

# Modulus

## Textbook

# Modulus



The percentage sign is used very differently in Python. This symbol (%) stands for [modulus](#). The modulus returns the *remainder* if that number was divided.

10 / 3 is equal to 3 with a remainder of 1.

```
1 fruits = 10 % 3
2 print(fruits)
```

Try it!

This will return `1`.

The modulus returns the remainder which is 1.

```
1 fruits = 29 % 5
2 print(fruits)
```

Try it!

This will return 4 .

29 / 5 is equal to 5 with a remainder of 4.

The modulus returns the remainder which is 4.

The modulus returns the remainder as if it was divided.

## Determining if a number is even or odd

The modulus is useful for determining characteristics of a certain value.

(This example includes an if statement, which will be taught in a later lesson. We include it just to demonstrate the concept of odd/even with the modulus.)

```
1 number = 245
2
3 print(number % 2)
```

Try it!

If this example prints a 0, we know that the variable named number is divisible by 2 with no remainder. If it prints a 1, we know that the variable named number had a 1 remainder when divided by two.

Every even number is divisible by two. So no matter what even number it is, if it is divided by two, there would be no remainder. Therefore, any even number % 2 is equal to 0. In other words, any even number has NO remainder when it is divided by 2. In this example, if the remainder is anything other than 0, it must not be an even number.

## Finding the Last 2 Numbers

You can also use the modulus to find the last 2 numbers from a 3 digit number.

```
1 number = 245
2
3 print(number % 100)
```

Try it!

This will return the last two digits (the tens place and the ones place). This is because the modulus returns the remainder. The remainder of 245 divided by 100 is 45.

## Critical Thinking Question Discussion

Discussing with your peers is a powerful way to help process information. As you discuss the following critical thinking questions, keep the following suggestions in mind.

- **Discuss in groups:** Explore how you and your classmates are thinking about these questions.
- **Communicate clearly:** Explain your ideas using terms from the textbook.
- **Analyze others' thinking:** Listen carefully to how peers approach the questions.
- **Compare methods:** Discuss different ways to tackle problems and suggest improvements.
- **Justify your answers:** Explain *why* you think what you do, using evidence and logical reasoning.

- **Learn from errors:** See mistakes as opportunities to deepen understanding, both for yourself and others.

## Critical Thinking Questions

- The textbook shows how to find if a number is even or odd using the modulus, and how to find the last two digits of a three-digit number. Can you think of another real-world scenario or a type of problem where finding a remainder (using modulus) would be useful? Explain your idea.
- Imagine you have a program that needs to display items in rows of 4. If you have 17 items, how could you use the modulus operator to figure out how many items would be in the *last, incomplete* row? Explain the result you'd expect and why.
- If  $x \% y$  returns 0, what does that tell you about the relationship between  $x$  and  $y$ ? Provide an example using numbers, and explain what this means in terms of division.

## Practice

The modulus is often a new concept for people to wrap their minds around. Make sure to do a lot of practice in this lesson until it begins to sink in. Remember, the modulus returns the remainder.

- $10 \% 2 = ?$

[Show answer/example](#)

- $17 \% 5 = ?$

[Show answer/example](#)

- $4 \% 4 = ?$

[Show answer/example](#)

- $125 \% 10 = ?$

[Show answer/example](#)

