**Title:** Gradient, Divergence and Curl

**Aim:** To visualize the two and three dimensional vectors in graphical manner, to find the curl and divergence of a vector Function.

**Question:**

1. Draw the two dimensional vector field for the vector
   a) $\vec{F}(x,y) = x\vec{i} + y\vec{j}$
   b) $\vec{F}(x,y) = x^2y^3\vec{i} - 3xy^2\vec{j}$
2. Draw the three dimensional vector field for the vector
   a) $\vec{F}(x,y,z) = x\vec{i} + y\vec{j} + z\vec{k}$
   b) $\vec{F}(x,y,z) = x^2\vec{i} + yz\vec{j} - xyz^2\vec{k}$
3. Find the Gradient of the function $F=x^2y^3-4y$ at the point (2,-1).
4. Find (a) the curl and (b) the divergence of the vector field
   $\vec{F}(x,y,z) = x^2yz\vec{i} + xy^2z\vec{j} + xyz^2\vec{k}$
5. Determine whether or not the vector field is conservative. If it is conservative, find a function $f$ such that $\nabla\vec{F} = f$ where $\vec{F}(x,y,z) = y^2z^3\vec{i} + 2xyz^3\vec{j} + 3xy^2z^2\vec{k}$

## Question 1:

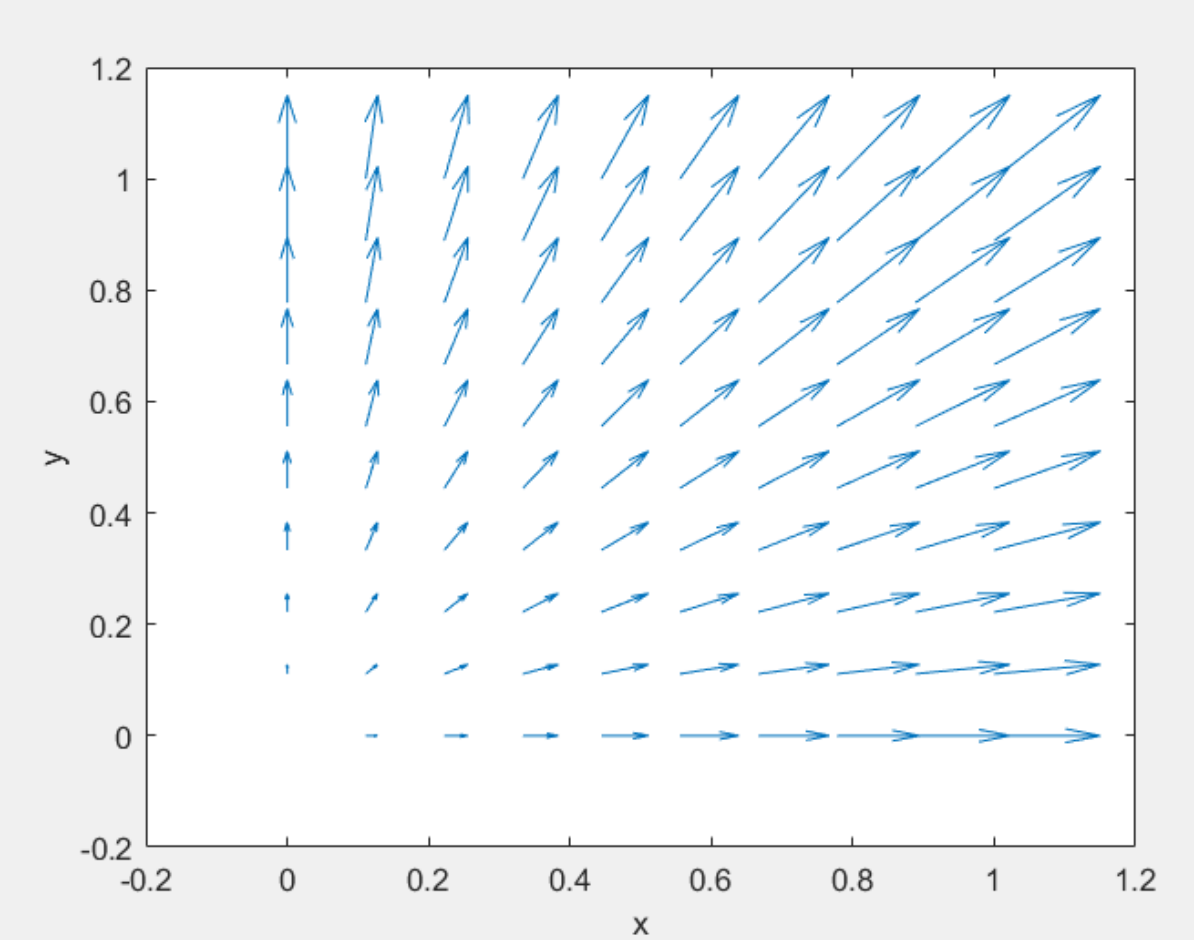
MATLAB CODE

```
% two dimensional vector field
clc
clear all
format compact
syms x y
F=input( 'enter the vector as i and j order in vector form: ')
P = inline(vectorize(F(1)), 'x', 'y');
Q = inline(vectorize(F(2)), 'x', 'y') ;
x = linspace(0, 1, 10);
y = x;
[X,Y] = meshgrid(x,y);
U = P(X,Y);
V = Q(X,Y);
quiver(X,Y,U,V,1.5)
axis  on
xlabel('x')
ylabel('y')
```

