Calculus III Optional Problem Set
TA: Wenlan Zheng

These problems are not required. They are extra practice to further understand core concepts. Come to office hours with any questions!

Week 1 Optional Problems:

1. How do you find the cross product **a** x **b** of two vectors if you know their lengths and the angle between them?

What if you know their components?

2.(a) How do you find the area of the parallelogram determined by **a** and **b**?

(b) How do you find the volume of the parallelepiped determined by **a**, **b**, and **c**?

3. (a) How do you tell if two vectors are parallel?

(b) How do you tell if two vectors are perpendicular?

(c) How do you tell if two planes are parallel?

Some textbook problems for extra practice:

12.1 5,6,27,28, 29

12.2 10,12, 15,17, 38

12.4 13,14,15

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Week 2 Optional Problems:

What are the traces of a surface? How do you find them?

Given the equation of a plane, can you find the intercepts? Given intercepts, can you find the plane?

Some textbook problems for extra practice:

12.5 43,44,67

12.6 3, 5, 7, 21-27

13.1 21-26

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Week 3 Optional Problems:

1. How do you find the length of a space curve given by a vector function**?**

2. How do you find the velocity, speed, and acceleration of a particle that moves along a space curve?

3. (a) What is the definition of curvature (equation wise)?

(b) Write a formula for curvature in terms of r'(t) and T'(t).

(c) Write a formula for curvature in terms of r'(t) and r''(t).

(d) Write a formula for the curvature of a plane curve with equation y = f(x).

Some textbook problems for extra practice:

13.2 9,10,35

13.3 2,3,5

13.4 19,20

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Week 4 Optional Problems:

1. What does it mean to say that f is continuous at (a,b)?

2. What does $\lim_{(x,y)\to(a,b)} f(x,y) = L$ mean? How can you show that such a limit does not exist?

3. How do you find a tangent plane to a graph of a function of two variables $z = f(x,y)$?

Some textbook problems for extra practice:

14.2 14,16, 30

14.3 20,28

14.4 3,4

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Week 5 Optional Problems:

1. Explain the geometric significance of the gradient.

2. If f has a local maximum at (a,b), what can you say about its partial derivatives at (a,b)?
(b) What is a critical point of f?

Some problems for extra practice:

14.5 1,5,23

14.6 7,8,9,13

14.7 5,11,17

Just for fun. Challenge problem!

For what values of the number r is the function continuous on $\mathbb{R}^3$?

$$f(x, y, z) = \begin{cases} \dfrac{(x + y + z)^r}{x^2 + y^2 + z^2} & \text{if } (x, y, z) \neq (0, 0, 0) \\ 0 & \text{if } (x, y, z) = (0, 0, 0) \end{cases}$$