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// by: Gustavo Madureira
// gtmadureira@gmail.com


//   - Converts between rectangular, cylindrical, and spherical coordinates. This program has a restriction where
// one needs a unique set of coordinates for each point. Restricting the radius to be non-negative " R≥0 and ρ≥0 ".
//   - The azimuth angle 'θ' to lie in a specific interval spanning '360° or 2π', such as " (-180°,+180°] or (-π,+π] "
// and inclination angle 'φ' to lie in a specific interval spanning '180° or π', such as " [0°,180°] or [0,π] ".



#pragma mode( separator(.,;) integer(h32) )



converter();



EXPORT COORDCONV()   // This command 'COORDCONV' launches the 'converter program'.

BEGIN

 converter();

END;




converter()   // converter program.

BEGIN

 LOCAL ch,X,Y,Z,R;
 LOCAL θ,ρ,φ,S1,S2;
 LOCAL truevar,angle;
 LOCAL msg_cyl,msg_sph;

 HFormat:=1;
 HSeparator:=0;
 HDigits:=3;
 HComplex:=00;

```

```
47
48  IF HAngle==0 THEN
49
50   msg_cyl:="The 'radial distance' must be non-negative (R≥0). And 'azimuth' interval -π<θ≤π.";
51   msg_sph:="The 'radial distance' must be non-negative (ρ≥0). The 'azimuth' interval -π<θ≤π and 'inclination' interval
    0≤φ≤π.";
52   angle:=π;
53
54  ELSE
55
56   msg_cyl:="The 'radial distance' must be non-negative (R≥0). And 'azimuth' interval -180<θ≤180.";
57   msg_sph:="The 'radial distance' must be non-negative (ρ≥0). The 'azimuth' interval -180<θ≤180 and 'inclination' interval
    0≤φ≤180.";
58   angle:=180;
59
60  END;
61
62
63
64     // Menu to choice of coordinates.
65
66   CHOOSE(ch,"Coordinates Converter","Recta → Cylin",
67   "Cylin → Recta","Cylin → Spher","Spher → Cylin",
68   "Recta → Spher","Spher → Recta");
69
70    CASE
71
72
73
74
75  // ***********************************  Rectangular → Cylindrical  ***************************************
76  IF ch==1 THEN
77
78   INPUT({{X,[0],{30,40,1}},{Y,[0],{30,40,2}},{Z,[0],{30,40,3}},{truevar,{"Vector","String"},{70,22,5}}},
79                 "Rectangular → Cylindrical",{"X: ","Y: ","Z: ","Output Type ? "},
80                {"Enter 'X' coordinate.","Enter 'Y' coordinate.","Enter 'Z' coordinate.",
81                 "Set output type.. eg: 'Vector' for math operations."},{0,0,0,1},{0,0,0,1});
82
83   R:=ROUND(√(X²+Y²),3);
84
85
86     // Solving azimuth angle 'θ' with the function 'ATAN2(x,y)'.
87     // Returning the coordinates at the correct angle for all four quadrants.
88
89      IF X>0 THEN θ:=ROUND(ATAN(Y/X),3); END;                      // X>0
90      IF X<0 AND Y≥0 THEN θ:=ROUND(ATAN(Y/X)+angle,3); END;        // X<0, Y≥0
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```
    IF X<0 AND Y<0 THEN θ:=ROUND(ATAN(Y/X)-angle,3); END;       // X<0, Y<0
    IF X==0 AND Y>0 THEN θ:=ROUND(angle/2,3); END;              // X=0, Y>0
    IF X==0 AND Y<0 THEN θ:=ROUND(-angle/2,3); END;             // X=0, Y<0
    IF X==0 AND Y==0 THEN θ:=ROUND(0,3); END;                   // X=0, Y=0


 Z:=ROUND(Z,3);
 S1:=[R,θ,Z];
 S2:=CHAR(91)+R+CHAR(32)+CHAR(32)+CHAR(8737)+θ+CHAR(32)+CHAR(32)+Z+CHAR(93)+CHAR(32)+CHAR(64)+" (R,θ,Z)";

 IF truevar==1 THEN RETURN S1; ELSE

  RETURN S2;

 END;
END;
// ********************************************  END  ************************************************



// ***********************************  Cylindrical → Rectangular  ***************************************
IF ch==2 THEN

