MATLAB EXERCISE 1.34 **Charge from field, in three coordinate systems.** Employing the function written in the previous MATLAB exercise, as well as the corresponding functions `divCyl()` and `divSph()` that, respectively, give the symbolic divergence in cylindrical and spherical coordinates [based on Eqs.(1.52) and (1.53) (from the book)], and Eq.(1.50) (from the book), write a MATLAB program that finds the charge density (ρ) from the symbolic expression for the electric field intensity vector ($\mathbf{E}$) as input (the medium is air). Once the user chooses one of the three coordinate systems, the program should offer the proper input for symbolic expressions describing the components of $\mathbf{E}$ (in that coordinate system). *(ME1_34.m on IR)*

```
%
%   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
%
%
%


%    Charge from field, in three coordinate systems


clear all;
close all;
syms EPS0
a = input('\nChoose coordinate system (1)Cartesian, (2)Spherical ,(3)Cylindrical : ');
switch a
    case 1
        syms x y z
        fprintf('\nVariables in Cartesian system are: x, y and z');
        fprintf('\nGive analytical expressions for E field components in terms of these↙
variables');
        Ex = input('\nEx is : ');
        Ey = input('\nEy is : ');
        Ez = input('\nEz is : ');
        rho = EPS0*divCar(Ex,Ey,Ez);
        fprintf('Charge density is given by the following expression: ');
        pretty(rho);
    case 2
        syms r theta phi
        fprintf('\nVariables in Spherical system are: r, theta and phi');
        fprintf('\nGive analytical expressions for E field components in terms of these↙
variables');
        Er = input('\nEr is : ');
        Et = input('\nEtheta is : ');
        Ep = input('\nEphi is : ');
        rho = EPS0*divSph(Er,Et,Ep);
        fprintf('Charge density is given by the following expression: ');
        pretty(rho);
    case 3
        syms r phi z
        fprintf('\nVariables in Cylindrical system are: r, phi and z');
        fprintf('\nGive analytical expressions for E field components in terms of these↙
variables');
        Er = input('\nEr is : ');
        Ep = input('\nEphi is : ');
        Ez = input('\nEz is : ');
        rho = EPS0*divCyl(Er,Ep,Ez);
```

```
        fprintf('Charge density is given by the following expression: ');
        pretty(rho);
    otherwise
        fprintf('Incorrect input!');
end;
```

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%   Symbolic divergence in cylindrical coordinates


function F = divCyl(fr,fp,fz)
syms r phi z
Fr = diff(r*fr,r);
Fp = diff(fp,phi);
Fz = diff(fz,z);
F = 1/r*Fr + 1/r*Fp + Fz;
```

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%    Symbolic divergence in spherical coordinates


function F = divSph(fr,ft,fp)
syms r phi theta
Fr = diff(r^2*fr,r);
Fp = diff(fp,phi);
Ft = diff(sin(theta)*ft,theta);
F = 1/r^2*Fr + 1/(r*sin(theta))*Fp + 1/(r*sin(theta))*Ft;
```