Theory Questions:- **Functions**

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Q1. What is the difference between a function and a method in Python?

Explanation:

Aspect	Function	Method
Definition	A block of code that performs a task.	A function that **belongs to an object**.
Calling	Called directly using its name.	Called using the object (e.g., `obj.method()`).
Association	Not associated with any object.	Always associated with an object or class.
Example use	General purpose code reusable anywhere.	Works specifically with the object it belongs to.

Example:

```
# Function example
def greet(name):
    return f"Hello, {name}!"

print(greet("Ritesh"))  # Calling a function directly
                        # Output: Hello, Ritesh!

# Method example
text = "hello world"
print(text.upper())    # Calling a method belonging to string object
                       # Output: HELLO WORLD
```

Q2. Explain the concept of function arguments and parameters in Python.

Explanation:

- **Parameters** → Variables defined in the function **definition** that accept input values.
- **Arguments** → Actual values passed to the function when it is **called**.
- Python supports different types of arguments:
    1. **Positional arguments**
    2. **Keyword arguments**
    3. **Default arguments**
    4. **Variable-length arguments**

Example:

```
# Function with parameters
def greet(name, message="Good Morning"):
    return f"Hello {name}, {message}!"

# Positional argument
print(greet("Ritesh"))    # Output: Hello Ritesh, Good Morning!

# Keyword argument
print(greet(name="Ritesh", message="Welcome to Python"))

                          # Output: Hello Ritesh, Welcome to Python!
# Default argument
print(greet("Ritesh"))    # Output: Hello Ritesh, Good Morning!
```

Q3. Different ways to define and call a function in Python?

Explanation:

- **Functions** are reusable blocks of code that perform a specific task. In Python, you can define and call functions in multiple ways:

1. **Standard function (`def`)**
   - Defined using the `def` keyword.
   - Can accept parameters and return values.
2. **Lambda function**
   - Also called an **anonymous function**.
   - Defined using `lambda` keyword, usually for simple, single-line tasks.
3. **Nested function**
   - A function defined **inside another function**.
   - Useful for encapsulation and keeping helper functions local to the outer function.

- **Calling a function** involves using its name followed by parentheses `()`.
- Arguments can be passed when calling functions to provide input values.

Examples:

```
# 1. Standard function
def greet(name):
    return f"Hello {name}!"

print(greet("Ritesh"))  # Calling standard function
                        # Output: Hello Ritesh!

# 2. Lambda function
square = lambda x: x**2
print(square(5))        # Calling lambda function
                        # Output: 25

# 3. Nested function
def outer():
    def inner():
        return "This is a nested function"
    return inner()      # Calling inner function inside outer

print(outer())          # Output: This is a nested function
```

Q4. What is the purpose of the `return` statement in a Python function?

Explanation:

- The **`return`** statement is used to **send a result from a function back to the caller**.
- Without `return`, a function returns `None` by default.
- `return` allows functions to produce a **value that can be stored, printed, or used in other operations**.
- It also helps in **breaking out of a function** immediately.

Examples:

```
# Function using return
def greet(name):
    return f"Hello {name}!"

# Using the returned value
message = greet("Ritesh")
print(message)                # Output: Hello Ritesh!

# Function without return
def greet_no_return(name):
    print(f"Hello {name}!")   # Output: Hello Ritesh!

result = greet_no_return("Ritesh")
print(result)                 # Output: Will print None
```

Q5. What are iterators in Python and how do they differ from iterables?

Explanation:

- **Iterable**: Any Python object capable of returning its elements one by one, e.g., `list`, `tuple`, `string`, `set`, or `dictionary`.
  - You can loop over it using a `for` loop.
- **Iterator**: An object that **produces elements one at a time** and keeps track of its current position.
  - Created from an iterable using the `iter()` function.
  - Use `next()` to access elements individually.

Key Differences Between Iterable and Iterator:

Aspect	Iterable	Iterator
Definition	Can be looped over to access elements	Produces elements one by one on demand
Object type	Any collection type (list, tuple, etc)	Created from an iterable using `iter()`
Access	Use `for` loop	Use `next()` function
Exhaustible	No	Yes, once traversed, cannot be reused

Example:

```
# Iterable example
fruits = ["apple", "banana", "cherry"]  # This is an iterable

print("Iterable output:")
for fruit in fruits:
    print(fruit)                         # Output: apple

                                         # Output: banana

                                         # Output: cherry

# Iterator example
fruits_iter = iter(fruits)               # Convert iterable to iterator

print("\nIterator output using next():")

print(next(fruits_iter))                 # Output: apple

print(next(fruits_iter))                 # Output: banana

print(next(fruits_iter))                 # Output: cherry
```

Q6. Explain the concept of generators in Python and how they are defined.