- $30 \% 3 = ?$

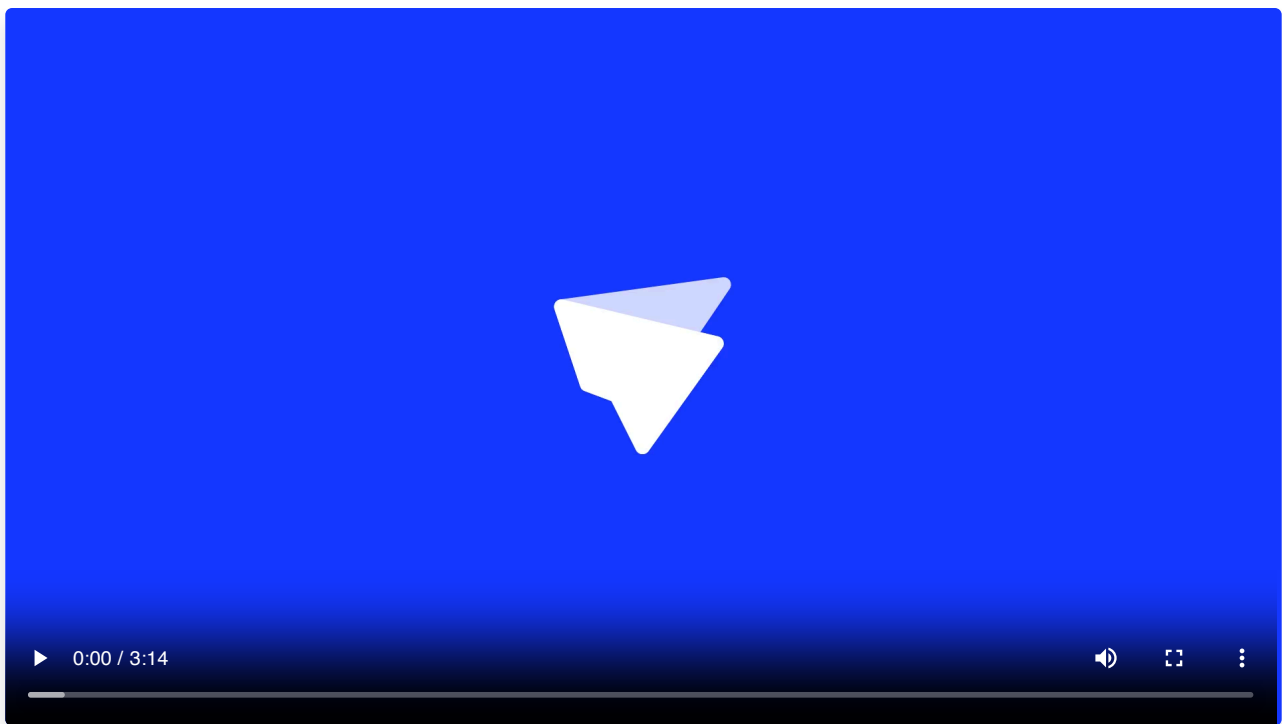
[Show answer/example](#)

- $19 \% 4 = ?$

[Show answer/example](#)

- $156 \% 100 = ?$

[Show answer/example](#)



## Checkpoint

### Modulus

Create an **input** that takes in a number.

Use the **modulus** to see what the remainder would be if you divide that number by **7**.

Print the **remainder**.

For example:

Input: `10`

Output: `3`

Another example:

Input: `23`

Output: `2`

## Questions (11)

1. What will the following code output? `27 % 4`

MULTIPLE CHOICE

Choose the correct answer:

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5
- F. 0

**2. What will the following code output?  $10 \% 5$** 

Choose the correct answer:

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4
- F. 5

**3. What will the following code output?  $12 \% 3$** 

Choose the correct answer:

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4
- F. 5

**4. What will the following code output?  $16 \% 5$** 

Choose the correct answer:

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4
- F. 5

MULTIPLE CHOICE

**5. What is the following symbol called in Python? %**

**Choose the correct answer:**

- A. Percentage
- B. Division
- C. Modulus
- D. Decimal

MULTIPLE CHOICE

**6. What does the modulus return in Python?**

**Choose the correct answer:**

- A. The remainder
- B. That number when divided
- C. The percentage
- D. The decimal

MULTIPLE CHOICE

**7. What do we know about the variable named total if the following prints a 0?**

```
print(total % 2)
```

**Choose the correct answer:**

- A. total is an even number
- B. total is an odd number
- C. total has the number 2 in it
- D. total is equal to 0

MULTIPLE CHOICE

**8. If you perform the modulus operation on  $10 \% 3$ , what will be the result?**

**Choose the correct answer:**

- A. 0
- B. 1
- C. 2
- D. 3

MULTIPLE CHOICE

9. If the expression "number % 2" prints a 1, what does it indicate?

Choose the correct answer:

