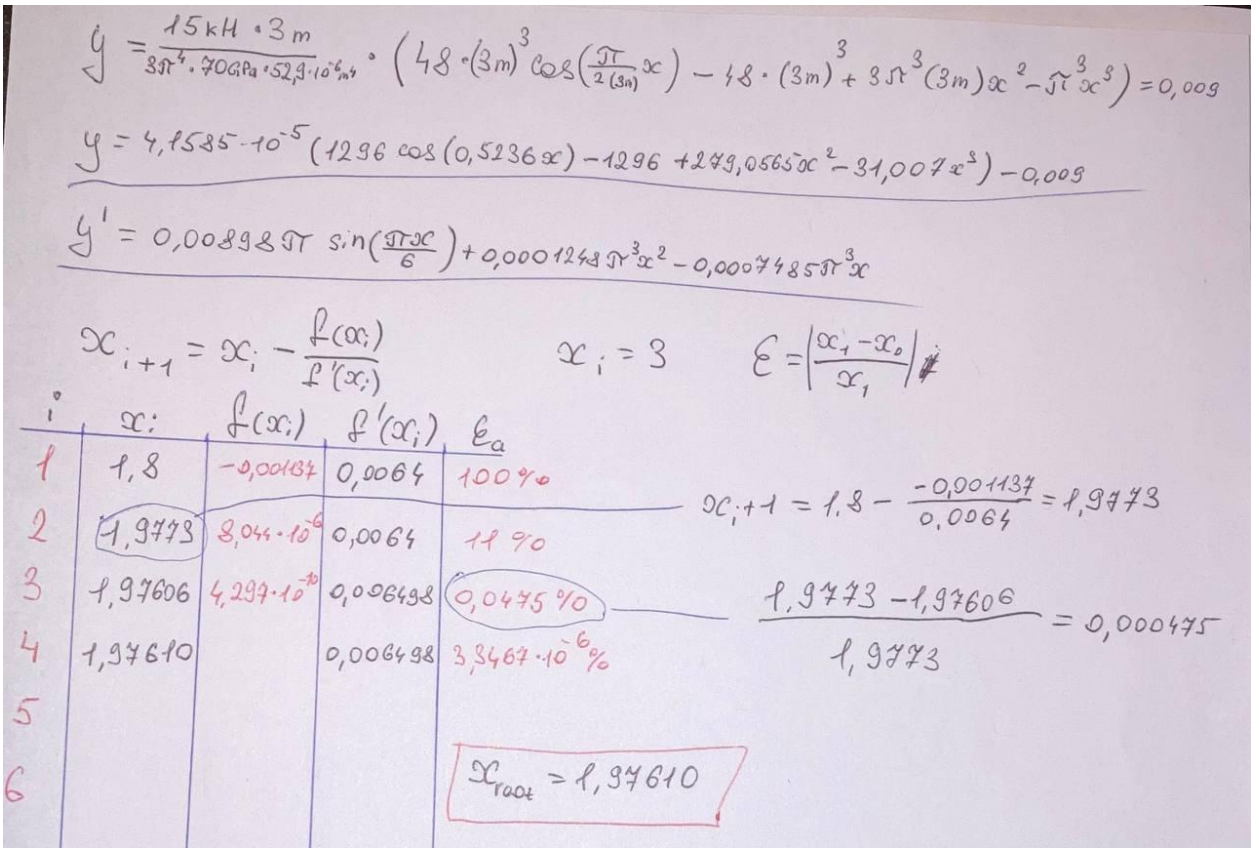
Problem 1

```
import math
import time

def f(x):
    res = (4.1585*10**-5)*(1296*math.cos(0.5236*x)-1296+279.0565*x**2-31.007*x**3)-0.009
    return res

def dfdx(x):
    res = abs(0.00898*math.pi*math.sin((math.pi*x)/6)+0.0001248*((math.pi)**3)*x**2-
0.0007485*((math.pi)**3)*x)
    return res

i = 1  # initial iteration
x0 = 1.8  # Initial guess
err = 1 #initial error
xi_1 = x0


print("Iteration: " + str(i) + ": x = " + str(x0) + ", f(x) = " +
        str(f(x0)) + "f'(x) = " + str(dfdx(x0)) + "ERROR = " + str(err))

# Iterating until either the tolerance or max iterations is met
while err > 0.0001:
    time.sleep(0.1)
    i = i + 1
    xi = xi_1-f(xi_1)/abs(dfdx(xi_1))
```

```
err = abs((xi-xi_1)/xi)
print("Iteration: " + str(i) + ": x = " + str(xi) + ", f(x) = " +
    str(f(xi)) + "f'(x) = " + str(dfdx(xi)) + "ERROR = " + str(err))
#err = abs((xi-xi_1)/xi)
#print(err)
xi_1 = xi
```

```
>>> %Run 'CFD HW 3.py'
Iteration: 1: x = 1.8, f(x) = -0.0011372074972175305f'(x) = 0.006413722004639834ERROR = 1
Iteration: 2: x = 1.9773085107827948, f(x) = 8.098908431159943e-06f'(x) = 0.006498105070439908ERROR = 0.08967164699685648
Iteration: 3: x = 1.9760621615250702, f(x) = -3.028601189281055e-10f'(x) = 0.006497645246852146ERROR = 0.0006307237100085462
Iteration: 4: x = 1.9760622081358203, f(x) = 2.1913026948539027e-14f'(x) = 0.006497645264080185ERROR = 2.358769372570388e-08
>>>
```



i	x_i	$f(x_i)$	$f'(x_i)$	ε_a
1	1,8	-0,001137	0,0064	100 %
2	1,9773	$8,044 \cdot 10^{-6}$	0,0064	11 %
3	1,97606	$4,297 \cdot 10^{-10}$	0,006498	0,0475 %
4	1,97610		0,006498	$3,3467 \cdot 10^{-6}$ %
5				
6				

