

MATLAB EXERCISE 1.19 **Work in the field of a point charge.** A point charge $Q_1 = 10$ nC is positioned at the center of a square contour $a = 10$ cm on a side, as shown in Fig.S1.11. In MATLAB, find the work done by electric forces in carrying a charge $Q_2 = -1$ nC from the point M_1 to the point M_2 marked in the figure – using function `LineIntegral` from the previous MATLAB exercise. (*ME1.19.m on IR*)

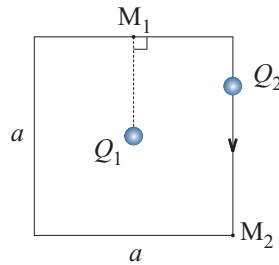


Figure S1.11 Movement of a charge Q_2 in the field of a charge Q_1 positioned at the center of a square contour; for MATLAB Exercise 1.19.

SOLUTION:

The result for the work W done by electric forces is -526.5 nJ.

```
%
% 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
%
%
% Work in the field of a point charge

clear all;
close all;

EPS0 = 8.8542*10^(-12);
Q1 = 10 * 10^(-9);
Q2 = -1 * 10^(-9);
a = 10*10^(-2);

% work
da = 0.000001 * a;
x0 = 0;
y0 = 0;
x1 = 0:da:a/2;
y1 = a/2 * ones(1,length(x1));
y2 = a/2: -da : -a/2;
x2 = a/2 * ones(1,length(y2));
x = [x1 x2];
y = [y1 y2];
r = sqrt((x-x0).^2 + (y-y0).^2);
F = [(x-x0)./r.^3 ; (y-y0)./r.^3]*(Q1*Q2/(4*pi*EPS0));
N=length(x);
dx = x - [-da x(1:N-1)];
dy = y - [a/2-da y(1:N-1)];
dl = [dx ; dy];
W = LineIntegral(F,dl);
% Output
fprintf('\nTotal work of electric force is: %2.3f nJ',W*10^9);
```