

1. (8 point) Find the unit tangent vector to the curve $\mathbf{r}(t) = \langle \sin(t), \cos(t), t^3/3 \rangle$ at the point $t = \pi$.

Answer. $\mathbf{r}'(t) = \langle \cos(t), -\sin(t), t^2 \rangle$, and so $\mathbf{r}'(\pi) = \langle -1, 0, \pi^2 \rangle$. Now, to make this vector into a unit, divide by the magnitude:

$$\hat{\mathbf{r}}'(\pi) = \frac{\mathbf{r}'(\pi)}{|\mathbf{r}'(\pi)|} = \frac{\langle -1, 0, \pi^2 \rangle}{\sqrt{1 + \pi^4}} = \left\langle \frac{-1}{\sqrt{1 + \pi^4}}, 0, \frac{\pi^2}{\sqrt{1 + \pi^4}} \right\rangle$$

□

$$\text{Answer: } \left\langle \frac{-1}{\sqrt{1 + \pi^4}}, 0, \frac{\pi^2}{\sqrt{1 + \pi^4}} \right\rangle$$

2. (1 point) True or False: The equations $\mathbf{r}(t) = \langle 0, 0, 0 \rangle + \langle 3, 1, -2 \rangle t$ and $\mathbf{s}(t) = \langle 6, 2, -4 \rangle + \langle -6, -2, 4 \rangle t$ define the same line.

Answer: True (they both contain $\langle 0, 0, 0 \rangle$ and $\langle 6, 2, -4 \rangle$)

3. (1 point) True or False: If two lines are not skew, they must intersect at a point.

Answer: False (they could be parallel)