MATLAB EXERCISE 1.8 **Three charges at rectangle vertices.** Three small charged bodies of equal charges $Q = -1$ nC are placed at three vertices of a rectangle with sides $a = 4$ cm and $b = 2$ cm. Using the program from the previous MATLAB exercise, find the direction and magnitude of the electric field vector at the remaining vertex of the rectangle. *(ME1_8.m on IR)*

SOLUTION:

We implement `1/Emag/10` as the scaling factor in function `vecPlot3D` (see MATLAB Exercise 1.4). For the viewpoint, we use MATLAB function `view` with a zero azimuthal angle and 90° elevation angle, so `view(0,90)`.

The resulting graph is shown in Fig.S1.4.

The magnitude of the resultant field vector is 26.307 kV/m. The unit vector of the resultant field is given by $(-0.3663, -0.9305, 0)$.

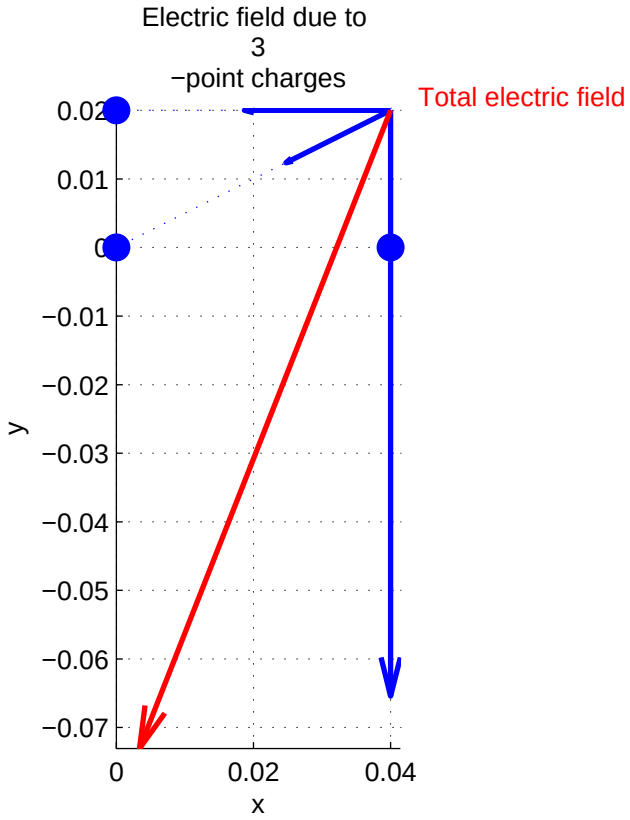

Figure S1.4 Electric field vector due to three charges at rectangle vertices; for MATLAB Exercise 1.8.

```
%
%   Book: MATLAB-Based Electromagnetics (Pearson Prentice Hall)
%   Author: Branislav M. Notaros
%   Instructor Resources
%   (c) 2011
%
%   This MATLAB code or any part of it may be used only for
%   educational purposes associated with the book
%
%
%


%   Three charges at rectangle vertices


clear all;
close all;
EPS0 = 8.8542*10^(-12);

N = 3;
a = 4;
b = 2;
x = [0 0 a];
y = [0 b 0];
z = [0 0 0];
xp = a;
yp = b;
zp = 0;
Q = [-1 -1 -1];

x = x * 10^(-2);
y = y * 10^(-2);
z = z * 10^(-2);
Q = Q * 10^(-9);

xp = xp * 10^(-2);
yp = yp * 10^(-2);
zp = zp * 10^(-2);

% Compute distance and direction between observation point and each charge

r = sqrt((xp - x).^2 + (yp - y).^2 + (zp - z).^2);
ux = (xp - x)./r;
uy = (yp - y)./r;
uz = (zp - z)./r;
uVec = [ux; uy; uz];

% Electric field computation

E = (ones(3,1)*(Q./(4*pi*EPS0*r.^2))).*uVec;
Etot = sum(E,2);
```

```
Emag = vectorMag(Etot);
Euv = (Etot/Emag)';

%Output

fprintf('Magnitude of resultant field at point P is %f V/m.\n',Emag );
disp('Unit vector of resultant force :');
disp(Euv);

figure(1);
plot3(0,0,0,'k');
hold on;
for i=1:N
plot3(x(i),y(i),z(i),'o','MarkerSize',10,'MarkerFaceColor','b');
line ([xp , x(i)],[yp,y(i)], [zp,z(i)],'LineStyle',':');
hold on;
vecPlot3D([xp yp zp],[xp yp zp] + E(:,i)',1/Emag/10,'b',0);
hold on;
end;
vecPlot3D([xp yp zp],[xp yp zp] + Etot',1/Emag/10,'r',0);
text(1.1*xp,1.1*yp,1.1*zp,'Total electric field','Color','r');

hold off;
axis equal;
view(0,90);
xlabel('x');
ylabel('y');
zlabel('z');
title({'Electric field due to ',int2str(N),'-point charges'});
```