Assignment 1 2DT903

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Part 1

```
Input signals are 1.75, 2, 3 kHz

f (Sample rate) = 5 kHz

f (Nyquist rate) = 2 * 3 kHz = 6 kHz

f (Sample rate) < f (Nyquist rate)
```

Due to the fact that the sample rate is less than the the Nyquist rate. This means that the sample rate of 5 kHz cant reconstruct the outputs of 1.75, 2 and 3 kHz.

Part 2

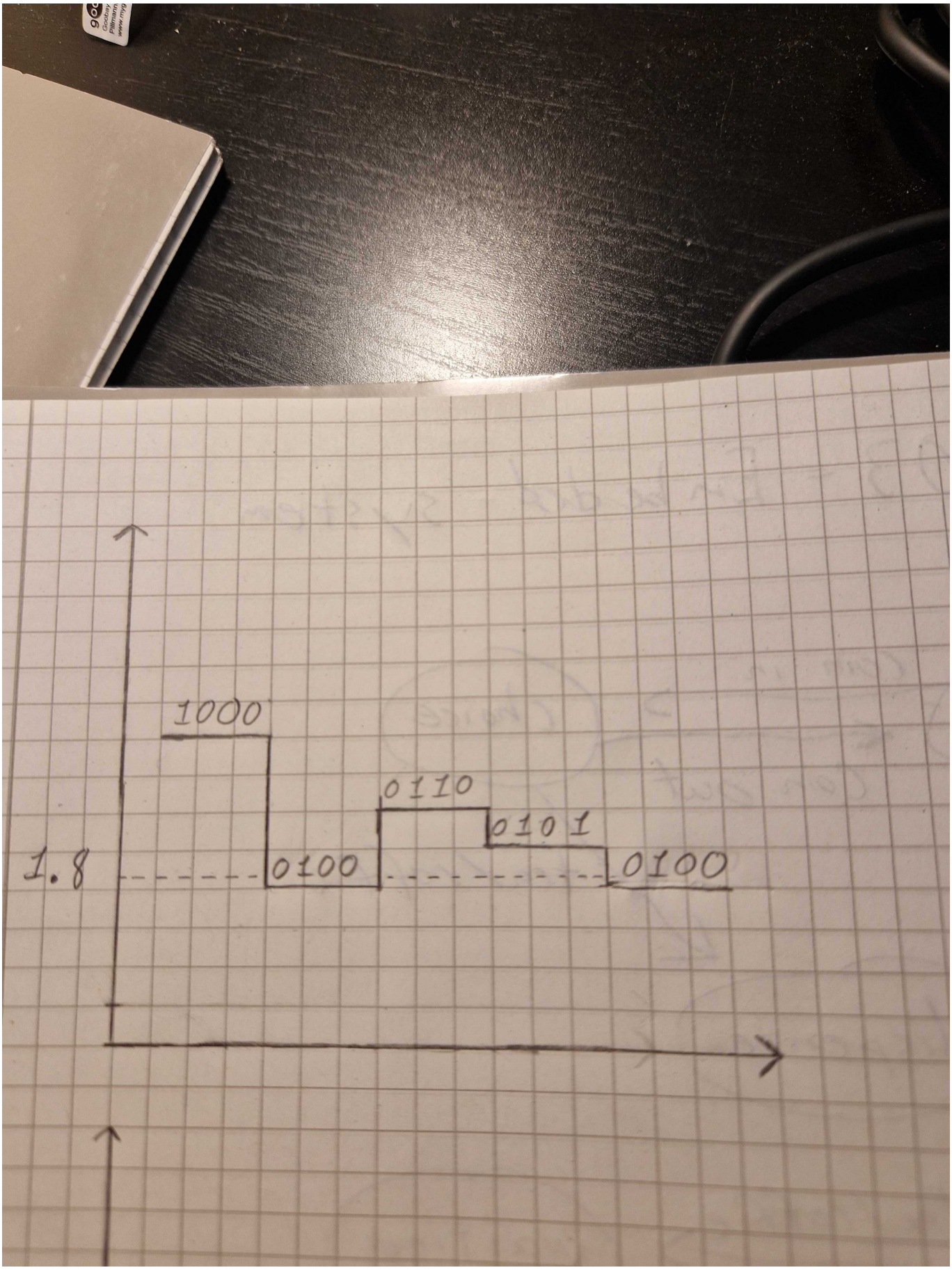
```
Vmin = 0.5
Vmax = 5
N = log(16)

Stepsize = (Vmax - Vmin) / (2^N - 1)

Stepsize = (5 - 0.5) / (2⁴ - 1)  = 4.5 / 15

Step size = 0.3
```

```
(0000) = 0.5
(0001) = 0.8
(0010) = 1.1
(0011) = 1.4
(0100) = 1.7
(0101) = 2.0
(0110) = 2.3
(0111) = 2.6
(1000) = 2.9
(1001) = 3.2
(1010) = 3.5
```

```
(1011) = 3.8
(1100) = 4.1
(1101) = 4.4
(1110) = 4.7
(1111) = 5.0
```

