Exam 1   MAT 397 Section 001   Spring 2016

This exam has 6 problems on 6 pages. No notes, calculators, or electronic devices of any kind are allowed. **Show all your work!**

Name: _____

1. (10 points) A wagon is pulled along a level path for a distance of 22m by a rope held at an angle of 60° above the horizontal. If the force applied to the rope is 100N, what is the work done by the force?

2. (20 points) Given vectors $\mathbf{a} = \langle 1,2,3 \rangle$ and $\mathbf{b} = \langle 1,7,9 \rangle$,

    a)   find $2\mathbf{a} - \mathbf{b}$.

    b)   find $\mathbf{a} \cdot \mathbf{b}$.

    c)   find $\mathbf{a} \times \mathbf{b}$.

    d)   find the vector projection $\text{proj}_{\mathbf{a}}\mathbf{b}$ of $\mathbf{b}$ onto $\mathbf{a}.$

3. (20 points)

a) Find symmetric equations for the line through the points $A(5, -2,3)$ and $B(6, -1,5)$.

b) Find the point at which the line from part a) intersects the plane $x + y + z = 2$.

4. (20 points) Let $\mathbf{a} = \langle 1,2,3 \rangle$ and $\mathbf{b} = \langle 1,7,9 \rangle$ as in Problem 2, and let C be the point $C(5,1,0)$.

    a) Find a scalar equation for the plane through the point C with normal vector $\mathbf{a}$.

    b) Find a scalar equation for the plane through the point C parallel to the vectors $\mathbf{a}$ and $\mathbf{b}$.

5. (10 points) Match the graphs below to the equations in the right-hand column by putting the number of the appropriate equation into the blank beside the letter corresponding to the graph.

A _____

B _____

C _____

D _____

(1) $2z = y^2 - x^2$
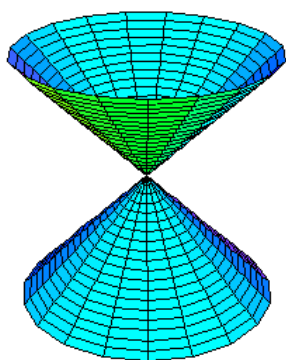
(2) $x^2 + 2y^2 + z^2 = 1$
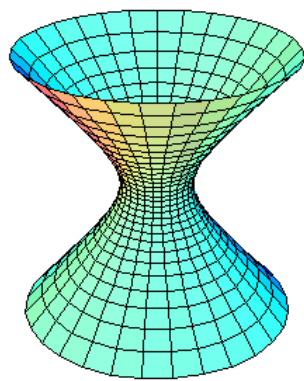
(3) $x + y - z = 1$

(4) $x^2 + y^2 - z^2 = 1$
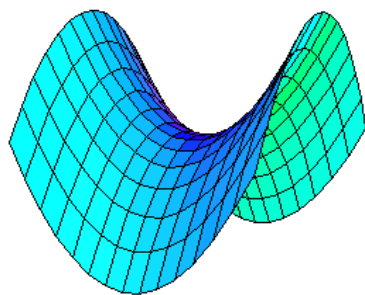
(5) $x^2 + y^2 - z^2 = 0$
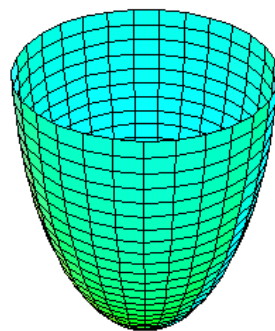
(6) $x^2 + y^2 - z = 0$

A

B

C

D

6. (20 points) Let $\mathbf{r}(t) = \langle \cos t, t \sin t, e^t \rangle$. Find the following.

a) The derivative $\mathbf{r}'(t)$.

b) The unit tangent vector $\mathbf{T}(t)$. (Don't simplify your result).

c) The unit tangent vector $\mathbf{T}(0)$ at time $t = 0$. (Simplify as much as possible).