## Part 1:

## Output:

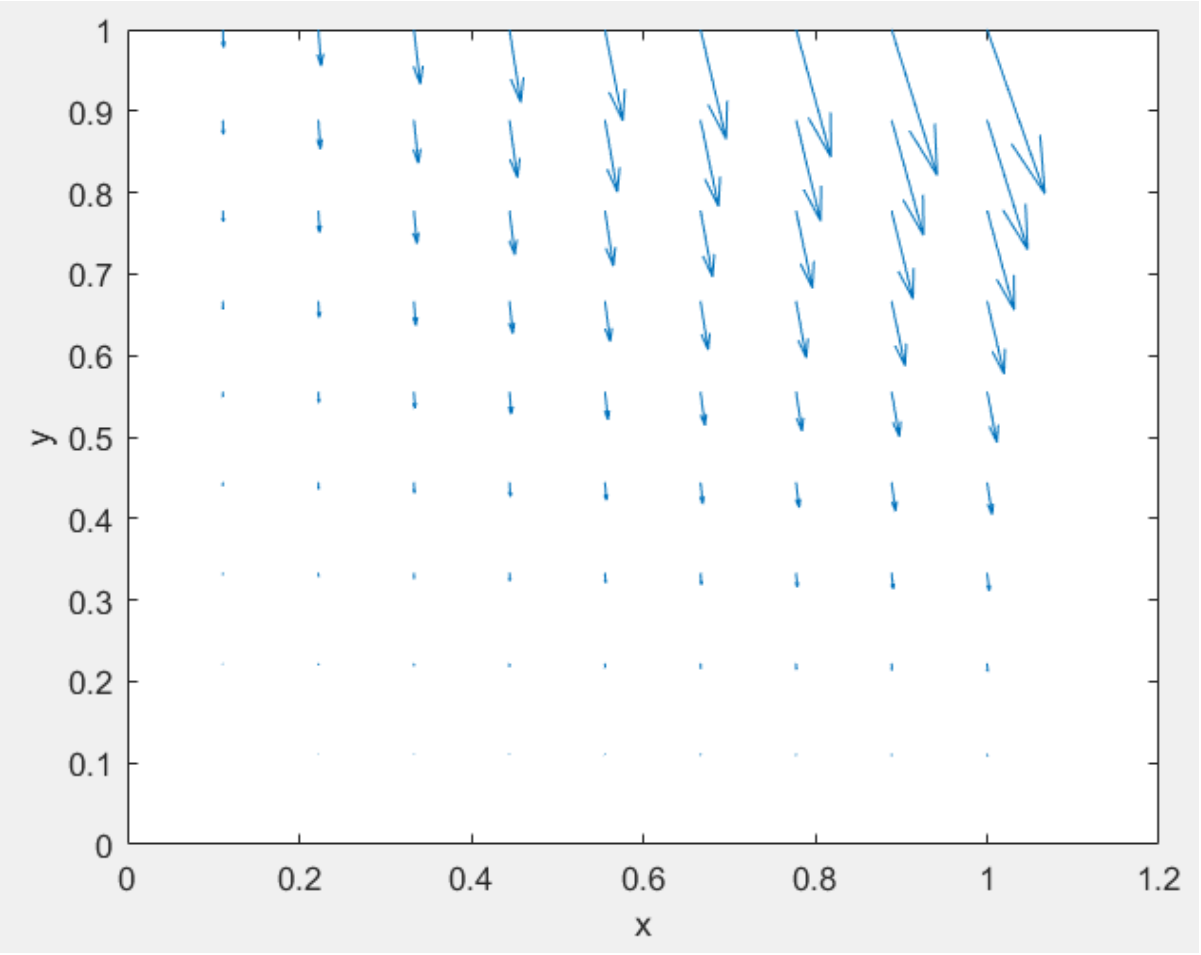
```
enter the vector as i and j order in vector form: [x y]
F =
[x, y]
```