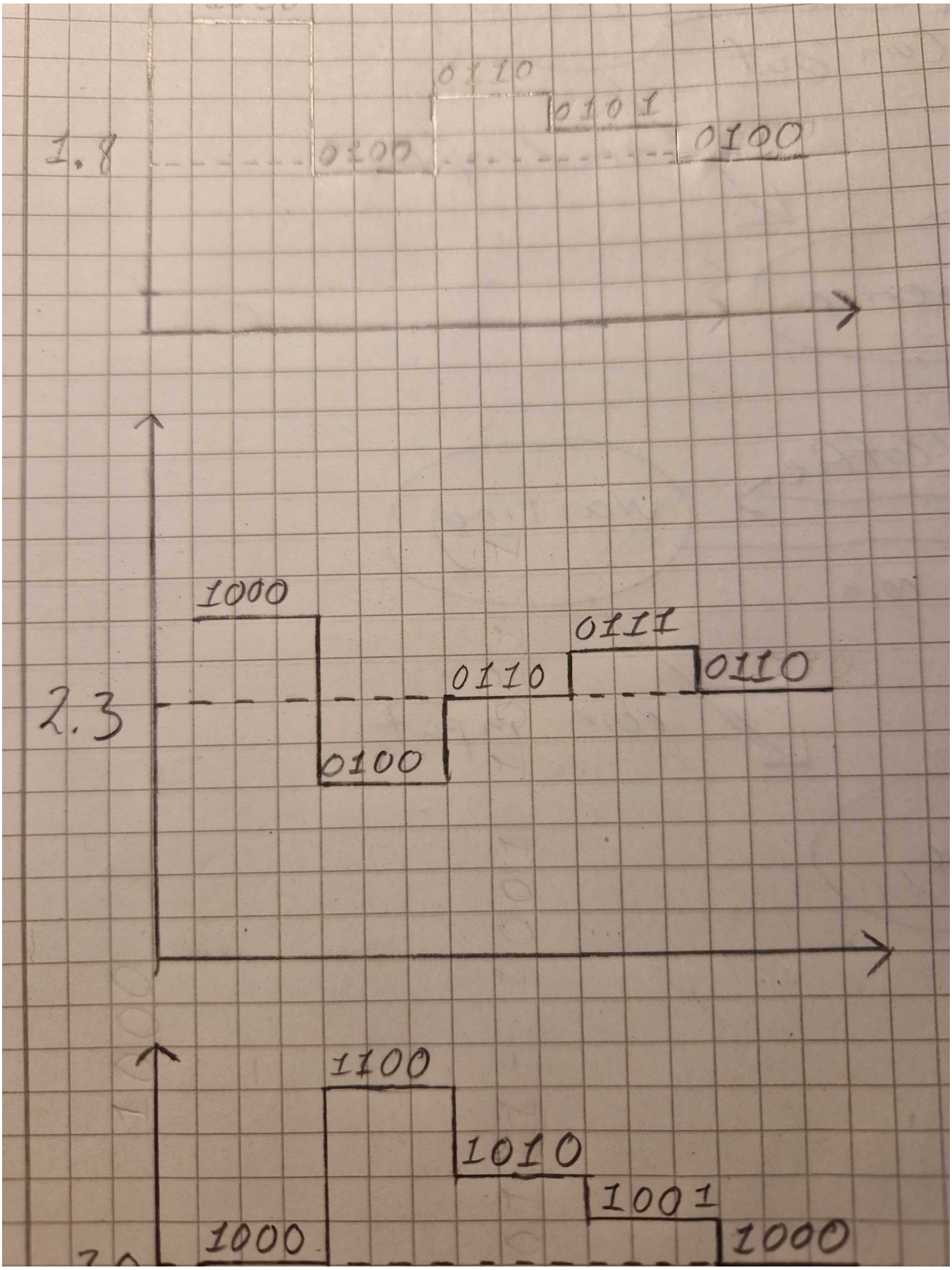
1.8 V

```
(1000) = 2.9
1.8 < 2.9 --> MSB = 0

(0100) = 1.7
1.8 > 1.7 --> MSB = 1

(0110) = 2.3
1.8 < 2.3 -->B = 0

(0101) = 2.0
1.8 < 2.0 -- MSB = 0

1.8 = (0100)
```



