Exercise 4.5 Let  be any direction (i.e., unit 3-vector) and . Find the energy eigenvalues and eigenvectors .

Solution.

In spherical coordinates .

From Exercise 3.4 the eigenvalues and eigenvectors of  are respectively



and

.

Since , we have that



and

.

Claim  are the respective eigenvalues and eigenvectors of *H*:

 ✔

 ✔

Thus



and

.