

PHYS512_HW2

September 23, 2022

```
[1]: import scipy as sp
import numpy as np
import matplotlib.pyplot as plt
from scipy import integrate
import sys
if not sys.warnoptions:
    import warnings
    warnings.simplefilter("ignore")
import math
```

1 Problem 1

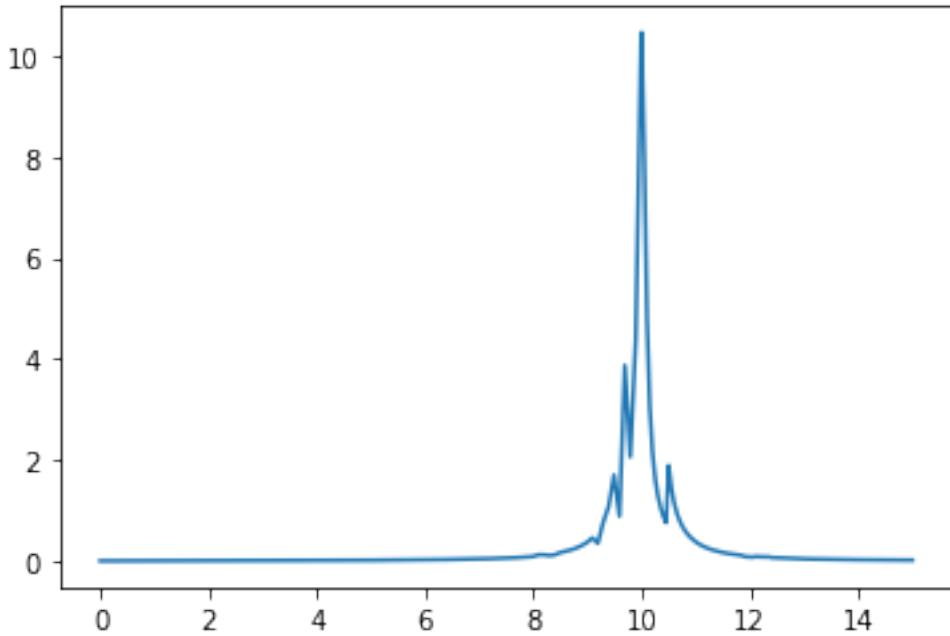
```
[2]: """
Work on the field from the spherical shell. Take a ring, expand to the shell for
→z < R and z > R.

"""

= 2 * 10**-13 # surface density
R = 10 # radius of the shell
_o = 8.85 * 10**-12
z_l_R = np.linspace(0, R-0.01, 101) # inside of the shell, values at z = R
→excluded
z_b_R = np.linspace(R, 15, 101) # outside of the shell and at z = R
z = np.hstack([z_l_R, z_b_R])
E_f = []
r = []
for i in range(len(z)):
    E = lambda : (1/(4*np.pi*_o)) * * R**2 * (z[i] - R * np.cos(* 180/np.
→pi))/(R**2 + z[i]**2 + 2*R*z[i]*np.cos(* 180/np.pi))**(3/2)
    r.append(z[i])
    E_f.append(sp.integrate.quad(E, 0, np.pi)[0])

plt.plot(r, E_f)
```

```
[2]: []
```



2 Problem 2

3 Problem 3

```
[19]: deg = 6
x = np.linspace(0.5, 1, 1001)
fun = math.log2
y = []
for i in range(len(x)):
    y.append(fun(x[i])) # finding log2(x) functions

cheb = np.polynomial.chebyshev.chebfit(x, y, deg - 1) # Chebyshev Coefficients

def chebyshev_pol(x, cheb):
    yy = []
    for i in range(len(x)):
        p = 0 # p(x)
        T = [1] # list of Chebyshev polynomials (defined separately for each x)
        for j in range(deg):
            if j == 0:
                p = p + cheb[j] * T[0] # first term of the polynomial with c_0
            elif j == 1:
                T.append(x[i])
                p += cheb[j] * T[1] # second term of the polynomial with c_1
            else:
```

```

        p += cheb[j] * (2*x[i] *T[j-1] - T[j-2]) # following terms of ↵
    ↵the polynomial
        T.append(2*x[i] *T[j-1] - T[j-2])

yy.append(p)

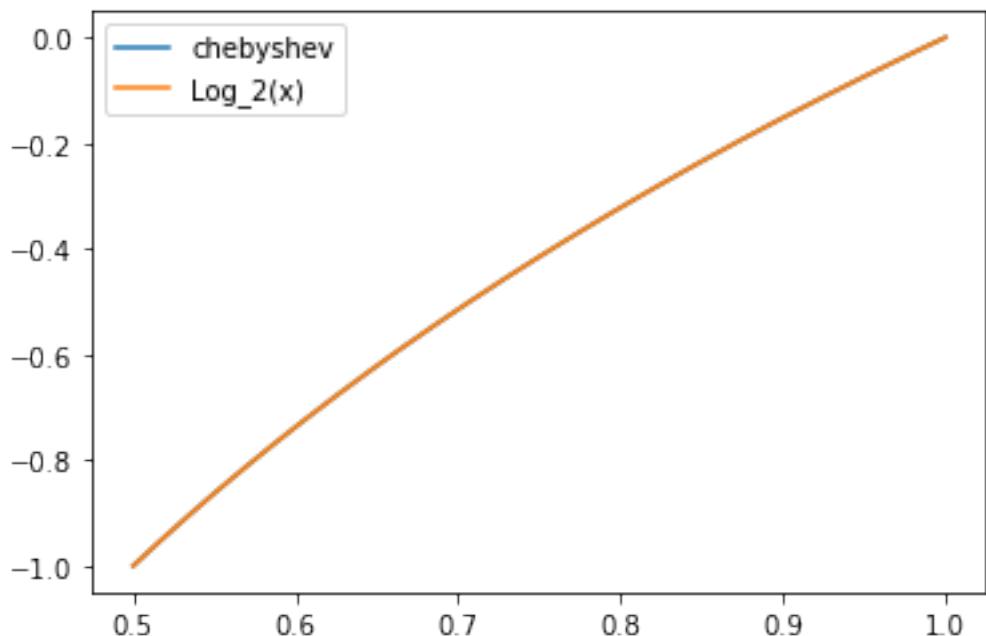
return yy

plt.plot(x, chebyshev_pol(x, cheb) , label = 'chebyshev')
plt.plot(x, y, label = 'Log_2(x)')
plt.legend()

print('Error is: ', np.sqrt(np.mean((np.array(y) - np.array(chebyshev_pol(x, cheb))))**2)))

```

Error is: 7.58174689141421e-06



[]: