Math 203
Lab Handout

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VECTORS:

To define a vector write the vector in the form $a \quad a_1, a_2, a_3$ and then click  .

Sum of vectors:

Example:$a \quad a_1, a_2, a_3$ press  ,$b \quad b_1, b_2, b_3$ click  , then

write $a \quad b$ and click 

Ex1 :

1- define the vectors $a \quad 6, 2, 3$, $b \quad -1, 5, 2$

2- find $a \quad b$

Dot product of vectors:

To find dot product (scalar product) write ab and then click 

Ex2 :

for a and b defined in Ex 1 find $a \quad b$

Cross product of vectors:

To find cross product : write $a \quad b$ and then click 

Ex 3:

Find the cross product for :$u \quad 1, 2, 0$, $v \quad 0, 3, 1$ then verify that it is orthognal to both $u$and v.

Length of a vector:

To find the length of a vector : define the vector then write $\|a\|$and then click 

Ex 4:

find the length of the vector u and then find the unit vector that has the same direction of u.

Angle between two vectors:

To find the angle between two vectors:

$$A \quad B \quad \|A\| \|B\| \cos$$

where is the angle between the vectors A and B, you can use the dot product to find the angle between two vectors.

Example *Define* $A \quad 1, 2, -3$ *and* $B \quad -2, 1, 2$ *and solve the equation* $\cos \quad \frac{A \quad B}{\|A\| \|B\|}$, *to get*

Solution is: $\left\{ \quad -\arccos\left(\frac{1}{7}\sqrt{14}\right)\right\}$

Apply Evaluate Numerically *to get* 2.1347.

Ex 5:

Find the angle between the two vectors and determine whether they are orthognal:

1- $a \quad -5,3,7 \quad , \quad b \quad 6,-8,2$

2- $u \quad -1,2,5 \quad , \quad v \quad 3,4,-1$

The volume of the parallelepiped spanned by three vectors *A*, *B*, and *C*

$V \quad |A \quad B \quad C \ |.$

Example:

find the volume of the parallelepiped spanned by $1,1,0$, $1,0,1$, and $0,1,1$.

How to plot Quadric surfaces:

To obtain an implicit plot of an equation involving three variables

1. Enter the equation in your document.
2. From the Plot 3D submenu, choose Implicit.

Ex 6:

Sketch and define then determine the axis and find traces of the following surfaces

1 - $\frac{x^2}{16} - \frac{y^2}{9} \quad z^2 \quad -1$

2- $\frac{x^2}{25} \quad \frac{y^2}{9} - \frac{z^2}{16} \quad 1$

3- $z \quad x^2 \quad \frac{y^2}{2}$

4- $16x^2 \quad 9y^2 \quad 16z^2 - 32x - 36y \quad 36 \quad 0$

5- $3z \quad -y^2 \quad x^2$

6- $z^2 \quad x^2 - y^2 \quad 0$

Vector functions and space curves

To define a vector function : **write the vector function in the form**

$r\ t \quad f\ t\ ,g\ t\ ,h\ t$ **and then click**  .

to find derivativeof a vector function : **write** $\frac{d}{dt} r\ t$ **and click**  .

to find integralof a vector function : **write** $\int_a^b r\ t\ dt$ **and click**  .

to plot a vector function :

1. define the vector function $r\ t$

2. From the Plot3D submenue, choose rectangular

Ex 7:

A) If $r\ t \quad 1 \quad t^2, t\exp\ -t\ , \frac{\sin t}{t}$ B) $r\ t \quad t, t^2, t^3$

C) $r\ t \quad t - \frac{3}{2}\sin t, 1 - \frac{3}{2}\cos t, t$ D) $r\ t \quad \cos t, \sin t, \ln t$

1. find $\int_0^1 r\ t\ dt$

2. find $\frac{d}{dt} r\ t$

3. sketch $r\ t$

function of several variables:

To define afunction of several variables :**write the function** $f\ x,y$ **, then click**  .