Explanation:

- **Generators** are special **iterators** that **generate values on the fly** instead of storing them in memory.
- They are **memory-efficient** and useful for large datasets or streams of data.
- Generators are defined in two main ways:
    1. Using a **function with the `yield` statement**.
    2. Using **generator expressions** (similar to list comprehensions but with parentheses).
- Each call to `next()` on a generator produces the **next value** until the generator is exhausted.

Example using `yield`:

```
# Generator function
def greet_generator(names):
    for name in names:
        yield f"Hello {name}!"

names_list = ["Ritesh", "Alex", "Maya"]
```

```
# Create generator
gen = greet_generator(names_list)

# Access values one by one
print(next(gen))   # Output: Hello Ritesh!
print(next(gen))   # Output: Hello Alex!
print(next(gen))   # Output: Hello Maya!
```

Example using `generator` expression:

```
# Generator expression
squares = (x**2 for x in range(1, 4))

print(next(squares))  # Output: 1
print(next(squares))  # Output: 4
print(next(squares))  # Output: 9
```

Q7. What are the advantages of using generators over regular functions?

Explanation:

Generators provide several advantages over regular functions that return lists:

1. **Memory Efficiency**
   - Generators produce values **one at a time** and do not store the entire sequence in memory.
   - Useful for **large datasets**.
2. **Lazy Evaluation**
   - Values are computed **only when needed** using `next()`.
   - Reduces unnecessary computations.
3. **Represent Infinite Sequences**
   - Generators can model **infinite series** (like Fibonacci numbers) which is impossible with lists.
4. **Pipeline Processing**
   - Generators can be **chained together** to create pipelines, processing data efficiently.

Example:

```
# Generator function
def greet_generator(names):
    for name in names:
        yield f"Hello {name}!"

names_list = ["Ritesh", "Alex", "Maya"]
```

```
gen = greet_generator(names_list)

print(next(gen))  # Output: Hello Ritesh!
print(next(gen))  # Output: Hello Alex!
print(next(gen))  # Output: Hello Maya!

# Memory efficiency demonstration
numbers = (x**2 for x in range(1, 1000000))  # Generator for 1 million squares
print(next(numbers))  # Output: 1
print(next(numbers))  # Output: 4
print(next(numbers))  # Output: 9
```

Q8. What is a lambda function in Python and when is it typically used?

Explanation:

- **Lambda functions** are **anonymous, one-line functions** in Python that do not require a formal `def` block.
- They are defined using the **`lambda` keyword**, followed by **arguments** and a **single expression**.
- Lambda functions are commonly used when you need a **small, temporary function** without cluttering your code.
- Typical use cases include **functional programming**, **inline operations**, and passing functions as **arguments to higher-order functions** like `map()`, `filter()`, or `sorted()`.
- **Advantages**: concise, readable for small operations, and memory-efficient since they don't require a full function definition.

Syntax:

```
lambda arguments: expression
```

Characteristics & Usage:

- **Concise** — Perfect for small, one-off operations.
- **Inline** — Can be defined and used in a single line.
- **Functional programming** — Ideal for passing as arguments to functions like `map()`, `filter()`, or `reduce()`.
- **Single expression only** — Cannot contain multiple statements or complex logic.
- **Temporary & lightweight** — Great for quick tasks without cluttering your code with full function definitions.

Example 1: Basic Lambda

```
# Lambda to greet Ritesh
greet = lambda name: f"Hello {name}!"
print(greet("Ritesh"))  # Output: Hello Ritesh!
```

Example 2: Lambda with map()

```
numbers = [1, 2, 3, 4, 5]
# Square each number using lambda
```

```
squares = list(map(lambda x: x**2, numbers))
print(squares)  # Output: [1, 4, 9, 16, 25]
```

Example 3: Lambda with filter()

```
# Filter numbers greater than 2
filtered = list(filter(lambda x: x > 2, numbers))
print(filtered)  # Output: [3, 4, 5]
```

Example 4: Lambda with reduce()

```
from functools import reduce

# Sum all numbers using reduce and lambda
total = reduce(lambda x, y: x + y, numbers)
print(total)  # Output: 15
```

Q9. Explain the purpose and usage of the `map()` function in Python.

