j}}{\sqrt{29}} = \frac{2}{\sqrt{29}} \vec{i} + \frac{5}{\sqrt{29}} \vec{j} = \frac{2\sqrt{29}}{29} \vec{i} + \frac{5\sqrt{29}}{29} \vec{j}$$

$$\hat{N}\left(\frac{1}{5}\right) = \frac{5}{\sqrt{29}} \vec{i} - \frac{2}{\sqrt{29}} \vec{j} = \frac{5\sqrt{29}}{29} \vec{i} - \frac{2\sqrt{29}}{29} \vec{j}$$