

**Instructions:** Show all work. Use exact answers unless specifically asked to round.

1. For the vector-valued function  $\vec{r}(t) = 3\cos t\vec{i} + 2\sin t\vec{j} + t^2\vec{k}$ , find the following:

a.  $\vec{r}'(t)$

$$-3\sin(t)\hat{i} + 2\cos t\hat{j} + 2t\hat{k}$$

b.  $\vec{r}''(t)$

$$-3\cos t\hat{i} - 2\sin t\hat{j} + 2\hat{k}$$

c.  $\int \vec{r}(t) dt$

$$\begin{aligned} & \int 3\cos t dt \hat{i} + \int 2\sin t dt \hat{j} + \int t^2 dt \hat{k} \\ &= (3\sin t + C_1)\hat{i} + (-2\cos t + C_2)\hat{j} + \left(\frac{1}{3}t^3 + C_3\right)\hat{k} \end{aligned}$$

d.  $\|\vec{r}'(t)\|$

$$= \sqrt{(-3\sin t)^2 + (2\cos t)^2 + (2t)^2} =$$

$$= \sqrt{9\sin^2 t + 4\cos^2 t + 4t^2}$$

$$= \sqrt{5\sin^2 t + \underbrace{4\sin^2 t + 4\cos^2 t}_{=4(1)} + 4t^2}$$

$$= \sqrt{5\sin^2 t + 4 + 4t^2}$$