- A. The number is odd
- B. The number is even
- C. The number is prime
- D. The number is a multiple of 2

MULTIPLE CHOICE

10. What is the result of  $17 \% 5$ ?

Choose the correct answer:

- A. 0
- B. 1
- C. 2
- D. 3

MULTIPLE CHOICE

11. What is the value of  $4 \% 4$ ?

Choose the correct answer:

- A. 0
- B. 1
- C. 2
- D. 4

## Challenges (5)

### 1. Orange Sharing

1. Imagine a family is sharing a box of oranges. Write a program that takes in **two inputs**.
2. The first input will be the number of family members and second input will be the number of oranges.
3. Assume the family divides the oranges among themselves **evenly**.
4. If the number of oranges doesn't divide evenly among the family members, leave them in the basket.
5. Print the number of oranges left in the basket.

Your number must be an **integer**, not a **float**.

For example:

Inputs: 5 , 46

Output: 1

Another example:

Inputs: 4 , 18

Output: 2

### 2. Print the last two numbers

Write a program that receives one number as the input. This number will always **be 10 or greater**.

Your program should print the last two digits of that number.

For example:

Input: 130

Output: 30

Another example:

Input: 54

Output: 54

*Note: If the number is 102, it will only print 2 - not 02.*



### 3. Separate the numbers

Write a program that receives one integer as an input. This integer will always be two digits.

The program should output the tens digit and the ones digit separately with a space between them.

For example, if the input is `83` the program should print `8 3`.

For example:

Input: `83`

Output: `8 3`

Input: `24`

Output: `2 4`

**Hint:** Remember you can add a space with concatenation by using  `+ " "`.

**Hint:** You can pull out the ones digit by using the modulus.

**Hint:** Try using division to get a value in the tens place. Remember that converting to an integer drops the decimal.

### 4. Reverse the number

Write a program that receives **one integer as an input**. This integer will always be two digits. The program should reverse the order of the digits and print the new number.

For example:

Input: `83`

Output: `38`

Another example:

Input: `56`

Output: `65`

**Hint:** To find a value in the one's place, try using `x % 10`. This will provide a remainder that is equal to the value in the ones place.

**Hint:** Try using division to get a value in the tens place. Remember that converting to an integer drops the decimal.

**Hint:** Try using concatenation in this challenge

## 5. Find the Ten's Place

Write a program that takes in one integer as the input. This integer will always be 100 or greater. Your program should print the tens digit of that number.

For example, if the input is `135` your program should print `3`.

For example:

Input: `135`

Output: `3`

Another example:

Input: `229`

Output: `2`

**Hint:** If you use the logic  $x \% 10$ , it will give you a remainder that is equal to the value in the ones place. See if you can use this logic to show the value in the tens place.

## Answer Keys & Solutions

### Checkpoint Solutions

#### Modulus

```
1 number = int(input("Enter a number: "))
2
3 answer = number % 7
4
5 print(answer)
```

### Questions

1. What will the following code output?  $27 \% 4$

MULTIPLE CHOICE

Correct Answer:

- |      |             |
|------|-------------|
| A. 1 | ✗ Incorrect |
| B. 2 | ✗ Incorrect |
| C. 3 | ✓ Correct   |
| D. 4 | ✗ Incorrect |
| E. 5 | ✗ Incorrect |
| F. 0 | ✗ Incorrect |

#### Explanation:

27 divided by 4 is equal to 6 with a remainder of 3.

2. What will the following code output?  $10 \% 5$

MULTIPLE CHOICE

Correct Answer:

- |      |             |
|------|-------------|
| A. 0 | ✓ Correct   |
| B. 1 | ✗ Incorrect |
| C. 2 | ✗ Incorrect |

D. 3

✗ Incorrect

E. 4

✗ Incorrect

F. 5

✗ Incorrect

**Explanation:**

10 divided by 5 is equal to 2 with a remainder of 0.

**3. What will the following code output?  $12 \% 3$**

MULTIPLE CHOICE

**Correct Answer:**

A. 0

✓ Correct

B. 1

✗ Incorrect

C. 2

✗ Incorrect

D. 3

✗ Incorrect

E. 4

✗ Incorrect

F. 5

✗ Incorrect

**Explanation:**

12 divided by 3 is equal to 4 with a remainder of 0.

