MATLAB EXERCISE 1.24 **Cartesian to cylindrical and spherical coordinate conversions.** (a) Write functions `car2Cyl()` and `car2Sph()` in MATLAB that convert the coordinates of a point given in the Cartesian coordinate system to the coordinates in the associated cylindrical and spherical coordinate systems [Fig.1.18(a) and (b) in the book], respectively. Assume that all lengths are expressed in meters, while the angles ϕ and θ should be expressed in radians. Check cases when some of the input data are zero. (b) Repeat (a) but for the conversions in the opposite direction, namely, write functions `cyl2Car()` and `sph2Car()` to convert cylindrical and spherical coordinates, respectively, to Cartesian coordinates of a point. *(car2Cyl.m, car2Sph.m, cyl2Car.m, and sph2Car.m on IR)*

SOLUTION:

```
%
%   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
%
%
%


%  Cartesian to cylindrical coordinate conversion


function[R,PHI,Z] = car2Cyl(x,y,z)
R = sqrt(x^2 + y^2);
if (x==0 && y==0)
    PHI = 0;
elseif x>=0
    PHI = asin(y/R);
else
    PHI = -asin(y/R) + pi;
Z = z;
end;
```

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%    Cartesian to spherical coordinate conversion


function [R,THETA,PHI] = car2Sph(x,y,z)
if (x==0)&&(y==0)&&(z==0)
    R = 0;
    THETA = 0;
    PHI = 0;
else
    R = sqrt(x^2 + y^2 + z^2);
    THETA = acos(z/R);
    if x>=0
        PHI = asin(y/sqrt(x^2 + y^2));
    else
        PHI = pi - asin(y/sqrt(x^2 + y^2));
    end;
end;
```

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%   Cylindrical to Cartesian coordinate conversion


function [X,Y,Z] = cyl2Car(r,phi,z)
X = r*cos(phi);
Y = r*sin(phi);
Z = z;
```

```
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%  Spherical to Cartesian coordinate conversion


function [X,Y,Z] = sph2Car(r,theta,phi)
X = r*sin(theta)*cos(phi);
Y = r*sin(theta)*sin(phi);
Z = r*cos(theta);
```