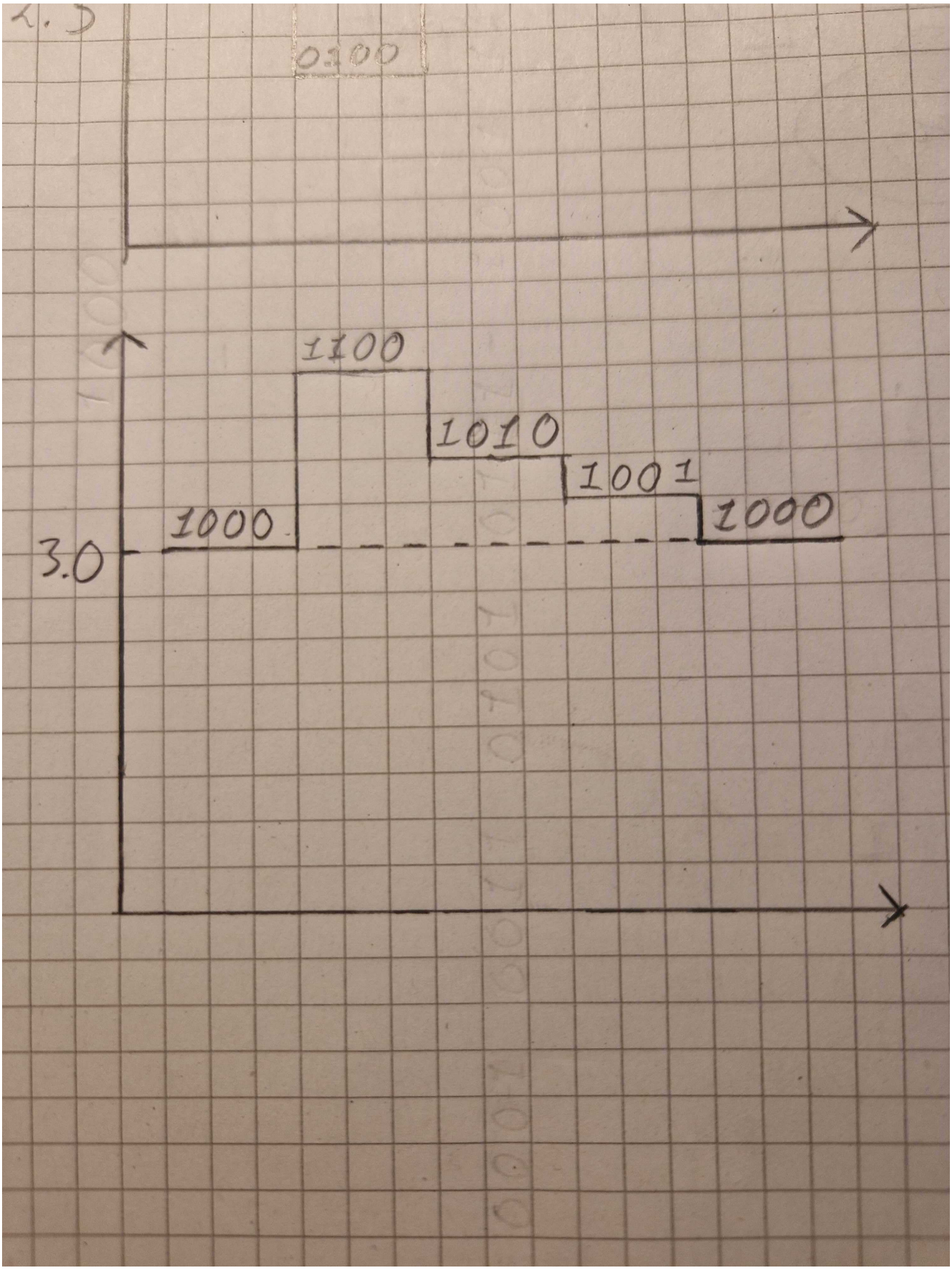
2.3 V

```
(1000) = 2.9
2.3 < 2.9 --> MSB = 0

(0100)
2.3 > 1.7 --> MSB = 1

(0110) = 2.3
2.3 >= 2.3 --> MSB = 1

(0111) = 2.6
2.3 < 2.6 --> MSB = 0

2.3 = (0110)
```


