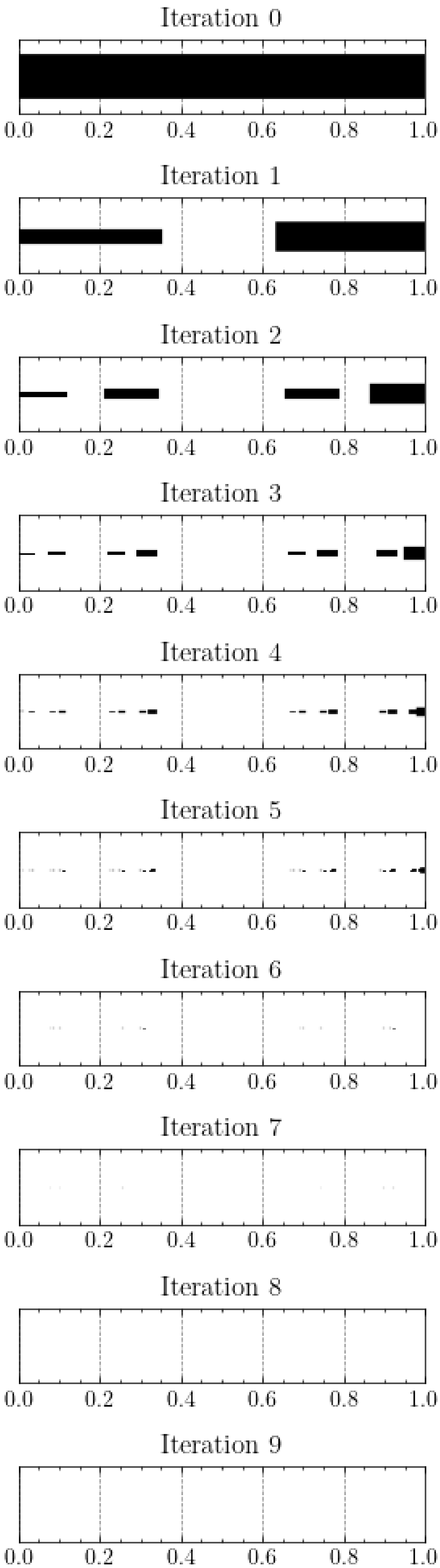
In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
import scienceplots
plt.style.use(['science','grid'])
```

In [8]:
```
alculate_segments(n):

 Start with the full segment (0, 1) and probability 1
egments = [(0, 1, 1)]
or _ in range(n):
   new_segments = []
   for start, end, prob in segments:
       third = (end - start) / 3
       left_segment = (start, start + third, prob * 1/3)  # Left th
       right_segment = (end - third, end, prob * 2/3)     # Right t
       new_segments.extend([left_segment, right_segment])
   segments = new_segments
eturn segments

lot_cantor_set(iterations):

ig, axs = plt.subplots(iterations, 1, figsize=(3, iterations*1))
or n in range(iterations):
   segments = calculate_segments(n)
   for start, end, prob in segments:
       axs[n].plot([start, end], [0, 0], linewidth=prob * 20, color
   axs[n].set_xlim([0, 1])
   axs[n].set_ylim([-1/((n+1)**2), 1/((n+1)**2)])
   axs[n].set_yticks([])
   axs[n].set_title(f"Iteration {n}")

lt.tight_layout()
lt.show()