 INPUT({{R,[0],{30,40,1}},{θ,[0],{30,40,2}},{Z,[0],{30,40,3}},{truevar,{"Vector","String"},{70,22,5}}},
              "Cylindrical → Rectangular",{"R: ","θ: ","Z: ","Output Type ? "},
             {"Enter radial distance 'R' coordinate.","Enter azimuth 'θ' coordinate.","Enter height 'Z' coordinate.",
              "Set output type.. eg: 'Vector' for math operations."},{0,0,0,1},{0,0,0,1});

  IF R≥0 AND -angle<θ≤angle THEN

   X:=ROUND(R*COS(θ),3);
   Y:=ROUND(R*SIN(θ),3);
   Z:=ROUND(Z,3);
   S1:=[X,Y,Z];
   S2:=CHAR(91)+X+CHAR(32)+CHAR(32)+Y+CHAR(32)+CHAR(32)+Z+CHAR(93)+CHAR(32)+CHAR(64)+" (X,Y,Z)";

    IF truevar==1 THEN RETURN S1; ELSE

     RETURN S2;

    END;

  ELSE
```

```
137
138      IF MSGBOX(msg_cyl,1)==true THEN
139
140       converter();
141
142      ELSE
143
144       "GOOD BYE"
145
146      END;
147     END;
148   END;
149   // ******************************************  END  ************************************************
150
151
152
153
154
155
156   // ***********************************  Cylindrical → Spherical  ***************************************
157   IF ch==3 THEN
158
159    INPUT({{R,[0],{30,40,1}},{θ,[0],{30,40,2}},{Z,[0],{30,40,3}},{truevar,{"Vector","String"},{70,22,5}}},
160                  "Cylindrical → Spherical",{"R: ","θ: ","Z: ","Output Type ? "},
161                 {"Enter radial distance 'R' coordinate.","Enter azimuth 'θ' coordinate.","Enter height 'Z' coordinate.",
162                  "Set output type.. eg: 'Vector' for math operations."},{0,0,0,1},{0,0,0,1});
163
164    IF R==0 AND θ==0 AND Z==0 THEN
165
166     ρ:=ROUND(0,3);
167     θ:=ROUND(0,3);
168     φ:=ROUND(0,3);
169     S1:=[ρ,θ,φ];
170     S2:=CHAR(91)+ρ+CHAR(32)+CHAR(32)+CHAR(8737)+θ+CHAR(32)+CHAR(32)+CHAR(8737)+φ+CHAR(93)+CHAR(32)+CHAR(64)+" (ρ,θ,φ)";
171
172     IF truevar==1 THEN RETURN S1; ELSE
173
174      RETURN S2;
175
176     END;
177
178    ELSE
179
180     IF R≥0 AND -angle<θ≤angle THEN
181
182      ρ:=ROUND(√(R²+Z²),3);
```

```
    θ:=ROUND(θ,3);
    φ:=ROUND(ACOS(Z/√(R²+Z²)),3);
    S1:=[ρ,θ,φ];
    S2:=CHAR(91)+ρ+CHAR(32)+CHAR(32)+CHAR(8737)+θ+CHAR(32)+CHAR(32)+CHAR(8737)+φ+CHAR(93)+CHAR(32)+CHAR(64)+" (ρ,θ,φ)";

   IF truevar==1 THEN RETURN S1; ELSE

    RETURN S2;

   END;

   ELSE

    IF MSGBOX(msg_cyl,1)==true THEN

     converter();

    ELSE

     "GOOD BYE"

    END;
   END;
  END;
 END;
// ***********************************************  END  ************************************************



// ***********************************  Spherical → Cylindrical  ***********************************
IF ch==4 THEN

 INPUT({{ρ,[0],{30,40,1}},{θ,[0],{30,40,2}},{φ,[0],{30,40,3}},{truevar,{"Vector","String"},{70,22,5}}},
              "Spherical → Cylindrical",{"ρ: ","θ: ","φ: ","Output Type ? "},
             {"Enter radial distance 'ρ' coordinate.","Enter azimuth 'θ' coordinate.","Enter inclination 'φ' coordinate.",
              "Set output type.. eg: 'Vector' for math operations."},{0,0,0,1},{0,0,0,1});

 IF ρ≥0 AND -angle<θ≤angle AND 0≤φ≤angle THEN

  R:=ROUND(ρ*SIN(φ),3);
  θ:=ROUND(θ,3);
  Z:=ROUND(ρ*COS(φ),3);
  S1:=[R,θ,Z];
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  S2:=CHAR(91)+R+CHAR(32)+CHAR(32)+CHAR(8737)+θ+CHAR(32)+CHAR(32)+Z+CHAR(93)+CHAR(32)+CHAR(64)+" (R,θ,Z)";

  IF truevar==1 THEN RETURN S1; ELSE

   RETURN S2;

