Main Problem

Question: Generate an array of Chern numbers for the Haldane model on a hexagonal lattice by sweeping the following parameters: [MORE QUESTION TEXT]

Docstrings

```
def compute_chern_number_grid(delta, a, t1, t2, N):
    """
    Args:
    delta (float): The grid size in kx and ky axis.
    [MORE ARGUMENTS]

    Returns:
    results (ndarray): 2D array of shape(N, N), the Chern numbers.
    [MORE RETURN VALUES]
    """
```

Dependencies

```
import numpy as np
import cmath
from math import pi, sin, cos, sqrt
```

Subproblem 1

Background: Source: [CITATION]
$\{\mathbf{a}_i\}$ are the vectors from a B site to its three nearest-neighbor A sites, then we have [MORE BACKGROUND TEXT]

Question: Write a Haldane model Hamiltonian on a hexagonal lattice.

Docstrings

```
def calc_hamiltonian(kx, ky, a, t1, t2, phi, m):
    """
    Function to generate the Haldane Hamiltonian.

    Args:
    kx (float): The x component of the wavevector.
    [MORE ARGUMENTS]

    Returns:
    hamiltonian (ndarray): matrix of shape(2, 2).
    """
```

Subproblem 2

Background: Source: [CITATION]
Here we can discretize the two-dimensional Brillouin zone into grids with step [MORE BACKGROUND TEXT]

Question: Calculate the Chern number using the Haldane Hamiltonian.

Docstrings

```
def compute_chern_number(delta, a, t1, t2, phi, m):
    """
    Function to compute the Chern number.

    Args:
    delta (float): The grid size in kx and ky axis.
    [MORE ARGUMENTS]

    Returns:
    chern_number (float): The Chern number.
    """
```

Subproblem 3

Question: Here we can discretize the two-dimensional Brillouin zone into grids with step [MORE QUESTION TEXT]

Docstrings

```
def compute_chern_number_grid(delta, a, t1, t2, N):
    """
    Function to calculate the Chern numbers.

    Args:
    delta (float): The grid size in kx and ky axis for discretizing the
Brillouin zone.
    [MORE ARGUME]

    Returns:
    results (ndarray): 2D array of shape(N, N), The Chern numbers.
    [MORE RETURN VALUES]
    """
```