1.8
0100
0110
0101
0100
2.3
1000
0100
0110
0111
0110
3.0
1000
1100
1010
1001
1000

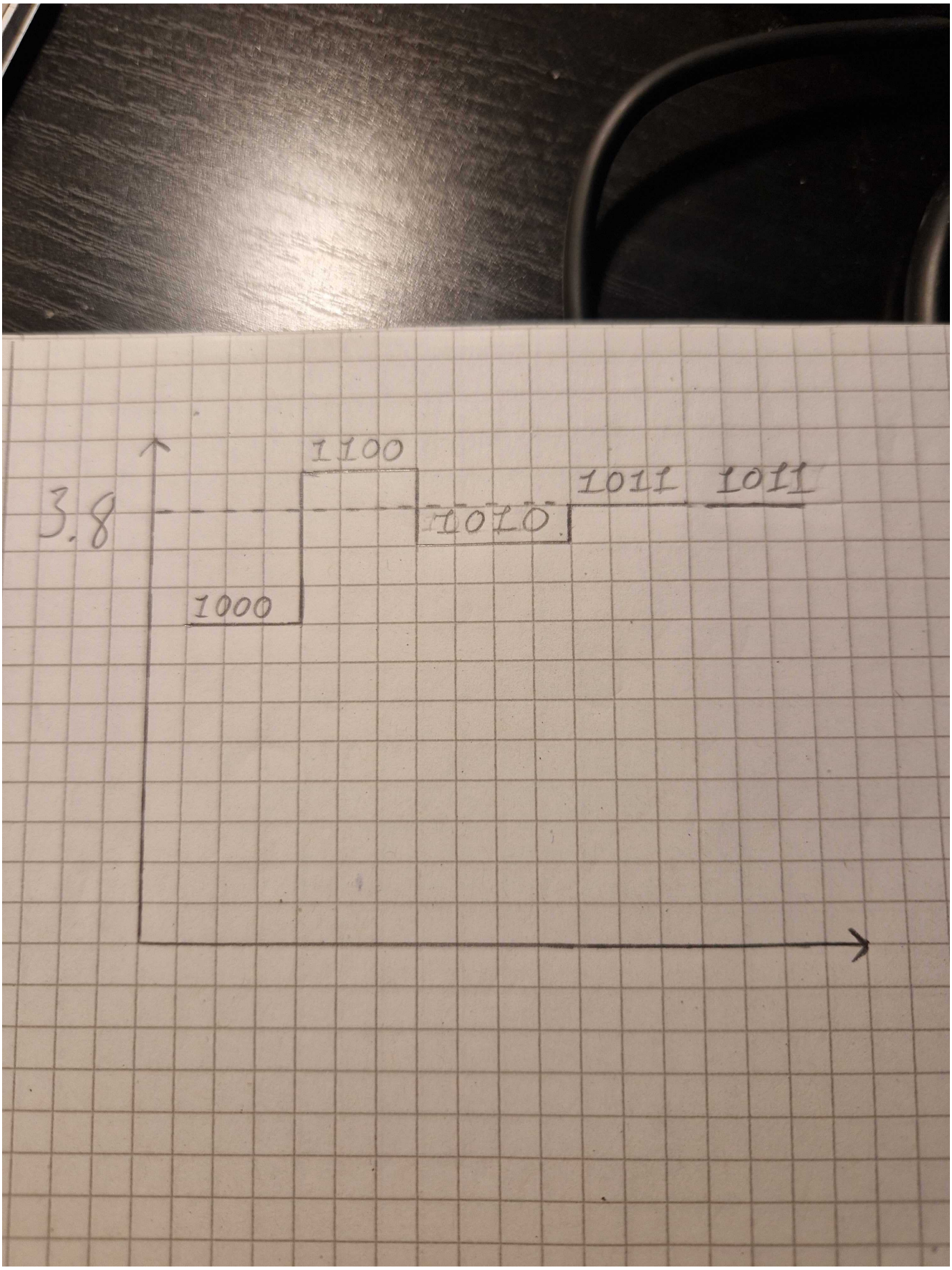
3.0 V

```
(1000) = 2.9
3.0 > 2.9 --> MSB = 1

(1100) = 4.1
3.0 < 4.1 --> MSB = 0

(1010) = 3.5
3.0 < 3.5 --> MSB = 0

(1001) = 3.2
3.0 < 3.2 --> MSB = 0

3.0 = (1000)
```