  END;

 ELSE

  IF MSGBOX(msg_sph,1)==true THEN

   converter();

  ELSE

   "GOOD BYE"

  END;
 END;
END;
// ***********************************************  END  ************************************************


// ***********************************  Rectangular → Spherical  ***************************************
IF ch==5 THEN

 INPUT({{X,[0],{30,40,1}},{Y,[0],{30,40,2}},{Z,[0],{30,40,3}},{truevar,{"Vector","String"},{70,22,5}}},
              "Rectangular → Spherical",{"X: ","Y: ","Z: ","Output Type ? "},
             {"Enter 'X' coordinate.","Enter 'Y' coordinate.","Enter 'Z' coordinate.",
              "Set output type.. eg: 'Vector' for math operations."},{0,0,0,1},{0,0,0,1});

 IF X==0 AND Y==0 AND Z==0 THEN

  ρ:=ROUND(0,3);
  θ:=ROUND(0,3);
  φ:=ROUND(0,3);
  S1:=[ρ,θ,φ];
  S2:=CHAR(91)+ρ+CHAR(32)+CHAR(32)+CHAR(8737)+θ+CHAR(32)+CHAR(32)+CHAR(8737)+φ+CHAR(93)+CHAR(32)+CHAR(64)+" (ρ,θ,φ)";

  IF truevar==1 THEN RETURN S1; ELSE

```

```
    RETURN S2;

   END;

  ELSE

   ρ:=ROUND(√(X²+Y²+Z²),3);


    // Solving azimuth angle 'θ' with the function 'ATAN2(x,y)'.
    // Returning the coordinates at the correct angle for all four quadrants.

     IF X>0 THEN θ:=ROUND(ATAN(Y/X),3); END;                      // X>0
     IF X<0 AND Y≥0 THEN θ:=ROUND(ATAN(Y/X)+angle,3); END;        // X<0, Y≥0
     IF X<0 AND Y<0 THEN θ:=ROUND(ATAN(Y/X)-angle,3); END;        // X<0, Y<0
     IF X==0 AND Y>0 THEN θ:=ROUND(angle/2,3); END;               // X=0, Y>0
     IF X==0 AND Y<0 THEN θ:=ROUND(-angle/2,3); END;              // X=0, Y<0
     IF X==0 AND Y==0 THEN θ:=ROUND(0,3); END;                    // X=0, Y=0


   φ:=ROUND(ACOS(Z/√(X²+Y²+Z²)),3);
   S1:=[ρ,θ,φ];
   S2:=CHAR(91)+ρ+CHAR(32)+CHAR(32)+CHAR(8737)+θ+CHAR(32)+CHAR(32)+CHAR(8737)+φ+CHAR(93)+CHAR(32)+CHAR(64)+" (ρ,θ,φ)";

   IF truevar==1 THEN RETURN S1; ELSE

    RETURN S2;

   END;
  END;
 END;
 // ***********************************************  END  ************************************************


 // ***********************************  Spherical → Rectangular  ***********************************
 IF ch==6 THEN

  INPUT({{ρ,[0],{30,40,1}},{θ,[0],{30,40,2}},{φ,[0],{30,40,3}},{truevar,{"Vector","String"},{70,22,5}}},
                "Spherical → Rectangular",{"ρ: ","θ: ","φ: ","Output Type ? "},
               {"Enter radial distance 'ρ' coordinate.","Enter azimuth 'θ' coordinate.","Enter inclination 'φ' coordinate.",
                "Set output type.. eg: 'Vector' for math operations."},{0,0,0,1},{0,0,0,1});
```

```
  IF ρ≥0 AND -angle<θ≤angle AND 0≤φ≤angle THEN

  X:=ROUND(ρ*SIN(φ)*COS(θ),3);
  Y:=ROUND(ρ*SIN(φ)*SIN(θ),3);
  Z:=ROUND(ρ*COS(φ),3);
  S1:=[X,Y,Z];
  S2:=CHAR(91)+X+CHAR(32)+CHAR(32)+Y+CHAR(32)+CHAR(32)+Z+CHAR(93)+CHAR(32)+CHAR(64)+" (X,Y,Z)";

  IF truevar==1 THEN RETURN S1; ELSE

   RETURN S2;

  END;

  ELSE

   IF MSGBOX(msg_sph,1)==true THEN

    converter();

   ELSE

    "GOOD BYE"

   END;
  END;
 END;
 // ***********************************************  END  ************************************************



  DEFAULT
   RETURN "GOOD BYE";

  END;


 END;
```