FYS2130 oblig 3 Vibishan

1) Frekvensbånd: 9 kHz, frekvens: 1313 kHz

$$\text{Q-faktor} = \frac{f_{center}}{f_2 - f_1} = \frac{f_{center}}{\text{frekvensbånd}} = \frac{1313\ \text{kHz}}{9\ \text{kHz}}$$

$$Q = 145.\dot{8} \approx 146$$

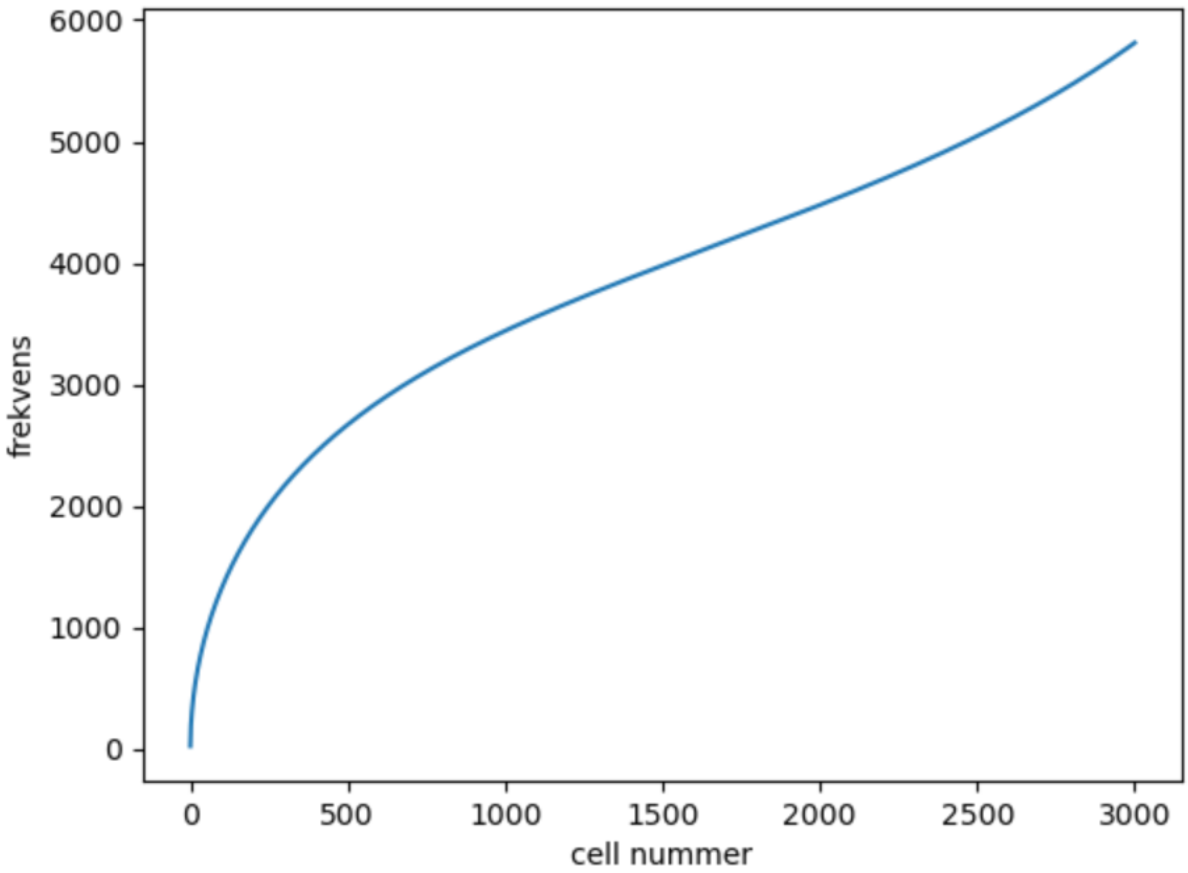
Oppgave 2A

Langs membranen øker tettheten og størrelsen forandrer seg. Dermed øker stivheten.