3.8 V

```
(1000) = 2.9
3.8 > 2.9 --> MSB = 1

(1100) = 4.1
3.8 < 4.1 --> MSB = 0

(1010) = 3.5
3.8 > 3.3125 --> MSB = 1

(1011) = 3.8
3.8 >= 3.8 --> MSB = 1

3.8 = (1011)
```



Part 3

First

```
f = CPU Clock Frequency / ADC Conversion Cycle

f = frequency

CPU Clock Frequency = 48 *10^6

ADC Conversion Cycle = 96

f = 48 * 10^6 / 96 = 5 * 10^5

f = 500 KHz
```

Second

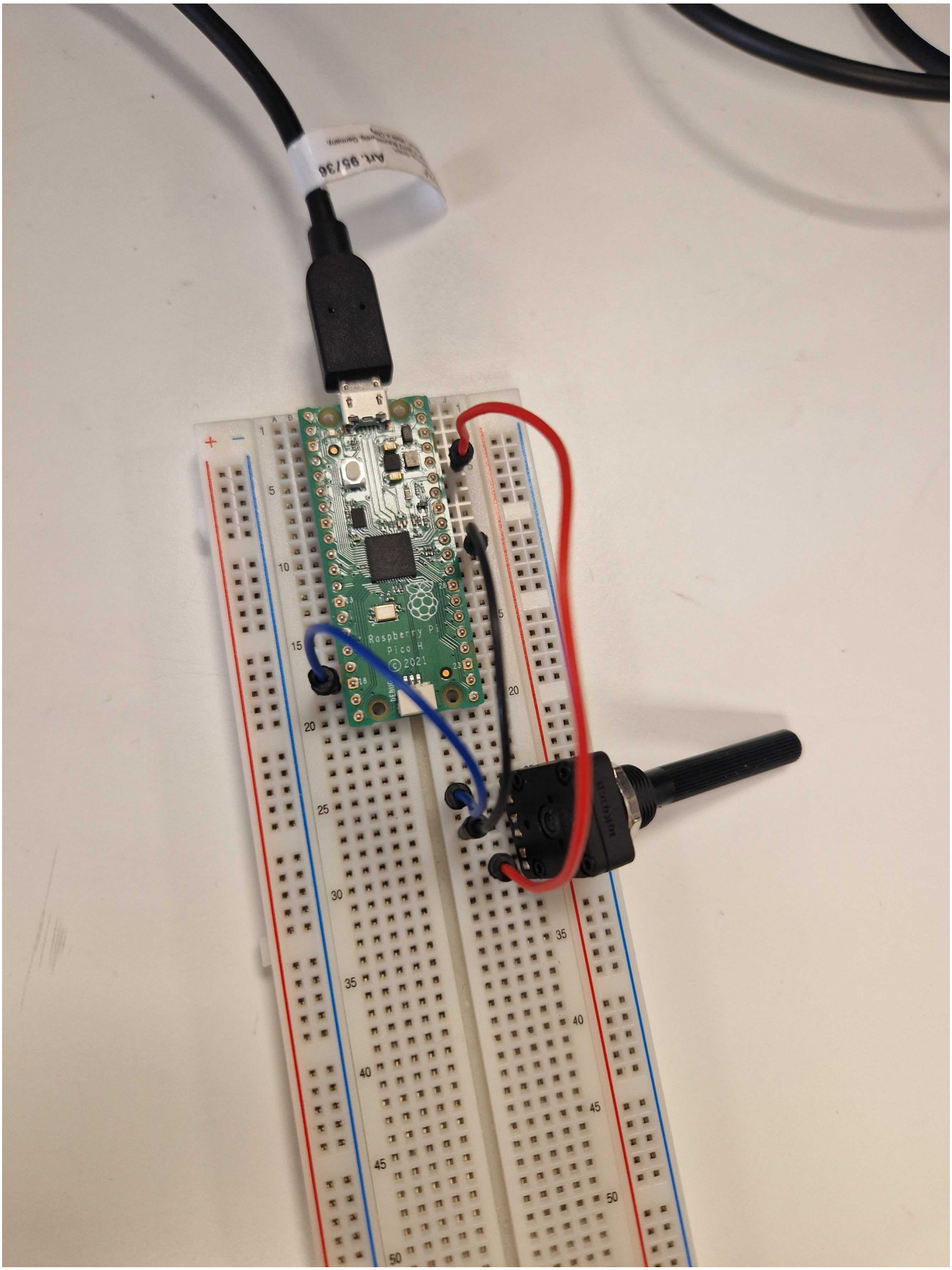
```
Resolution = (Vmax - Vmin) / (2^n -1)

n = 12

Vmax = 3.3

Vmin = 0

Resolution = 3.3 / (2^12 - 1)

Resolution = 3.3 / 4095

Resolution = 0.00080586= 0.80586 mV
```

