

Calculus 160
Midterm Exam
Spring 2005

Notes: There are 100 points possible on this exam, allotted as indicated by each problem. You have 3 hours to complete the exam. You may use a calculator, but no other aids such as books, notes or neighbors are permitted. Remember that your exam should be a form of clear communication, so show all work, write in complete sentences, organize your ideas and so on. Full credit may not be awarded if work is not shown.

Definitions and Theorems

- 1) (5) Define scalar multiplication.
- 2) (5) Define 2x2 and 3x3 determinants.
- 3) (10) Define vector valued function, component functions, curve, parametrization and parameter.
- 4) (10) State and prove the formula for arclength of a curve.

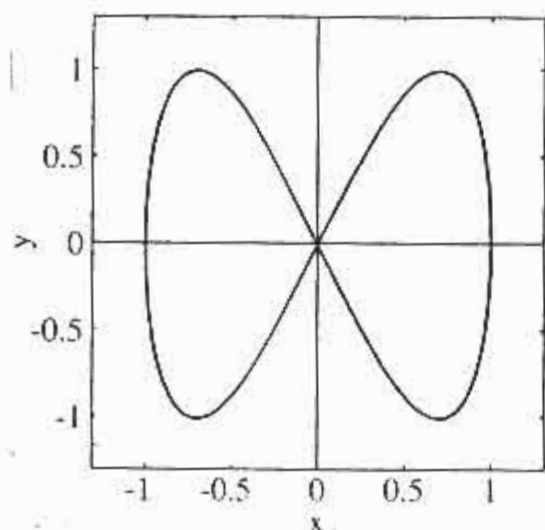
True/False (3 points each)

- 5) a) For any vectors \mathbf{u} and \mathbf{v} , $\mathbf{u} \times \mathbf{v} = \mathbf{v} \times \mathbf{u}$
- b) For any vectors \mathbf{u} and \mathbf{v} , $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{u} = 0$
- c) The cross product of two unit vectors is a unit vector.
- d) The vector valued function $\mathbf{f}(t) = \langle t, t^3, t^5 \rangle$ is smooth.
- e) If $\mathbf{r}(t)$ is a vector valued function then $d/dt |\mathbf{r}(t)| = |\mathbf{r}'(t)|$

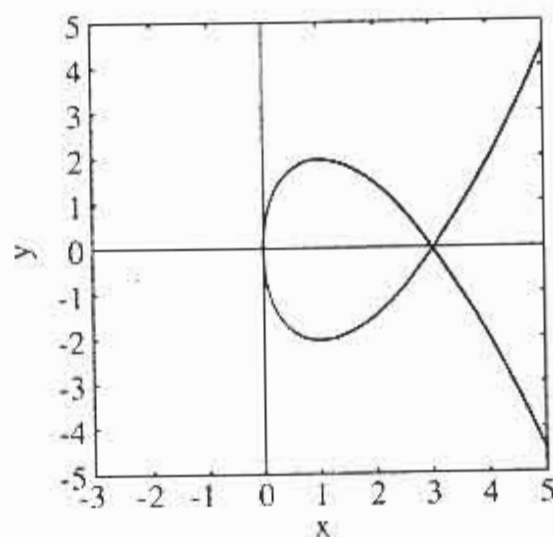
Calculations

- 6) (5) Find the distance between the points (1,3, -2) and (4, 4, 1).
- 7) (5) Find the angle between the vectors $\langle 1, 1, 0 \rangle$ and $\langle 0, 1, 0 \rangle$
- 8) (5) Which of the following two graphs is the graph of the vector valued function $\langle t^2, t^3 - 3t \rangle$? Explain your choice.

A



B



- 9) (10) Find the equation of the tangent line to the curve $\mathbf{r}(t) = \cos(t) \mathbf{i} - 2t \mathbf{j} + \sin(t) \mathbf{k}$ at the point (1,0,0).
- 10) (10) Find the curvature of the curve given of the function $\mathbf{r}(t) = \langle t^2, e^t, 2t \rangle$ at the point (0,1,0).
by

Word Problems

- 11) (10) Eugenie is trying to walk both Jodi Sedlock's dog, Molly, and Joe D'Uva's dog, Duke, at the same time. The two dogs have different ideas about where they want to go. If Molly pulls with a force of 20 Newtons 30 degrees to the left of straight ahead and Duke pulls with a force of 10 Newtons directly to Eugenie's right, which way is she pulled and with what force?
- 12) (10) Spaceship A has position $A(t) = \langle 2+t, 3-t, 1+2t \rangle$ at time t . Spaceship B has position $B(t) = \langle 2, 1-2t, 2+t \rangle$ at time t . Do their paths cross? If so, do the spaceships collide?