ber of iterations to plot
terations = 10
cantor_set(num_iterations)
```



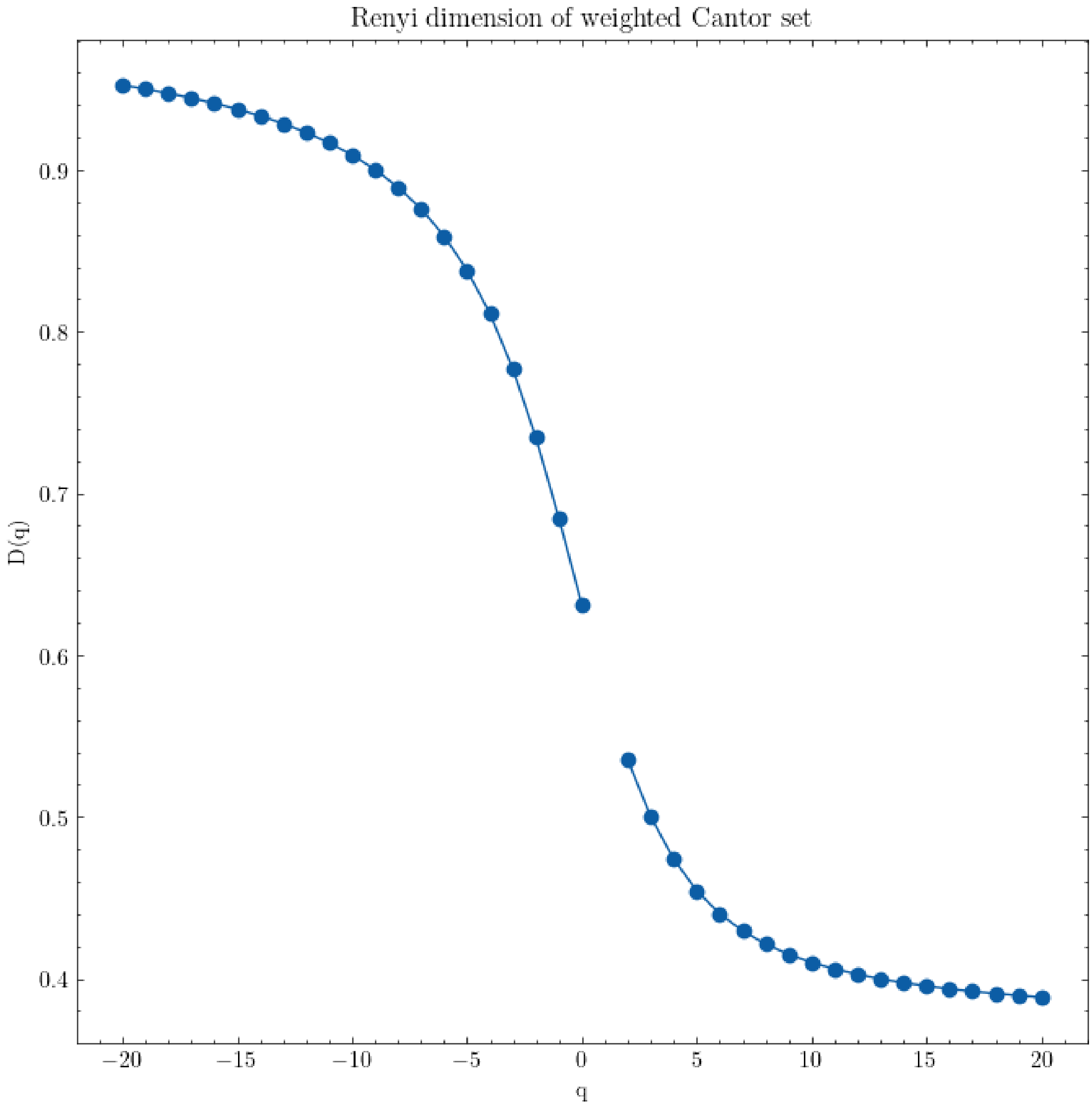
plot D_q in the range for q $\in [-20, 20]$

In [3]:
```
def getRenyiDimension(q):
    term1 = np.log(float(2)**(q) + 1)
    term2 = - q * np.log(3)
    term3 = (1-q) * np.log(3)
    renyi = (term1 + term2) / term3

    return renyi
```

In [4]:
```
#
qMin = -20
qMax = 20
q_ = np.arange(qMin, qMax+1)
Dq = np.zeros(q_.shape)

for i in range(len(q_)):
    q = q_[i]
    Dq[i] = getRenyiDimension(q)
```

```
/var/folders/gt/mfl3krb11tg0vm1rn1bxgmfh0000gn/T/ipykernel_69021/
3726201848.py:5: RuntimeWarning: invalid value encountered in dou
ble_scalars
  renyi = (term1 + term2) / term3
```

In [5]:
```
# visualize the result
plt.figure(figsize=(8,8))
plt.plot(q_, Dq, 'o-')
plt.xlabel('q')
plt.ylabel('D(q)')
plt.grid()
plt.title('Renyi dimension of weighted Cantor set')
plt.show()
```



The gap between [0,1] is due to the limit $\frac{1}{1-q}$ for $q = 1$

c.) evaluate D1 and D2

In [6]:
```python
import sympy as sp

# Define the variable
q = sp.symbols('q')

# Define the expression
expression = (sp.log(2**q + 1) - q * sp.log(3)) / ((1 - q) * sp.lo

# Applying L'Hospital's Rule for q = 1
# First, we need to compute the derivative of the numerator and th

numerator = sp.log(2**q + 1) - q * sp.log(3)
denominator = (1 - q) * sp.log(3)

# Derivatives
numerator_derivative = sp.diff(numerator, q)
denominator_derivative = sp.diff(denominator, q)

# Evaluate the derivatives for q = 1
result_lhospital_q1 = numerator_derivative.subs(q, 1) / denominato

result_lhospital_q1.simplify()
print(result_lhospital_q1)

# evaluate D2 for q = 2
result_for_q_2 = expression.subs(q, 2).simplify()
print(result_for_q_2)

# print both in []
print("\n \nOutput for OpenTa:")
print([result_lhospital_q1, result_for_q_2])
```

```
-(-log(3) + 2*log(2)/3)/log(3)
-log(5)/log(3) + 2


Output for OpenTa:
[-(-log(3) + 2*log(2)/3)/log(3), -log(5)/log(3) + 2]
```

d.) Copmute $D_{-\infty}$ and D_{∞}

In [7]:
```python
# compute the symbolic expression for D_(-inf) and D_(+inf)
D_minus_inf = sp.limit(expression, q, -sp.oo)
D_plus_inf = sp.limit(expression, q, sp.oo)

print("\n \nOutput for OpenTa:")
print([D_minus_inf, D_plus_inf])
```

```


Output for OpenTa:
[1, -log(2)/log(3) + 1]
```

In [ ]:

```
```