to find the derivative of the function $f\ x,y$: **write** $\frac{\partial}{\partial y} f\ x,y$ **and click** 

to find the double integral of the function $f\ x,y$: **write** $\int_a^b \int_c^d f\ x,y\ dydx$ **and click** 

Ex 8:

For $f \quad \frac{x^2 - y^2}{x^2 \quad y^2}$ find

1. $\frac{\partial^2 f}{\partial x^2}$

2. $\frac{\partial^2 f}{\partial y^2}$

3. $\int_0^1 \int_1^2 f dydx$

To plot a defined function *f* of two variables

1. Select the function name *f* or select the expression $f\ x,y$.

2. From the Plot 3D submenu, choose Rectangular.

Ex 9:

Sketch the function A) $f\ x,y \quad \frac{\sin x \sin y}{xy}$ B) $f\ x,y \quad \frac{-3y}{x^2 \quad y^2 \quad 1}$

Gradiant of a function of several variables:

To evaluate the gradiant of a function of several variables: define the function f, then write f and click 

To plot a gradient field

1. Type an expression $f(x,y)$.
2. Leave the insertion point in the expression, and from the Plot 2D submenu, choose Gradient.

Ex 10 :

If A) $f \quad xy^2z^3$,B) $h(x,y) \quad xy\sin xy$, find the gradiant of the function and plot its graph.

Vector field

To find the divergent of a vector field :**define the vector field** ,**then write** F **and click** 

to find the curl of a vector field : **define the vector field** ,**then write** F **and click** 

To plot a two-dimensional vector field

1. Type a pair of two-variable expressions
2. Leave the insertion point in the vector, and from the Plot 2D submenu, choose Vector Field

Ex 11:

For A) $F \quad \left(\frac{1}{\sqrt{\left(1 \quad |y^2 - t^2|^2\right)}}, \frac{y^2 - t^2}{\sqrt{\left(1 \quad |y^2 - t^2|^2\right)}} \right)$

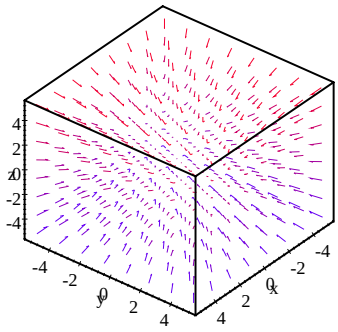
B) $F \quad \ln(1 \quad y^2)$,$\ln(1 \quad x^2)$, plot F

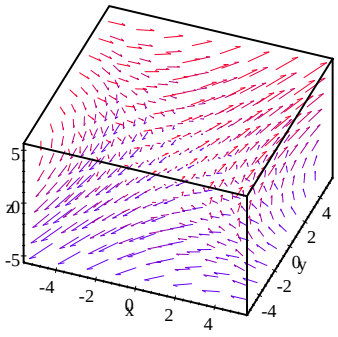
To plot a three-dimensional vector field

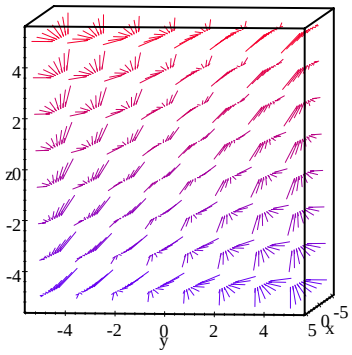
1. Type three three-variable expressions, representing the x-, y-, and z-components of a vector field, into a vector.
2. Leave the insertion point in the vector.
3. From the Plot 3D submenu, choose Vector Field.

To change the view

1. Click the frame until a small box appears in the upper-right corner of the frame.
2. With the left mouse button held down, rotate the plot.







Ex 12:

For A) $F \quad xz, 2xz, zy$ B) $F \quad \frac{y}{z}, -\frac{x}{z}, \frac{z}{4}$ C)$F \quad yz, xz, xy$ find

1. F

2. F

3. sketch F.