Explanation:

- The **`map()` function** applies a given function to **each item of an iterable** (like a list, tuple, etc.) and returns a **map object**, which is an iterator.
- Useful when you want to **perform the same operation on multiple items** without using a loop.
- **Lazy evaluation**: the values are computed **only when iterated**, saving memory for large datasets.

Common Uses of `map()`:

- Transforming all elements in a list/tuple without using a loop.
- Applying **mathematical operations** to all elements.
- Preprocessing or cleaning **data in bulk**, e.g., converting strings to uppercase.
- Chaining with **`filter()`** or **`reduce()`** for functional programming pipelines.
- Syntax:

```
map(function, iterable)
```

Example 1: Basic map with a named function

```
# Function to greet a person
def greet(name):
    return f"Hello {name}!"

names = ["Ritesh", "Alex", "Maya"]

# Apply greet function to each name
greetings = map(greet, names)
```

```
# Convert to list and print
print(list(greetings))
# Output: ['Hello Ritesh!', 'Hello Alex!', 'Hello Maya!']
```

Example 2: map with lambda function

```
numbers = [1, 2, 3, 4, 5]

# Square each number using lambda and map
squared = map(lambda x: x**2, numbers)

print(list(squared))
# Output: [1, 4, 9, 16, 25]
```

Example 3: map with multiple iterables

```
numbers1 = [1, 2, 3]
numbers2 = [4, 5, 6]

# Add corresponding elements from two lists
sum_list = map(lambda x, y: x + y, numbers1, numbers2)

print(list(sum_list))
# Output: [5, 7, 9]
```

Q10. What is the difference between `map()`, `reduce()`, and `filter()` functions in Python?

Explanation:

Python provides **built-in functional programming tools** like `map()`, `reduce()`, and `filter()` to process iterables efficiently:

Function	Purpose	Returns	
`map()`	Applies a function to **each item** in an iterable	**Map object (iterator)**	Transform
`reduce()`	Applies a function **cumulatively** to items of an iterable, reducing it to a **single value**	Single value	Summing
`filter()`	Selects elements that **meet a condition**	Filter object (iterator)	Filtering nu

Key Differences:

1. **Purpose**:
    - `map()` → **changes/transforms every element** in an iterable.
    - `filter()` → **chooses only certain elements** that satisfy a condition.
    - `reduce()` → **combines all elements** to produce a single result.
2. **Return Type**:
    - `map()` and `filter()` return **iterators**, which can be converted to a list.
    - `reduce()` returns a **single value**.
3. **Number of Iterables**:
    - `map()` can work with **one or more iterables**.
    - `filter()` works with **one iterable**.

   - `reduce()` works with **one iterable**.

4. **Use Case Example**:

   - `map()` → Transforming `[1,2,3]` into `[1,4,9]` (squares).
   - `filter()` → Picking `[3,4,5]` from `[1,2,3,4,5]` (numbers >2).
   - `reduce()` → Summing `[1,2,3,4,5]` into `15`.

Example 1: `map()`

```
numbers = [1, 2, 3, 4, 5]

# Square each number
squared = map(lambda x: x**2, numbers)
print(list(squared))       # Output: [1, 4, 9, 16, 25]
```

