

$$14. \vec{r}(t) = (5t-1)\vec{i} + t^2\vec{j}$$

$$\begin{aligned} \vec{r}(t+\Delta t) &= [5(t+\Delta t)-1]\vec{i} + (t+\Delta t)^2\vec{j} \\ &= (5t+5\Delta t-1)\vec{i} + (t^2+2t\Delta t+(\Delta t)^2)\vec{j} \end{aligned}$$

$$\vec{r}'(t) = \lim_{\Delta t \rightarrow 0} \frac{\vec{r}(t+\Delta t) - \vec{r}(t)}{\Delta t}$$

$$= \lim_{\Delta t \rightarrow 0} \frac{(5t+5\Delta t-1)\vec{i} + (t^2+2t\Delta t+(\Delta t)^2)\vec{j} - ((5t-1)\vec{i} + t^2\vec{j})}{\Delta t}$$

$$= \lim_{\Delta t \rightarrow 0} \frac{(5t+5\Delta t-1)\vec{i} + (t^2+2t\Delta t+(\Delta t)^2)\vec{j} + (-5t+1)\vec{i} - t^2\vec{j}}{\Delta t}$$

$$= \lim_{\Delta t \rightarrow 0} \frac{5\Delta t\vec{i} + (2t\Delta t + (\Delta t)^2)\vec{j}}{\Delta t}$$

$$= \lim_{\Delta t \rightarrow 0} \frac{\cancel{\Delta t} [5\vec{i} + (2t + (\Delta t))\vec{j}]}{\cancel{\Delta t}}$$

$$= \lim_{\Delta t \rightarrow 0} 5\vec{i} + (2t + \Delta t)\vec{j}$$

$$= 5\vec{i} + (2t+0)\vec{j}$$

$$= \boxed{5\vec{i} + 2t\vec{j}}$$

$$15. \int (3t\vec{i} + \vec{j} - 2t\vec{k}) dt$$

$$= \boxed{\frac{3}{2}t^2\vec{i} + t\vec{j} - 2t\vec{k} + \vec{C}}$$