

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

(a) Find the unit tangent vector  $\mathbf{T}(t)$ .

(b) Find the principal normal vector  $\mathbf{N}(t)$ .

(c) Find the length of the curve  $C: \mathbf{r}(t) = \sin 2t \mathbf{i} - \cos 2t \mathbf{j} + t \mathbf{k}, 0 \leq t \leq 3$ .