Name _____ **KEY**

Instructions: Show all work. Answers without work required to obtain the solution will not receive full credit. Some questions may contain multiple parts: be sure to answer all of them. Give exact answers unless specifically asked to estimate.

1. Find $\frac{d}{dt}[\vec{r}(t)]$ for $\vec{r}(t) = 2\cos t\,\hat{\imath} + 2\sin t\,\hat{\jmath} + 4\cos 2t\,\hat{k}$.

$$r'(t) = -2\sin t\,\hat{\imath} + 2\cos t\,\hat{\jmath} - 8\sin 2t\,\hat{k}$$

2. Find $\int_0^1 \frac{4}{1+t^2}\hat{\imath} + \frac{2t}{1+t^2}\hat{k}\,dt$.

$$4\arctan t\,\hat{\imath} + 0\hat{\jmath} + \ln|1+t^2|\,\Big|_0^1$$

$$\overset{\arctan 1}{= 4(-0 + \pi/4)\,\hat{\imath} + 0\hat{\jmath} + (\ln 2 - \underset{=0}{\ln 1})\,\hat{k}}$$

$$\pi\hat{\imath} + \ln 2\,\hat{k}$$

3. Find all first partial derivatives of $R(p,q) = \tan^{-1}(pq^2)$.

$$R_p = \frac{1}{1+(pq^2)^2}\cdot q^2 = \frac{q^2}{1+p^2q^4}$$

$$R_q = \frac{1}{1+(pq^2)^2}\cdot 2pq = \frac{2pq}{1+p^2q^4}$$