Example 2: `filter()`

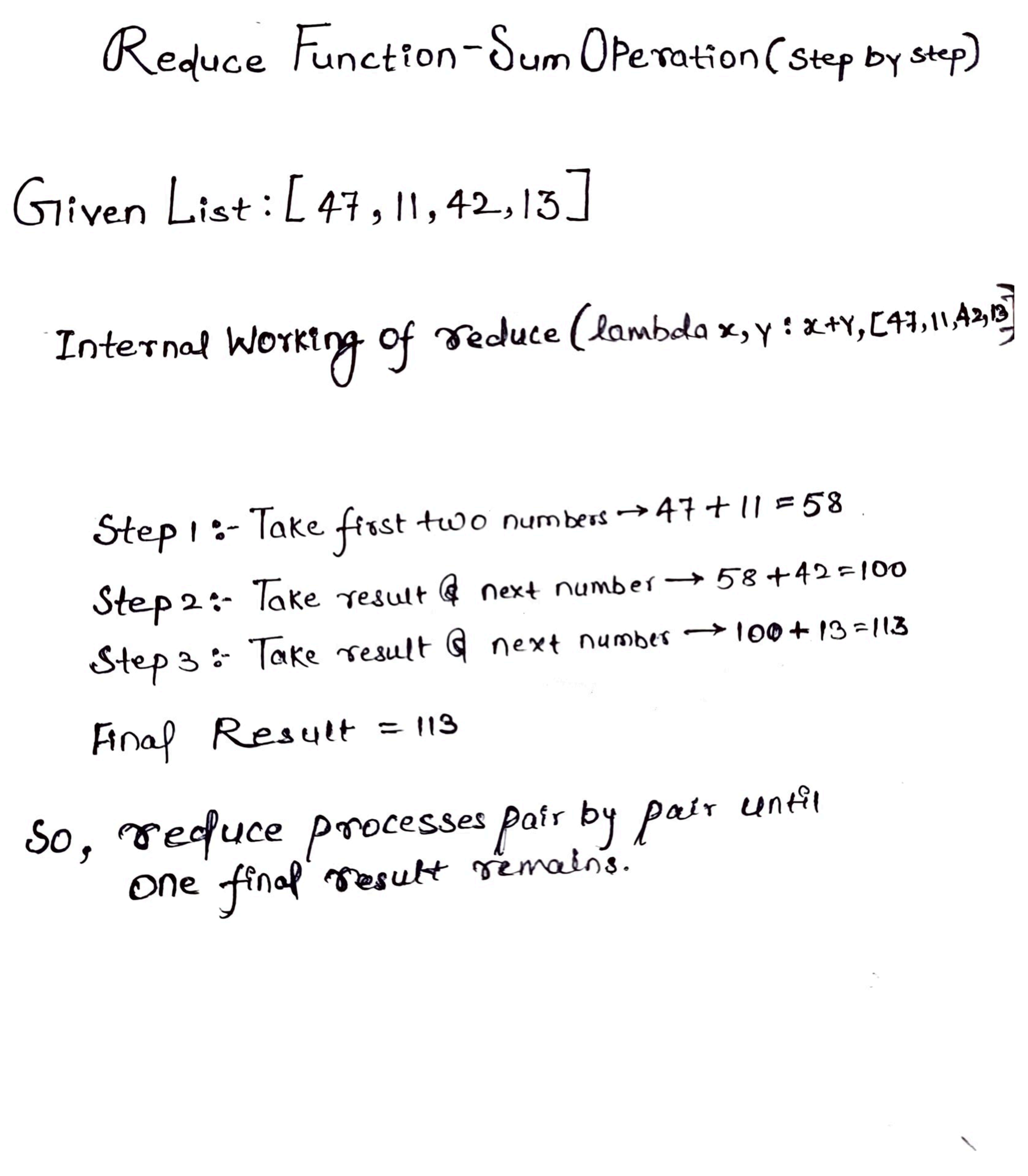
```
numbers = [1, 2, 3, 4, 5]

# Keep numbers greater than 2
filtered = filter(lambda x: x > 2, numbers)
print(list(filtered))     # Output: [3, 4, 5]
```

Example 3: `reduce()`

```

from functools import reduce

numbers = [1, 2, 3, 4, 5]

# Sum all numbers cumulatively
total = reduce(lambda x, y: x + y, numbers)
print(total)             # Output: 15
```

Q11. Using pen & Paper write the internal mechanism for sum operation using reduce function on this given list: [47,11,42,13]; (Attach paper image for this answer) in doc or

colab notebook.



Reduce Function-Sum Operation (step by step)

Given List: [47, 11, 42, 13]

Internal Working of reduce (lambda x, y : x+y, [47,11,42,13]

Step 1 :- Take first two numbers → 47 + 11 = 58

Step 2 :- Take result & next number → 58 + 42 = 100

Step 3 :- Take result & next numbers → 100 + 13 = 113

Final Result = 113

So, reduce processes pair by pair until one final result remains.

