MATH 237 Sochacki Team Work 2 25 Points
Oct. 26, 2016

All necessary work must be shown for credit. Your write up should be in pencil. You may NOT use computers, notes or texts. You can use your calculators. All of your team members must help. You cannot have more than 4 team members. Each team member's printed name must be on the left and the written name must be on the right. Your signature means you only worked with team members on this problem. All of the team members below are to work on the following problem together. Each team is to turn in only ONE write up on one side of each of the two sheets given.

1. KEY WEST 1. Jur Key

2. ______ 2. ______

3. ______ 3. ______

4. ______ 4. ______

1. The position of a sled going down a curve is given by $\bar{r}(t) = (\sin 2t - 2t\cos 2t)\ \bar{i} + 2t^2\ \bar{j} + (2t\sin 2t + \cos 2t)\ \bar{k}$. Your engineering firm is hired to determine the tangential and normal components of the acceleration for the sled. Give these terms and then their values when $t = \frac{3\pi}{8}$. Does this seem safe to you?

$$\bar{r}'(t) = (2\cos 2t - 2\cos 2t + 4t\sin 2t)\bar{i} + 4t\bar{j} + (2\sin 2t + 4t\cos 2t - 2\sin 2t)$$

$$= 4t\sin 2t\ \bar{i} + 4t\bar{j} + 4t\cos 2t\ \bar{k}$$

$$\frac{ds}{dt} = \|\bar{r}'(t)\| = \sqrt{16t^2\sin^2 2t + 16t^2 + 16t^2\cos^2 2t} = \sqrt{32t^2} = \sqrt{32}|t| = 4\sqrt{2}t$$

$$\bar{T}(t) = \frac{\bar{r}'(t)}{\|\bar{r}'(t)\|} = \frac{1}{\sqrt{2}}\sin 2t\ \bar{i} + \frac{1}{\sqrt{2}}\bar{j} + \frac{1}{\sqrt{2}}\cos 2t\ \bar{k}$$

$$\bar{T}'(t) = \sqrt{2}\cos 2t\ \bar{i} + 0\bar{j} - \sqrt{2}\sin 2t\ \bar{k}$$

$$\kappa = \frac{\|\bar{T}'(t)\|}{\frac{ds}{dt}} = \frac{\sqrt{2}}{4\sqrt{2}t} = \frac{1}{4t} \qquad \frac{ds}{dt} = 4\sqrt{2}t \qquad \frac{d^2s}{dt^2} = 4\sqrt{2}$$

$$a_T = 4\sqrt{2} \qquad a_N = \frac{1}{4t}(4\sqrt{2}t)^2 = 8t$$

$$t = \frac{3\pi}{8} \qquad a_T = 4\sqrt{2} \qquad a_N = 3\pi$$

2. The creature Nosidam lives on the planet Otulp. The surface of the planet is given by $16x^2 - y^2 + 9z^2 = 0$. Nosidam is moving along the curve $\bar{r}(t) = 3t\cos 4t\ \bar{i}\ +\ 12\text{t}\ \bar{j}\ \ + 4t\sin 4t\ \bar{k}$. Show that Nosidam is moving along the surface of Otulp. Show whether or not Nosidam's velocity is perpendicular to the gradient of Otulp.

$f(x,y,z) = 16x^2 - y^2 + 9z^2$

Otulp: level surface: $f(x,y,z) = 0$

$$f(\bar{r}(t)) = f(3t\cos 4t, 12t, 4t\sin 4t)$$
$$= 16(3t\cos 4t)^2 - (12t)^2 + 9(4t\sin 4t)^2$$
$$= 16 \cdot 9t^2\cos^2 4t - 144t^2 + 9 \cdot 16t^2\sin^2 4t$$
$$= t^2(144\cos^2 4t + 144\sin^2 t - 144) = 0$$

$$\nabla f = \langle 32x, -2y, 18z \rangle$$

$$\nabla f(\bar{r}(t)) = \langle 32 \cdot 3t\cos 4t, -2(12t), 18 \cdot 4t\sin 4t \rangle$$
$$= \langle 96t\cos 4t, -24t, 72t\sin 4t \rangle$$

$$\bar{r}'(t) = \bar{v}(t) = \langle 3\cos 4t - 12t\sin 4t, 12, 4\sin 4t + 16t\cos 4t \rangle$$

$$\nabla f(\bar{r}(t)) \cdot \bar{r}'(t) =$$

$$288t\cos^2 4t - 1152t^2\cos 4t\sin 4t - 288t + 288t\sin^2 4t + 1152t^2\sin 4t\cos 4t$$

$$= 0.$$