Oppgave 2B & 2C

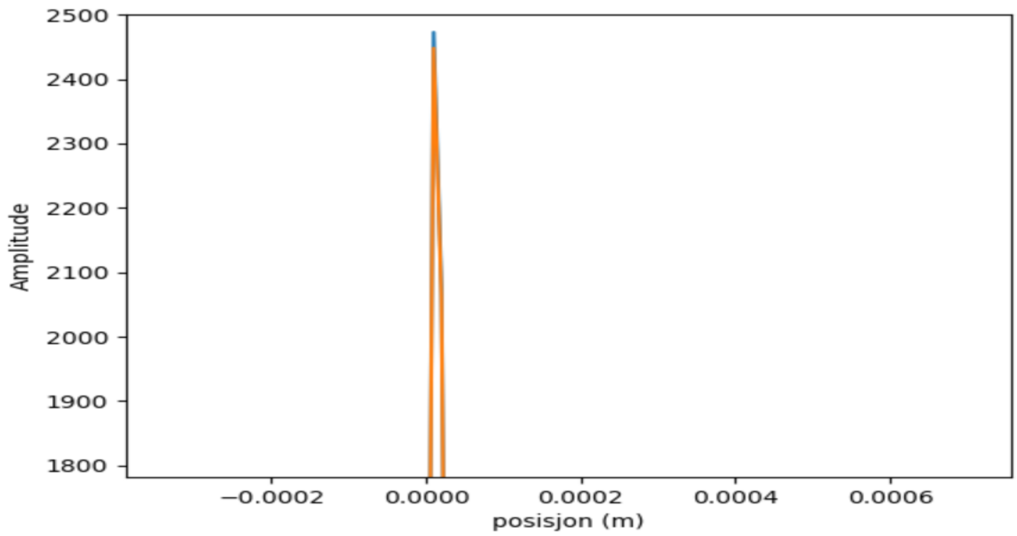
```
import numpy as np
from numpy import pi, sqrt
import matplotlib.pyplot as plt


#oppgave 2B
N = 3000  #cell total
length_tot = 0.03 #30mm in m
Lcell = length_tot/3000 #length per cell

height = np.linspace(0.0003, 0.0001, N)
width = np.linspace(0.0001, 0.0003, N)
density = np.linspace(1500, 2500, N)
volume = np.zeros(N)

for i in range (N):
    volume[i] = height[i]*width[i]*Lcell

def masse(l):
    mass = density[l] * volume[l]
    return mass

print(masse(2))

#Oppgave 2C

cell = np.linspace(0,3000,3000) #cell number
k = np.linspace(10e-6,10e-1,3000)#fjærstivhet

frekvens = np.zeros(3000)
```

```
for i in range (3000):
    frekvens[i] = (1/(2*pi)) * sqrt(k[i]/masse(i))

plt.plot(cell, frekvens)
plt.xlabel('cell nummer')
plt.ylabel('frekvens (Hz)')
plt.show()
```



Oppgave 2D

```
import numpy as np
import numpy as np
import matplotlib.pyplot as plt
from numpy import sqrt, pi

N=3000
height = np.linspace(0.0003, 0.0001, N)
width = np.linspace(0.0001, 0.0003, N)
density = np.linspace(1500, 2500, N)
L=1e-5
m = height*width*density*L

k=np.linspace(10e-6,10e-1,3000)
f=(1/2*pi)*sqrt(k/m)

C4=261.63
C4s=277.18
C4w=2*pi*C4
C4sw=2*pi*C4s
F=1
b=10**(-7)

aC4 =(F/m)/(sqrt((f**2-C4w**2)**2+(b*C4w/m)**2))
aC4s=(F/m)/(sqrt((f**2-C4w**2)**2+(b*C4sw/m)**2))

x = np.linspace(0,0.03,3000)
plt.plot(x,aC4)
plt.plot(x,aC4s)

plt.xlabel("posisjon (m)")
plt.ylabel("Amplitude")
plt.show()
```



Oppgave 3

3a)

$$\frac{\partial^2 Q}{dt} + \frac{R}{L}\frac{dQ}{dt} + \frac{1}{LC} = \frac{V_0}{L}\cos(w_F t)$$

$$\Rightarrow \ddot{x} + \frac{b}{m}\dot{x} + \omega_0^2 \dot{x} = \frac{F}{m}\cos(w_F t)$$

$$\frac{b}{m} = \frac{R}{L}, \quad \omega_0^2 = \frac{1}{LC}, \quad \frac{F}{m} = \frac{V_0}{L}$$

faseskift: $\cot\phi = \dfrac{w_0^2 - w_F^2}{w_F\, b/m} = \dfrac{\left(\frac{1}{LC}\right) - w_F^2}{R\,\frac{V_0}{L}}$

amplitude: $A = \dfrac{F/m}{\sqrt{(w_0^2 - w_F^2)^2 + (w_F\, b/m)}}$

$$Q = \sqrt{\frac{km}{b^2}} = \sqrt{\frac{L}{R^2 C}}$$

3b) $L = 25\,\mu H$, $R = 1{,}0\,\Omega$, $C = 100\,nF$

$$Q = \sqrt{\frac{2{,}5 \cdot 10^{-6}\ H}{(\Omega)^2 \cdot 100 \cdot 10^{-9}\ F}} = 15{,}8$$