**4. What will the following code output?  $16 \% 5$**

MULTIPLE CHOICE

**Correct Answer:**

A. 0

✗ Incorrect

B. 1

✓ Correct

C. 2

✗ Incorrect

D. 3

✗ Incorrect

E. 4

✗ Incorrect

F. 5

✗ Incorrect

**Explanation:**

16 divided by 5 is equal to 3 with a remainder of 1.

**5. What is the following symbol called in Python? %**

MULTIPLE CHOICE

**Correct Answer:**

- A. Percentage ✗ Incorrect
- B. Division ✗ Incorrect
- C. Modulus ✓ Correct
- D. Decimal ✗ Incorrect

**Explanation:**

It's not percentage.

**6. What does the modulus return in Python?**

MULTIPLE CHOICE

**Correct Answer:**

- A. The remainder ✓ Correct
- B. That number when divided ✗ Incorrect
- C. The percentage ✗ Incorrect
- D. The decimal ✗ Incorrect

**Explanation:**

The modulus shows a specific value you get after dividing.

**7. What do we know about the variable named total if the following prints a 0?**

MULTIPLE CHOICE

**Correct Answer:**

- A. total is an even number ✓ Correct

B. total is an odd number

✗ Incorrect

C. total has the number 2 in it

✗ Incorrect

D. total is equal to 0

✗ Incorrect

### Explanation:

We know that divided by 2 it doesn't have a remainder.

## 8. If you perform the modulus operation on $10 \% 3$ , what will be the result?

MULTIPLE CHOICE

### Correct Answer:

A. 0

✗ Incorrect

B. 1

✓ Correct

C. 2

✗ Incorrect

D. 3

✗ Incorrect

### Explanation:

What will be the remainder?

## 9. If the expression "number % 2" prints a 1, what does it indicate?

MULTIPLE CHOICE

### Correct Answer:

A. The number is odd

✓ Correct

B. The number is even

✗ Incorrect

C. The number is prime

✗ Incorrect

D. The number is a multiple of 2

✗ Incorrect

### Explanation:

If it has a remainder of 1, that means it's not divisible by 2.

MULTIPLE CHOICE

## 10. What is the result of $17 \% 5$ ?

Correct Answer:

- |      |             |
|------|-------------|
| A. 0 | ✗ Incorrect |
| B. 1 | ✗ Incorrect |
| C. 2 | ✓ Correct   |
| D. 3 | ✗ Incorrect |

### Explanation:

What would be the remainder?

## 11. What is the value of $4 \% 4$ ?

MULTIPLE CHOICE

Correct Answer:

- |      |             |
|------|-------------|
| A. 0 | ✓ Correct   |
| B. 1 | ✗ Incorrect |
| C. 2 | ✗ Incorrect |
| D. 4 | ✗ Incorrect |

### Explanation:

What would be the remainder?

## Challenges

### 1. Orange Sharing

Solution:

```
1 family = int(input("Number of family members"))
2
3 oranges = int(input("Number of oranges"))
4
5 remainder_oranges = oranges % family
6
7 print(remainder_oranges)
```

## 2. Print the last two numbers

Solution:

```
1 number = int(input("Pick a number that is 10 or greater"))
2
3 last_two_digits = number % 100
4 print(last_two_digits)
```

## 3. Separate the numbers

Solution:

```
1 number = int(input("Pick a number that is two digits"))
2
3 tens = int(number / 10)
4
5 ones = number % 10
6
7 print(str(tens) + " " + str(ones))
```

## 4. Reverse the number

Solution:

```
1 number = int(input("Pick a number that is two digits"))
2
3 tens = int(number / 10)
4
5 ones = number % 10
6
7 print(str(ones) + str(tens))
```

## 5. Find the Ten's Place

Solution:

```
1 number = int(input("Pick a number that is 100 or greater"))
2
3 last_two_digits = number % 100
4
5 tens = int(last_two_digits / 10)
6
7 print(str(tens))
```