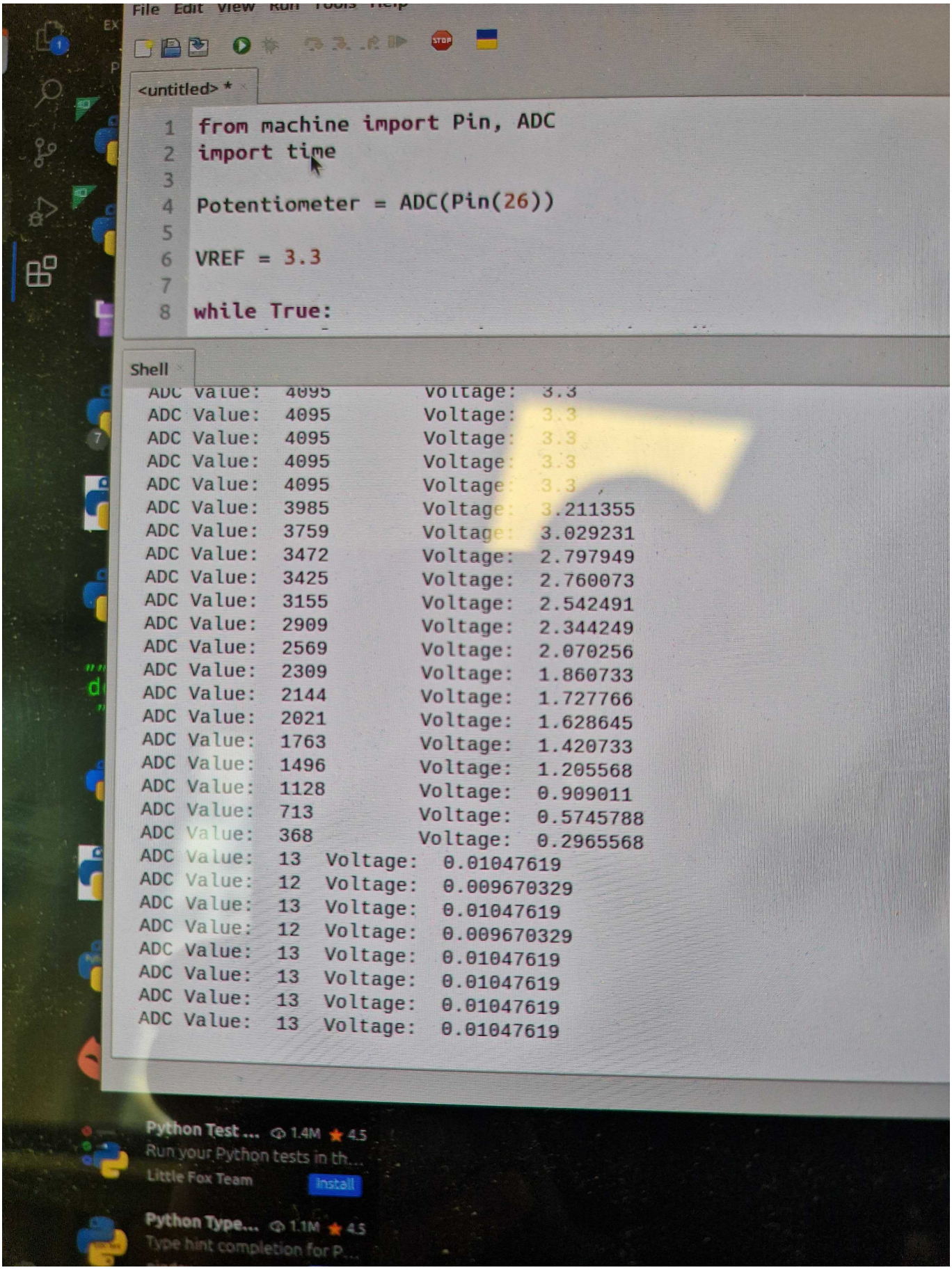
Third

```
from machine import Pin, ADC
import time

Potentiometer = ADC(Pin(26))

VREF = 3.3

while True:
    adc_value = Potentiometer.read_u16()

    adc_value_12bit = adc_value >> 4

    voltage = (adc_value_12bit / 4095) * VREF
```

```
    print("ADC Value: ", adc_value_12bit, "\tVoltage: ", voltage)

    time.sleep(1)
```

