

```
In[2]:= x = r * Sin[θ] * Cos[φ];
y = r * Sin[θ] * Sin[φ];
z = r * Cos[θ];
```

$$\psi = \text{FullSimplify}\left[\frac{1}{4\sqrt{\pi}} * \frac{2 * z^2 - x^2 - y^2}{r^2} + \sqrt{\frac{3}{\pi}} * \frac{x * z}{r^2}\right]$$

$$\text{Out[5]} = \frac{1 + 3 \cos[2\theta] + 4\sqrt{3} \cos[\phi] \sin[2\theta]}{8\sqrt{\pi}}$$

```
In[6]:= c0,0 = Integrate[SphericalHarmonicY[0, 0, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

```
Out[6]= 0
```

```
In[7]:= c1,1 = Integrate[SphericalHarmonicY[1, 1, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

```
Out[7]= 0
```

```
In[8]:= c1,0 = Integrate[SphericalHarmonicY[1, 0, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

```
Out[8]= 0
```

```
In[9]:= c1,-1 = Integrate[SphericalHarmonicY[1, -1, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

```
Out[9]= 0
```

```
In[10]:= c2,-2 = Integrate[SphericalHarmonicY[2, -2, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

```
Out[10]= 0
```

```
In[11]:= c2,-1 = Integrate[SphericalHarmonicY[2, -1, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

$$\text{Out[11]} = \sqrt{\frac{2}{5}}$$

```
In[12]:= c2,-0 = Integrate[SphericalHarmonicY[2, 0, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

$$\text{Out[12]} = \frac{1}{\sqrt{5}}$$

```
In[13]:= c2,1 = Integrate[SphericalHarmonicY[2, 1, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

$$\text{Out[13]} = -\sqrt{\frac{2}{5}}$$

```
In[14]:= c2,2 = Integrate[SphericalHarmonicY[2, 2, θ, φ]**ψ*Sin[θ], {θ, 0, π}, {φ, 0, 2 * π}]
```

```
Out[14]= 0
```