**Part 2:**

**Output:**

```
enter the vector as i and j order in vector form: [x^2*y^3 -3*x*y^2]
F =
[x^2*y^3, -3*x*y^2]
```



## Question 2:

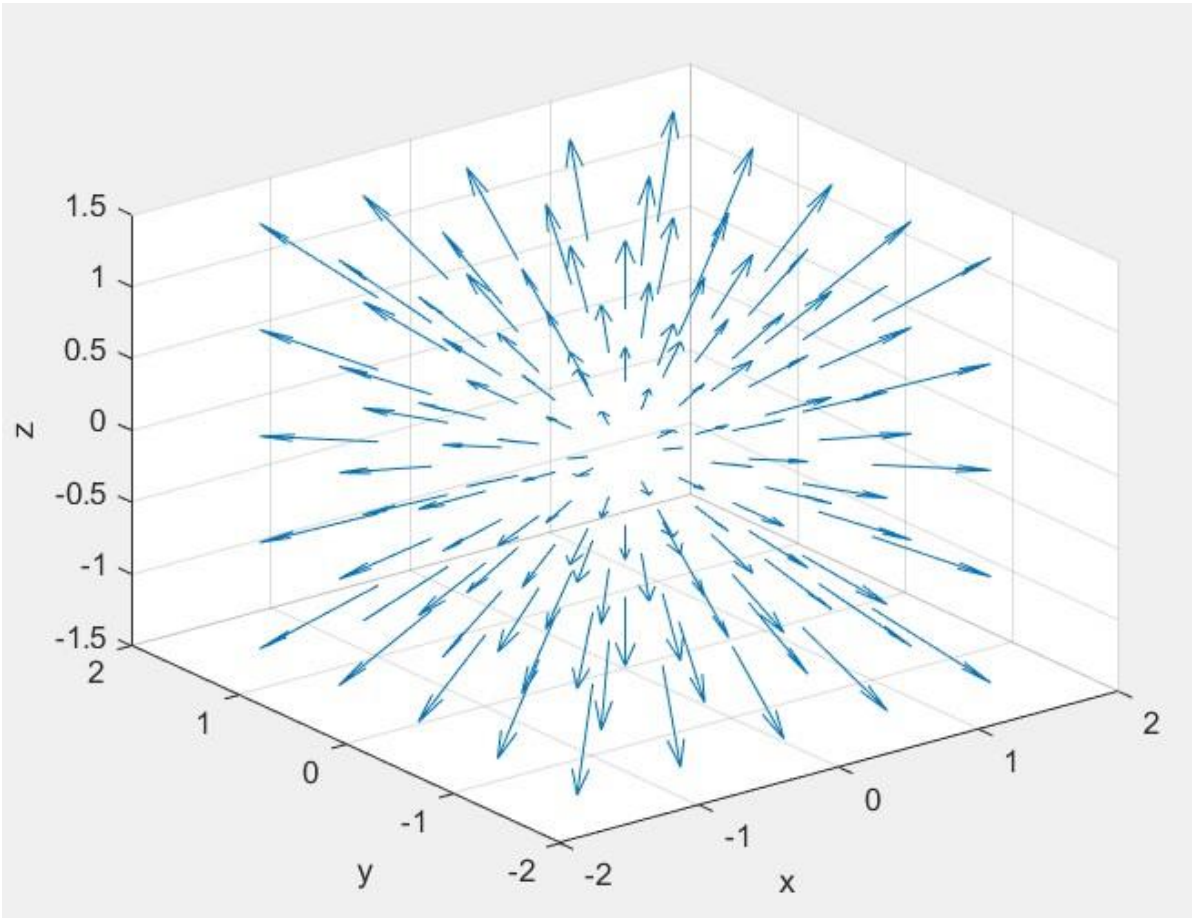
MATLAB CODE

```
clc
syms xyz
F=input( 'enter the vector as i, j and k order in vector form:' )
P = inline(vectorize(F(1)), 'x', 'y','z');
Q = inline(vectorize(F(2)), 'x', 'y','z');
R = inline(vectorize(F(3)), 'x', 'y','z');
x = linspace(-1, 1, 5);
y = x;
z=x;
[X,Y,Z] = meshgrid(x,y,z);
U = P(X,Y,Z);
V = Q(X,Y,Z);
W = R(X,Y,Z);
quiver3(X,Y,Z,U,V,W,2)
axis on
xlabel('x')
ylabel('y')
zlabel('z')
```

