1. (a) Mutant #3 Mutant #4

(b) Case #3 Case #4

(c) Case #3 only strongly kill Mutant #2, So |killed mutants| = 1

since |mutants| = 5

Then mutation score = $\frac{|\text{killed mutants}|}{|\text{mutants}|} = \frac{1}{5}$

The surviving mutants are Mutant #1, #3, #4, #5

(d) Case#4 strongly kills Mutant #1, #2, #4, #5

Case#5 strongly kills only Mutant #4

So the complete test suit strongly kills Mutant #1, #2, #4, #5

|killed mutants| = 4 |mutants| = 5

mutation score = $\frac{|\text{killed mutants}|}{|\text{mutants}|} = \frac{4}{5}$

The surviving mutant is Mutant #3

(e)

Mutants# \ Case#	1	2	3	4	5
1				killed	
2			killed	killed	
3	killed				
4	killed			killed	killed
5				killed	

"killed" means some mutant is killed by some case.

Mutant #4

(f) Mutant #1, #3, #5

2. (a) Yes, it is.

Directly analyze the source code of caesar_cipher, or compare the two source codes

(b) Yes, it is.

Blackbox testing and compare the outputs of the two functions with the same inputs

(c) Yes, it is

Blackbox testing and compare the outputs of the two functions with the same inputs

(d) No, it isn't.

3. (a) $x = F(y) = y$

Since there are 26 characters in alphabets, then any character with bias 26 will be itself.

Besides, Line #6: output += chr((ascii_val - 65 + b)%26 + 65)

Here, chr((ascii_val - 65 + b)%26 + 65) is defined as original expression

change b into b+26: chr((ascii_val - 65 + b + 26)%26 + 65)

= chr((ascii_val - 65 + b)%26 + 26%26 + 65)

= chr((ascii_val - 65 + b)%26 + 26%26 + 65)

= chr((ascii_val - 65 + b)%26 + 65) = original expression

So does Line #8.

Therefore, $Z = f(g(x)) = f((s, b+26)) = f((s, b)) = f(x) = y$

(b) No test case can detect the defects.

Mutant #4: Δ8. output += chr((ascii_val - 97 - b)%26 + 97)

Here, chr((ascii_val - 97 - b)%26 + 97) is defined as original expression

change b into b+26: chr((ascii_val - 97 - (b+26))%26 + 97)

= chr((ascii_val - 97 - b)%26 - 26%26 + 97)

= chr((ascii_val - 97 - b)%26 - 0 + 97)

= chr((ascii_val - 97 - b)%26 + 97) = original expression

Outputs before transformed and after transformed are the same.

So any defects can't be detected.

4. (a) O#1: "bcd"

O#2: "C"

O#3: "VWX"

O#4: "Hello, World!"

O#5: "Vlbxhal"

(b) no test case can detect the defects.

Mutant #4 is Δ8. output += chr((ascii_val - 97 - b)%26 + 97)

Here, chr((ascii_val - 97 - b)%26 + 97) is defined as original expression

After inserting $b = -(26 - b)\%26$,

we have chr((ascii_val - 97 - (-(26 - b)%26))%26 + 97)

= chr((ascii_val - 97 + (26 - b)%26))%26 + 97)

= chr((ascii_val - 97 + (26%26) - (b%26))%26 + 97)

= chr((ascii_val - 97 + 0 - b)%26 + 97) notic that (b%26)%26 = b%26

= chr((ascii_val - 97 - b)%26 + 97) = original expression

The outputs before inserting and after inserting are the same.