MATH 231: Calculus of Several Variables
Section 1, 107 Ag Sc & Ind Bldg,
TR 9:05 AM - 9:55 AM

Homework 10: Due Tuesday, Oct 8

For this homework, you will graph using Wolfram Alpha. Visit `www.wolframalpha.com`. And type equations into the search bar. For example, to plot a parametric function, like $x(t) = \sin(10t), y(t) = t, z(t) = 1$ from $t = 0$ to $t = 2\pi$, you'll type

When you answer the questions, it's ok to be brief. Just make sure to clearly communicate what you are thinking.

1. Plot the following equations in Wolfram Alpha and answer the questions.

   - $x(t) = \sin(10t), y(t) = t, z(t) = 1$, for $t = -2\pi$ to $t = 2\pi$
   - $x(t) = \sin(10t), y(t) = t, z(t) = t$, for $t = -2\pi$ to $t = 2\pi$
   - $x(t) = \sin(10t), y(t) = t, z(t) = t^2$, for $t = -2\pi$ to $t = 2\pi$

   (a) How do the changes in $z(t)$ affect the shape of the graph?

   (b) What do you predict will happen when $z(t) = t^3$?

2. Plot the following equations in Wolfram Alpha and answer the question.

   - $x(t) = 0, y(t) = 0, z(t) = t$, for $t = -10$ to $t = 10$
   - $x(t) = 0, y(t) = t, z(t) = t$, for $t = -10$ to $t = 10$
   - $x(t) = t, y(t) = t, z(t) = t$, for $t = -10$ to $t = 10$

   (a) How does the graph change as x and y go from being 0 to t?

3. Plot the following equations in Wolfram Alpha and answer the questions.

   - $x(t) = \sin(5t), y(t) = t, z(t) = t$, for $t = -2\pi$ to $t = 2\pi$
   - $x(t) = \sin(5t), y(t) = \cos(5t), z(t) = t$, for $t = -2\pi$ to $t = 2\pi$
   - $x(t) = \sin(5t), y(t) = \cos(5t), z(t) = \sin(t)$, for $t = -2\pi$ to $t = 2\pi$

- $x(t) = \sin(5t), y(t) = \cos(5t), z(t) = \sin(5t)$, for $t = -2\pi$ to $t = 2\pi$
- $x(t) = \sin(5t), y(t) = \cos(5t), z(t) = \sin(10t)$, for $t = -2\pi$ to $t = 2\pi$

(a) What happens to the graph when y goes from being t to $\cos(5t)$?

(b) Describe the graph when all three are trigonometric functions?

(c) How do you think the frequency in $z(t)$ (e.g. $5t$ versus $10t$ versus t) affects the graph?

4. Plot these two surfaces in Wolfram Alpha and answer the following questions.

- $x^2 + y^2 + \dfrac{z^2}{3} = 1$
- $3x^2 + 3y^2 + z^2 = 1$

(a) How are the two graphs similar?

(b) Are they the same surface?

5. Plot these surfaces in Wolfram Alpha and answer the following question..

- $-x^2 - y^2 + z^2 = 1$
- $-x^2 - y^2 + \dfrac{z^2}{2} = 1$
- $-x^2 - y^2 + z^2 + 1 = 0$

(a) How do the graphs differ? Explain why you should expect those differences.

6. Plot these surfaces in Wolfram Alpha and answer the following questions.

- $x^2 + y^2 - z^2 + \dfrac{1}{1000} = 0$
- $x^2 + y^2 - z^2 + \dfrac{1}{100000} = 0$
- $x^2 + y^2 - z^2 = 0$

(a) Going from the first graph to the last, what trend do you notice? How does it match with the equations?

Some Review Questions (Multiple choice)

7. Which of the following pairs is the center and radius of the sphere

$$x^2 + y^2 + z^2 - x - 6y + 2z + \frac{25}{4} = 0$$

(a) $(-1/2, -3, 1)$ and 4

(b) $(-1/2, -3, 1)$ and 2

(c) $(1/2, 3, -1)$ and 4

(d) $(1/2, 3, -1)$ and 2

8. Consider the vector $\vec{v} = \langle 1, 0, 1 \rangle$. Which of the following vectors is perpendicular to $\vec{v}$ with magnitude $\sqrt{2}$.

   (a) $\left\langle \sqrt{2}, 0, \sqrt{2} \right\rangle$

   (b) $\left\langle 0, \frac{1}{\sqrt{2}}, 0 \right\rangle$

   (c) $\left\langle \frac{\sqrt{2}}{\sqrt{3}}, \frac{\sqrt{2}}{\sqrt{3}}, -\frac{\sqrt{2}}{\sqrt{3}} \right\rangle$

   (d) $\langle -1, 0, 1 \rangle$

9. Which of the following is a plane that *is parallel to* the vector $\langle 1, 1, 1 \rangle$ and the point $(0, 0, 0)$? (Hint: If a plane is parallel to a vector and a vector has no location, we can think of the plane as "containing" the vector)

   (a) $x + y + z = 0$

   (b) $-x + y = 0$

   (c) $x + y + z = 0$

   (d) You can't calculate this expression

10. Are the equations $x(t) = t, y(t) = t, z(t) = t$ and $x(t) = t + 1, y(t) = t + 1, z(t) = t + 1$ describing the same line? Explain.