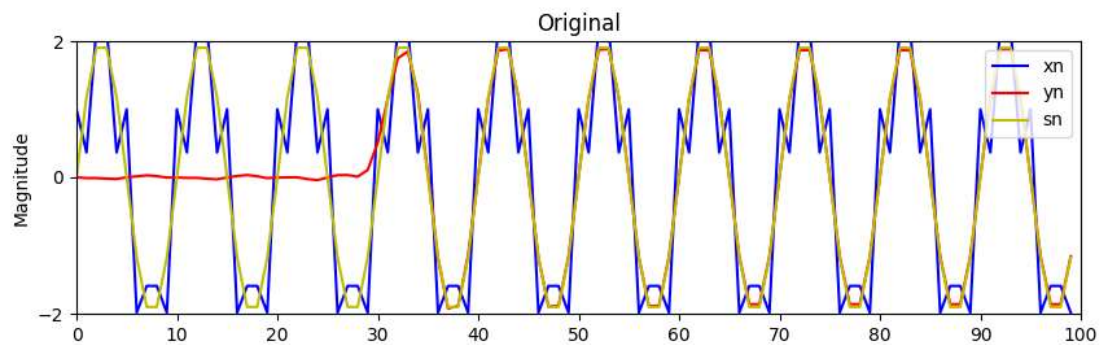


HW3-3

a)

程式輸出結果



程式碼

```
1 import numpy as np
2 import matplotlib.pyplot as plt
3 import scipy.signal
4 from matplotlib.pyplot import MultipleLocator
5 # Create a simple signal
6 fs = 5000
7 f1 = 500
8 f2 = 2000
9 t = np.linspace(0, 99, 100)
10
11 xn = 2*np.sin( 2 * np.pi * f1 / fs * t ) + np.cos( 2 * np.pi * f2 / fs * t )
12 sn = 2*np.sin(2*np.pi*f1*t/fs)
13
14 l = np.linspace(0, 60, 61)
15 b = 0.4*np.sinc(0.4*(l-30))
16 a = np.array([1.0])
17
18 w, gd = scipy.signal.group_delay((b, a))
19 print(np.mean(gd))
20 yn = scipy.signal.lfilter(b,a,xn)
21 plt.figure(figsize=(10, 6))
22 plt.subplot(2, 1, 1)
23 plt.plot(t, xn,color='b', label='xn')
24 plt.plot(t, yn,color='r', label='yn')
25 plt.plot(t, sn,color='y', label='sn')
26 plt.xlim(0, 100)
27 plt.ylim(-2, 2)
28 plt.gca().xaxis.set_major_locator(MultipleLocator(10))
29 plt.gca().yaxis.set_major_locator(MultipleLocator(2))
30 plt.title('Original')
31 plt.ylabel('Magnitude')
32 plt.legend(loc='upper right')
33 plt.show()
```

b) `30.000000000005113`

因為 $x(t)$ 經過 bl 中長度減掉 30，表示前

30 個頻率點為延遲的故造成 group delay