In[3]:=
```
Maximize[3 x - 2 x^4 , x]
```

Out[3]=
$$\left\{\frac{9 \times 3^{1/3}}{8}, \left\{x \to \frac{3^{1/3}}{2}\right\}\right\}$$

In[5]:=
```
Roots[(0.5) x^4 + 7 x^3 - x^2 - 3 x - 1 == 0, x]
```

Out[5]=
$$x == -14.1123 \,||\, x == -0.35604 - 0.212475\, i \,||\, x == -0.35604 + 0.212475\, i \,||\, x == 0.824385$$

In[6]:=
```
Factor[15 x + (73 x^2)/2 - (5 x^3)/2 - (75 x^4)/2 - (25 x^5)/2 + x^6]
```

Out[6]=
$$\frac{1}{2}(-15 + x)(-1 + x)\, x\, (1 + x)(2 + x)(1 + 2\, x)$$

In[7]:=
```
Roots[1/2 (-15 + x) (-1 + x) x (1 + x) (2 + x) (1 + 2 x) == 0, x]
```

Out[7]=
$$x == 15 \,||\, x == 1 \,||\, x == 0 \,||\, x == -1 \,||\, x == -2 \,||\, x == -\frac{1}{2}$$

In[19]:=
```
eq1 = x^2 + y^2 == R^2
eq2 = a x + b y == 0
solutions = Solve[{eq1, eq2}, {x, y}]
```

Out[19]=
$$x^2 + y^2 == R^2$$

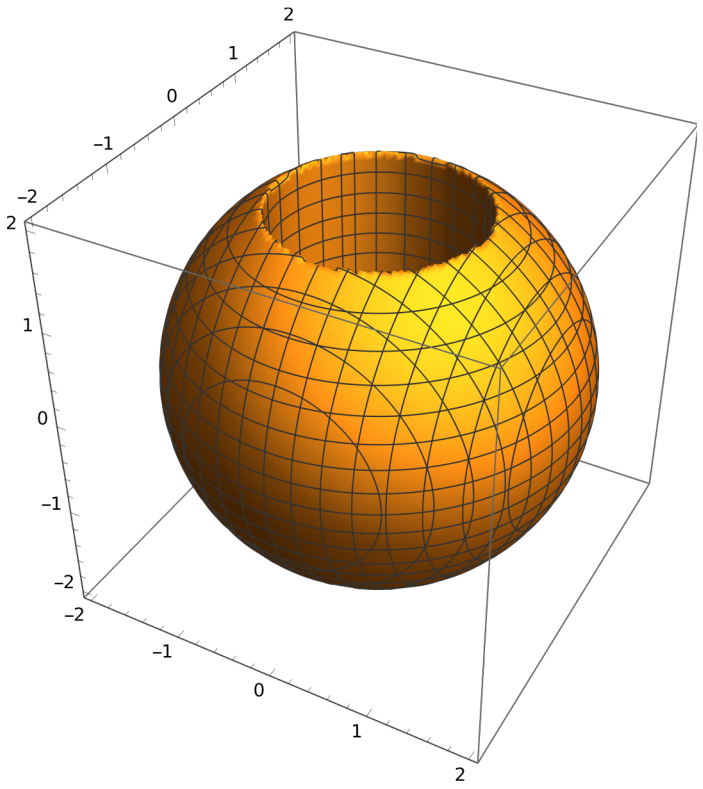
$$a\, x + b\, y == 0$$

Out[21]=
$$\left\{\left\{x \to -\frac{b\, R}{\sqrt{a^2 + b^2}}, y \to \frac{a\, R}{\sqrt{a^2 + b^2}}\right\}, \left\{x \to \frac{b\, R}{\sqrt{a^2 + b^2}}, y \to -\frac{a\, R}{\sqrt{a^2 + b^2}}\right\}\right\}$$

In[120]:=

```
R = 2;
r = 1;
RegionPlot3D[x^2 + y^2 + z^2 ≤ R^2 && x^2 + y^2 ≥ r^2,
 {x, -R, R}, {y, -R, R}, {z, -R, R}, PlotPoints → 100]
```

Out[122]=



In[144]:=

```
initalPoint = {r_1, θ_1, ϕ_1};
finalPoint = {r_2, θ_2, ϕ_2};
cartInital = CoordinateTransform["Spherical" → "Cartesian", initalPoint];
cartFinal = CoordinateTransform["Spherical" → "Cartesian", finalPoint];
displacementCartesian = cartFinal - cartInital
```

Out[148]=

$$\{-\text{Cos}[\phi\_]\, r\_\, \text{Sin}[\theta\_] + 2\, \text{Cos}[2\, \phi\_]\, r\_\, \text{Sin}[2\, \theta\_],\ -r\_\, \text{Sin}[\theta\_]\, \text{Sin}[\phi\_] + 2\, r\_\, \text{Sin}[2\, \theta\_]\, \text{Sin}[2\, \phi\_],\ -\text{Cos}[\theta\_]\, r\_ + 2\, \text{Cos}[2\, \theta\_]\, r\_\}$$

In[150]:=

```
displacementSpherical = ToSphericalCoordinates[displacementCartesian]
```

Out[150]=

$$\left\{\sqrt{\left(\left(-\text{Cos}[\theta\_]\, r\_ + 2\, \text{Cos}\left[2\, \theta\_\right] r\_\right)^2 + \left(-\text{Cos}[\phi\_]\, r\_\, \text{Sin}[\theta\_] + 2\, \text{Cos}\left[2\, \phi\_\right] r\_\, \text{Sin}\left[2\, \theta\_\right]\right)^2 + \left(-r\_\, \text{Sin}[\theta\_]\, \text{Sin}[\phi\_] + 2\, r\_\, \text{Sin}\left[2\, \theta\_\right] \text{Sin}\left[2\, \phi\_\right]\right)^2\right)},\ \text{ArcTan}\left[-\text{Cos}[\theta\_]\, r\_ + 2\, \text{Cos}\left[2\, \theta\_\right] r\_,\ \sqrt{\left(\left(-\text{Cos}[\phi\_]\, r\_\, \text{Sin}[\theta\_] + 2\, \text{Cos}\left[2\, \phi\_\right] r\_\, \text{Sin}\left[2\, \theta\_\right]\right)^2 + \left(-r\_\, \text{Sin}[\theta\_]\, \text{Sin}[\phi\_] + 2\, r\_\, \text{Sin}\left[2\, \theta\_\right] \text{Sin}\left[2\, \phi\_\right]\right)^2\right)}\right],\ \text{ArcTan}\left[-\text{Cos}[\phi\_]\, r\_\, \text{Sin}[\theta\_] + 2\, \text{Cos}\left[2\, \phi\_\right] r\_\, \text{Sin}\left[2\, \theta\_\right],\ -r\_\, \text{Sin}[\theta\_]\, \text{Sin}[\phi\_] + 2\, r\_\, \text{Sin}\left[2\, \theta\_\right] \text{Sin}\left[2\, \phi\_\right]\right]\right\}$$