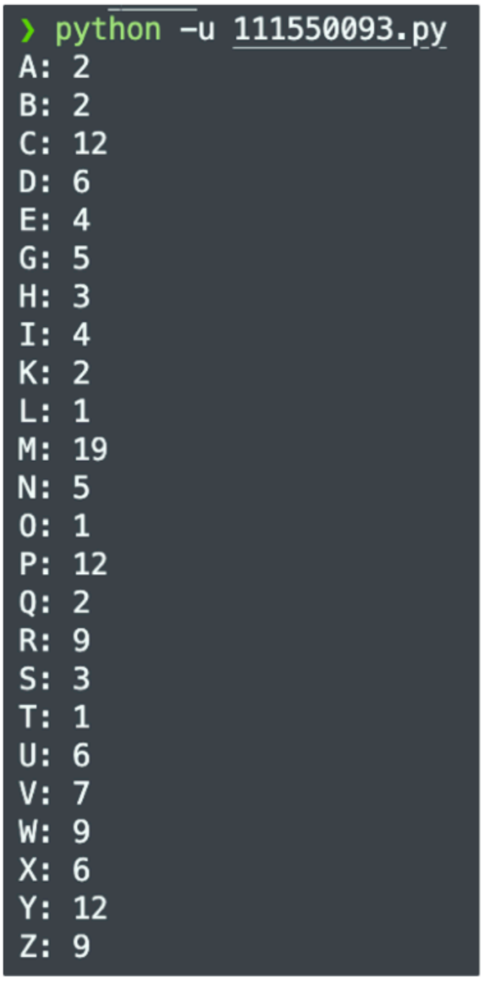
Quiz1

Problem 1

1. See the attached file `111550093.py`.



```
❯ python -u 111550093.py
A: 2
B: 2
C: 12
D: 6
E: 4
G: 5
H: 3
I: 4
K: 2
L: 1
M: 19
N: 5
O: 1
P: 12
Q: 2
R: 9
S: 3
T: 1
U: 6
V: 7
W: 9
X: 6
Y: 12
Z: 9
```

2. The plaintext of encrypted message is:

> A COMPUTER SCIENTIST MUST OFTEN EXPERIENCE A FEELING OF NOT FAR REMOVED FROM ALARM ON ANALYZING AND EXPLORE THE FLOOD OF ADVANCED KNOWLEDGE WHICH EACH YEAR BRINGS WITH IT

3. The relation between C and P is shown as the following table:

Ciphertext	A	B	C	D	E	F	G	H	I	J	K	L	M
	0	1	2	3	4	5	6	7	8	9	10	11	12
Plaintext	U	X	A	D	G	J	M	P	S	V	Y	B	E
	20	23	0	3	6	9	12	15	18	21	24	1	4
Ciphertext	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	13	14	15	16	17	18	19	20	21	22	23	24	25
Plaintext	H	K	N	V	T	W	Z	C	F	I	L	O	R
	7	10	13	21	19	22	25	2	5	8	11	14	17

4. 由 $\begin{cases} f(0) & = & b \mod 26 \\ f(1) & = & a+b \mod 26 \end{cases}$，以及 $f(0)=2(A), f(1)=11(L)$ 可知 $a=9, b=2$

5. Neither ChatGPT 3 nor 4 can decipher the context, but there is an online tool that can. Link

Problem 2

1. To calculate key space of $y = ax + b \mod 30$, we need to consider the possible values for a and b.

   For a, since the encryption mapping to be invertible, so there is $\phi{(30)}=8$ possible values.

   For b, as it is used in modular addition, b can be any integer from 0 to 29.

   So the total size of key space is $8 \times 30 = 240$

2. There are 8 number which are invertible: $1, 7, 11, 13, 17, 19, 23, 29$.
   - $1 \times 1 \equiv 1 \mod 30$
   - $7 \times 13 \equiv 1 \mod 30$
   - $11 \times 11 \equiv 1 \mod 30$
   - $13 \times 7 \equiv 1 \mod 30$
   - $17 \times 23 \equiv 1 \mod 30$
   - $19 \times 19 \equiv 1 \mod 30$
   - $23 \times 17 \equiv 1 \mod 30$
   - $29 \times 29 \equiv 1 \mod 30$

3. By running the following program, we can get $k_{enc} = (13, 16)$:

```python
datas = [[4, 8], [10, 26], [27, 7]]

ans_a = 0
ans_b = 0
for a in range(30):
    for b in range(30):
        check = 1
        for pair in datas:
            if (pair[1] % 30 != (a * pair[0] + b )% 30):
                check = 0
                break
        if(check == 1):
            ans_a = a
            ans_b = b
print(str(ans_a) + " " + str(ans_b))
```

4. Exchange `point[0]` and `point[1]`, we can get $k_{dec} = (7, 8)$