Problem 2

```
import time

print(" example = 3*x1+4*x2-x3 -> A*x1+B*x2-C*x3")

x11 = float(input("Equation 1 A=?"))
x12 = float(input("Equation 1 B=?"))
x13 = float(input("Equation 1 C=?"))
a1 = float(input("= ?: "))

x21 = float(input("Equation 2 A=?"))
x22 = float(input("Equation 2 B=?"))
x23 = float(input("Equation 2 C=?"))
a2 = float(input("= ?: "))

x31 = float(input("Equation 3 A=?"))
x32 = float(input("Equation 3 B=?"))
x33 = float(input("Equation 3 C=?"))
a3 = float(input("= ?: "))

print("original matrix: ")
print(x11, x12, x13, "|", a1)
print(x21, x22, x23, "|", a2)
print(x31, x32, x33, "|", a3)

time.sleep(1)
```

```
A = x21 - x11*(x21/x11)
B = x22 - x12*(x21/x11)
C = x23 - x13*(x21/x11)
a2 = a2 - a1*(x21/x11)

A1 = x31 - x11*(x31/x11)
B1 = x32 - x12*(x31/x11)
C1 = x33 - x13*(x31/x11)
a3 = a3 - a1*(x31/x11)

print("first row pivoting matrix: ")
print(x11, x12, x13, "|", a1)
print(A, B, C, "|", a2)
print(A1, B1, C1, "|", a3)

time.sleep(1)

A1 = A1 - A*(B1/B)
B11 = B1 - B*(B1/B)
C1 = C1 - C*(B1/B)
a3 = a3 - a2*(B1/B)

print("second row pivoting matrix: ")
print(x11, x12, x13, "|", a1)
print(A, B, C, "|", a2)
print(A1, B11, C1, "|", a3)
```

time.sleep(1)

x3 = a3/C1

*x2 = (a2 - C*x3)/B*

*x1 = (a1 - x12*x2 - x13*x3)/x11*

print("root of the matrix is: ", "x1 = ", x1, "x2 = ", x2, "x3 = ", x3)

```
>>> %Run 'CFD HW 3.1.py'
 example = 3*x1+4*x2-x3 -> A*x1+B*x2-C*x3
Equation 1 A=?8
Equation 1 B=?2
Equation 1 C=?-2
= ?: -2
Equation 2 A=?10
Equation 2 B=?2
Equation 2 C=?4
= ?: 4
Equation 3 A=?12
Equation 3 B=?2
Equation 3 C=?2
= ?: 6
original matrix:
8.0 2.0 -2.0 | -2.0
10.0 2.0 4.0 | 4.0
12.0 2.0 2.0 | 6.0
first row pivoting matrix:
8.0 2.0 -2.0 | -2.0
0.0 -0.5 6.5 | 6.5
0.0 -1.0 5.0 | 9.0
second row pivoting matrix:
8.0 2.0 -2.0 | -2.0
0.0 -0.5 6.5 | 6.5
0.0 0.0 -8.0 | -4.0
root of the matrix is:  x1 =  1.5 x2 =  -6.5 x3 =  0.5
```

$\frac{10}{8} = \frac{5}{4}$

$$\begin{aligned} 8x_1 + 2x_2 - 2x_3 &= -2 \\ 10x_1 + 2x_2 + 4x_3 &= 4 \\ 12x_1 + 2x_2 + 2x_3 &= 6 \end{aligned}$$

$$\left|\begin{array}{ccc|c} 8 & 2 & -2 & -2 \\ 10 & 2 & 4 & 4 \\ 12 & 2 & 2 & 6 \end{array}\right| \quad \begin{array}{l} R_2 - \frac{10}{8} R_1 \\ R_3 - \frac{3}{2} R_1 \end{array}$$

$$\left|\begin{array}{ccc|c} 8 & 2 & -2 & -2 \\ 0 & -0{,}5 & 6{,}5 & 6{,}5 \\ 0 & -1 & 5 & 9 \end{array}\right| \quad R_3 - R_2 \cdot 2$$

$$\left|\begin{array}{ccc|c} 8 & 2 & -2 & -2 \\ 0 & -0{,}5 & 6{,}5 & 6{,}5 \\ 0 & 0 & -8 & -4 \end{array}\right|$$

$-8x_3 = -4$

$x_3 = 0{,}5$

$-0{,}5x_2 + 6{,}5 \cdot 0{,}5 = 6{,}5$

$x_2 = -6{,}5$

$8x_1 + 2 \cdot (-6{,}5) - 2 \cdot 0{,}5 = -2$

$x_1 = 1{,}5$