## Part 1:

## Output:

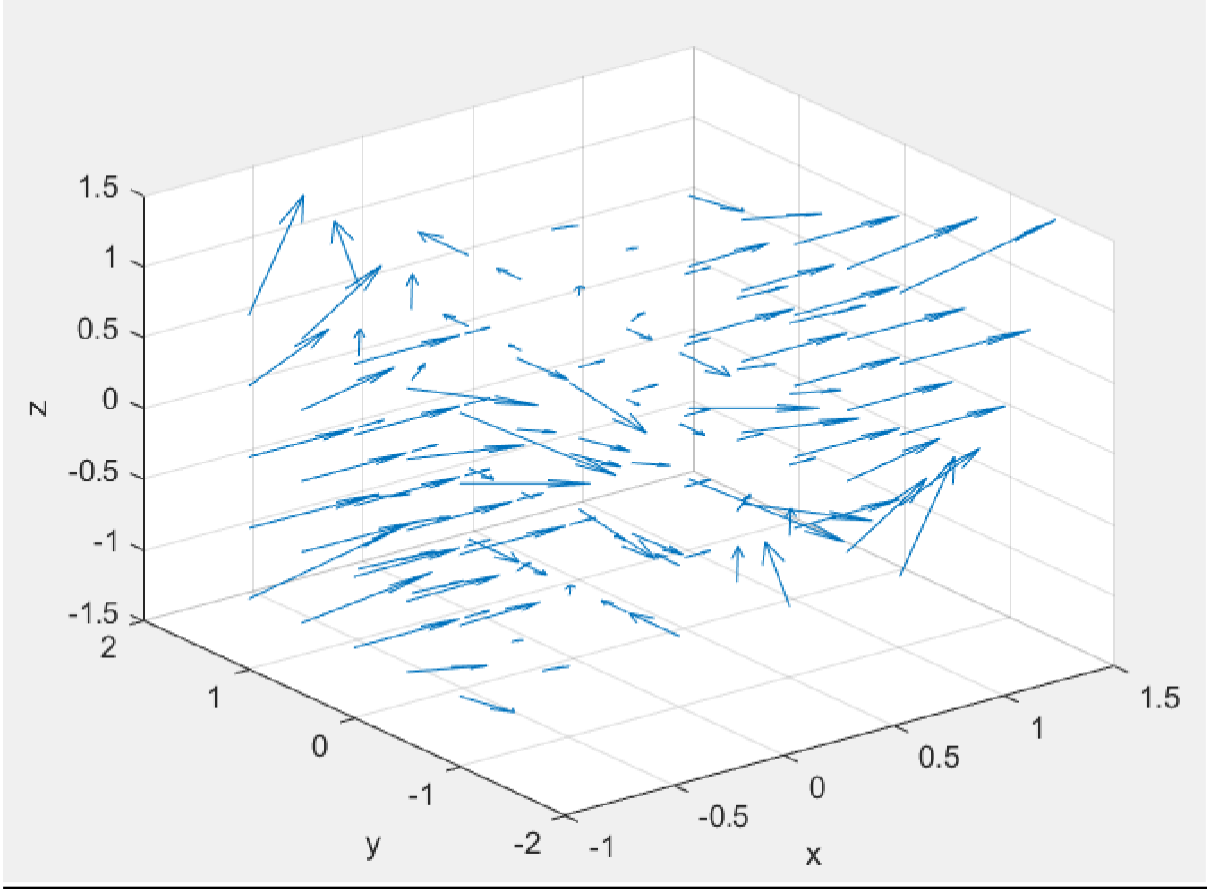
```
enter the vector as i, j and k order in vector form:[x y z]
F =
[x, y, z]
```



