

1. Find the length of the curve given by $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + \frac{2}{3}t^3\mathbf{k}$ from the point $(0, 0, 0)$ to the point $(3, 9, 18)$. (7 points)

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2. Let $\mathbf{r}(t) = \cos t\mathbf{i} + \sin t\mathbf{j} + 4t\mathbf{k}$.

- (a) Find the unit tangent and unit normal vectors at the point $\left(-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 3\pi\right)$. (7 points)

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- (b) Find the value of the curvature at every point on the curve. (6 points)