Pictures


Art. 95736
Raspberry Pi
Pico H
©2021


File Edit View Run Tools Help
<untitled> *
1 from machine import Pin, ADC
2 import time
3
4 Potentiometer = ADC(Pin(26))
5
6 VREF = 3.3
7
8 while True:
Shell
ADC Value: 4095 Voltage: 3.3
ADC Value: 4095 Voltage: 3.3
ADC Value: 4095 Voltage: 3.3
ADC Value: 4095 Voltage: 3.3
ADC Value: 4095 Voltage: 3.3
ADC Value: 3985 Voltage: 3.211355
ADC Value: 3759 Voltage: 3.029231
ADC Value: 3472 Voltage: 2.797949
ADC Value: 3425 Voltage: 2.760073
ADC Value: 3155 Voltage: 2.542491
ADC Value: 2909 Voltage: 2.344249
ADC Value: 2569 Voltage: 2.070256
ADC Value: 2309 Voltage: 1.860733
ADC Value: 2144 Voltage: 1.727766
ADC Value: 2021 Voltage: 1.628645
ADC Value: 1763 Voltage: 1.420733
ADC Value: 1496 Voltage: 1.205568
ADC Value: 1128 Voltage: 0.909011
ADC Value: 713 Voltage: 0.5745788
ADC Value: 368 Voltage: 0.2965568
ADC Value: 13 Voltage: 0.01047619
ADC Value: 12 Voltage: 0.009670329
ADC Value: 13 Voltage: 0.01047619
ADC Value: 12 Voltage: 0.009670329
ADC Value: 13 Voltage: 0.01047619
ADC Value: 13 Voltage: 0.01047619
ADC Value: 13 Voltage: 0.01047619
ADC Value: 13 Voltage: 0.01047619
Python Test ... 1.4M 4.5
Run your Python tests in th...
Little Fox Team
Install
Python Type... 1.1M 4.5
Type hint completion for P...