**Part 2:**

**Output:**

```
enter the vector as i, j and k order in vector form:[x^2, y*z, -x*y*z^2]
F =
[x^2, y*z, -x*y*z^2]
```



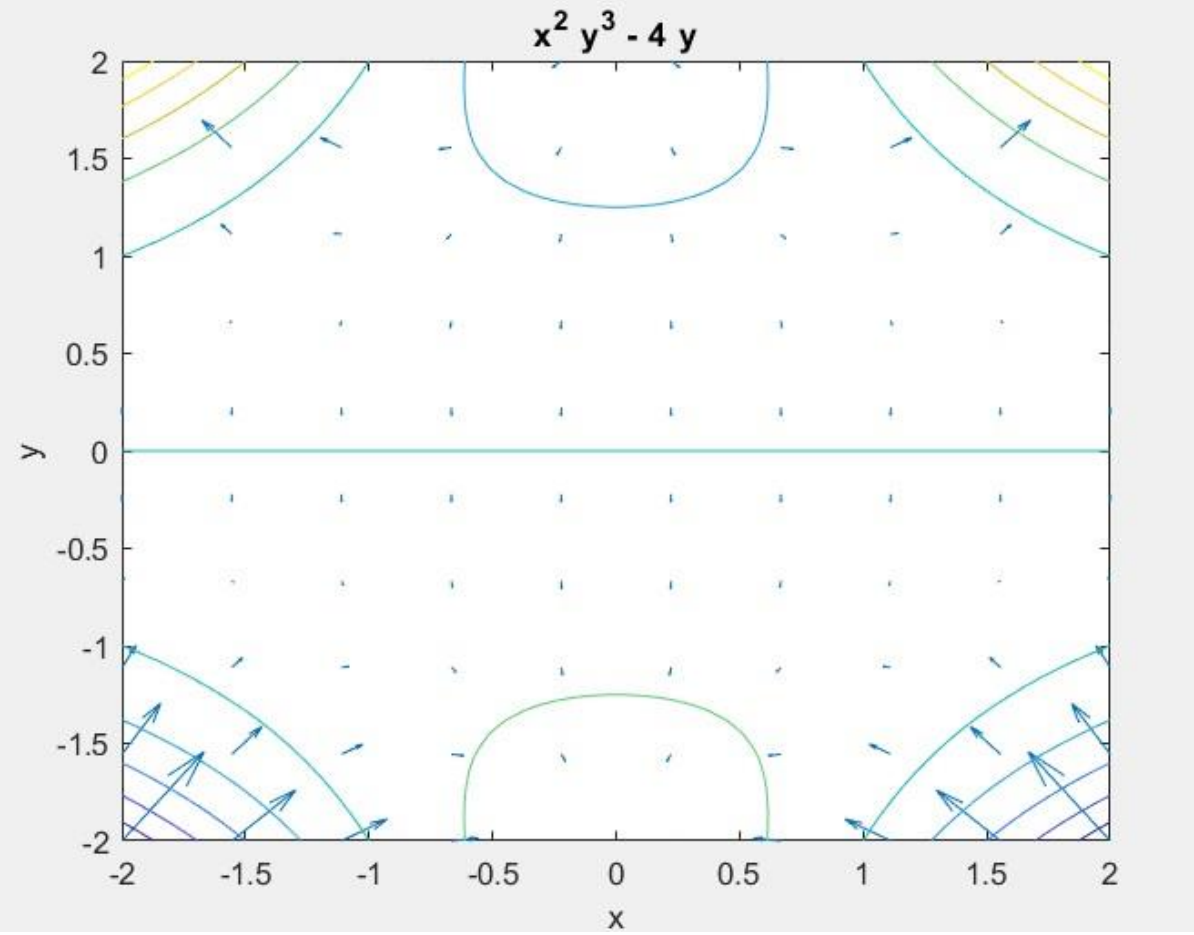
## Question 3:

MATLAB CODE

```
syms x y
f=input( 'enter the function f(x,y): ');
f1=diff(f,x);
f2=diff(f,y);
P = inline(vectorize(f1), 'x', 'y');
Q = inline(vectorize(f2), 'x','y');
x = linspace(-2, 2, 10);
y = x;
[X,Y] = meshgrid(x,y);
U = P(X,Y);
V = Q(X,Y);
quiver(X,Y,U,V,1)
axis on
xlabel('x')
ylabel('y')
hold on
ezcontour(f,[-2 2])
```

## Output:

```
enter the function f(x,y): x^2*y^3-4*y
```



## Question 4:

MATLAB CODE

```
clc
clear all
syms x y z real
F = [x^2*y*z x*y^2*z x*y*z^2];
curl_F = curl(F, [x y z])
div_F = divergence(F, [x y z])
```

## Output:

```
curl_F =
  x*z^2 - x*y^2
  y*x^2 - y*z^2
- z*x^2 + z*y^2
div_F  =
6*x*y*z
```

## Question 5:

MATLAB CODE

```
clc
clear all
syms x y z real
F = [y^2*z^3 2*x*y*z^3 3*x*y^2*z^2];
curl_F = curl(F, [x y z])
f = potential(F, [x y z])
```

## Output:

```
curl_F =
0
0
0
f =
x*y^2*z^3
```