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Name

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Signature

Exam #2

Math 321-A

Thursday, October 26, 2006

For full credit show all work. When in doubt, explain your reasoning.

Find all integrals numerically; you need not find an exact solution to them. Round answers to the third decimal place.  
Find all angles in radians.

1. Let  $\vec{r}(t) = \langle e^t, \cos(t), \sin(t) \rangle$ ,  $P = \vec{r}(0)$ , and let  $f(x, y, z)$  be a differentiable function with  $\nabla f(P) = \langle -4, 5, -7 \rangle$ . Compute the following derivative at  $t = 0$ .

$$\left. \frac{d}{dt} (f(\vec{r}(t))) \right|_{t=0}$$

2. What are the two components of acceleration that we have discussed in class, and what do they measure? Which one can be negative, and what does that indicate?
3. Let  $\vec{r}(t) = \langle R \cos(t), R \sin(t) \rangle$  parametrize a circle of radius  $R > 0$  centered at the origin. Compute its curvature using  $d\vec{T}/ds$ .
4. At a point  $P$  on a curve, we have  $\vec{v} = \langle 1, 3, 5 \rangle$  and  $\vec{a} = \langle 2, 4, 6 \rangle$ . Compute the unit tangent, the unit normal, and the unit binormal vectors at the point  $P$ .
5. Compute the direction of greatest increase for  $f(x, y, z) = \sin(x) \sin(y) \sin(z)$  at the point  $P = (\pi/4, \pi/2, 3\pi/4)$ .
6. At a point  $P$  on a curve, we have  $\vec{v} = \langle 1, 1, 2 \rangle$ ,  $\vec{a} = \langle 2, 1, 7 \rangle$ , and  $d\vec{a}/dt$  (the jerk) =  $\langle 3, 1, 0 \rangle$ . Find the torsion of the curve at the point  $P$ .
7. At a point  $P$  on a curve, we have  $\vec{v} = \langle 3, -2, -4 \rangle$  and  $\vec{a} = \langle 1, -1, -3 \rangle$ . Find  $a_T$  and  $a_N$  at  $P$ .
8. What are the differences between intrinsic and extrinsic properties of a curve? Give three examples of each.
9. Find the directional derivative of  $f(x, y) = e^x \sin(y)$  at  $P = (1, \pi/3)$  in the direction of  $\vec{u} = \langle -5/13, 12/13 \rangle$ .
10. Outline the process we used to create tangent planes for parametric surfaces in the computer lab.