→ **Practical Questions:**

Q1. Write a Python function that takes a list of numbers as input and returns the sum of all even numbers in the list.

```
def sum_of_evens(nums):
    return sum(n for n in nums if n % 2 == 0)
```

```
print(sum_of_evens([1, 2, 3, 4, 5, 6, 7, 8]))
```

```
20
```

Q2. Create a Python function that accepts a string and returns the reverse of that string.

```
def reverse_string(s):
    return s[::-1]

print(reverse_string("Ritesh"))
```

```
hsetiR
```

Q3. Implement a Python function that takes a list of integers and returns a new list containing the squares of each number.

```
def square_list(numbers):
    return [num ** 2 for num in numbers]

print(square_list([1, 2, 3, 4, 5]))
```

```
[1, 4, 9, 16, 25]
```

Q4. Write a Python function that checks if a given number is prime or not from 1 to 200.

```
def is_prime(num):
    if num < 2:
        return False
    for i in range(2, num):
        if num % i == 0:
            return False
    return True

def prime_numbers_upto_200():
    primes = []
    for n in range(1, 201):
        if is_prime(n):
            primes.append(n)
    return primes


print(prime_numbers_upto_200())
```

```
[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83,
```

Q5. Create an iterator class in Python that generates the Fibonacci sequence up to a specified number of terms.

```
class FibonacciIterator:
    def __init__(self, n_terms):
        self.n_terms = n_terms   # total terms required
        self.count = 0           # counter
        self.a, self.b = 0, 1    # starting values

    def __iter__(self):
        return self

    def __next__(self):
        if self.count < self.n_terms:
            value = self.a
            self.a, self.b = self.b, self.a + self.b
            self.count += 1
            return value
        else:
            raise StopIteration

fib = FibonacciIterator(10)     # generate first 10 terms
for num in fib:
    print(num, end=" ")
```

```
0 1 1 2 3 5 8 13 21 34
```

Q6. . Write a generator function in Python that yields the powers of 2 up to a given exponent.

```
def powers_of_two(n):
    for i in range(n + 1):
        yield 2 ** i

for num in powers_of_two(5):
    print(num, end=" ")
```

```
1 2 4 8 16 32
```

Q7. Implement a generator function that reads a file line by line and yields each line as a string.

```
# Step 1: Create a sample file
with open("sample.txt", "w") as f:
    f.write("Hello\n")
    f.write("This is Ritesh\n")
    f.write("Learning Python\n")
```

```
# Step 2: Generator function to read file line by line
def read_file_line_by_line(filename):
    with open(filename, "r") as file:
        for line in file:
            yield line.strip()   # strip() removes \n at the end


# Step 3: Use the generator
for line in read_file_line_by_line("sample.txt"):
    print(line)
```

```
Hello
This is Ritesh
Learning Python
```

Q8. Use a lambda function in Python to sort a list of tuples based on the second element of each tuple

```
def sort_tuples_by_second(tuples_list):
    return sorted(tuples_list, key=lambda x: x[1])



data = [(1, 5), (3, 1), (4, 7), (2, 3)]
result = sort_tuples_by_second(data)
print(result)
```

```
[(3, 1), (2, 3), (1, 5), (4, 7)]
```

Q9.Write a Python program that uses `map()` to convert a list of temperatures from Celsius to Fahrenheit.

```
# Function to convert Celsius to Fahrenheit
def celsius_to_fahrenheit(celsius):
    return (celsius * 9/5) + 32

# List of temperatures in Celsius
celsius_list = [0, 20, 37, 100]

# Using map() to convert all temperatures
fahrenheit_list = list(map(celsius_to_fahrenheit, celsius_list))


print("Celsius:", celsius_list)
print("Fahrenheit:", fahrenheit_list)
```

```
Celsius: [0, 20, 37, 100]
Fahrenheit: [32.0, 68.0, 98.6, 212.0]
```

Q10 Create a Python program that uses `filter()` to remove all the vowels from a given string

```
# Function to check if a character is NOT a vowel
def is_not_vowel(ch):
    vowels = "aeiouAEIOU"
    return ch not in vowels

# Input string
text = "Hello, This is Ritesh"

# Using filter() to remove vowels
result = ''.join(filter(is_not_vowel, text))


print("Original String:", text)
print("After Removing Vowels:", result)
```

```
Original String: Hello, This is Ritesh
After Removing Vowels: Hll, Ths s Rtsh
```

Q11. Imagine an accounting routine used in a book shop. It works on a list with sublists, which look like this:

Order Number	Book Title and Author	Quantity	Price per Item
34587	Learning Python, Mark Lutz	4	40.95
98762	Programming Python, Mark Lutz	5	56.80
77226	Head First Python, Paul Barry	3	32.95
88112	Einführung in Python3, Bernd Klein	3	24.99

Write a Python program, which returns a list with 2-tuples. Each tuple consists of the order number and the product of the price per item and the quantity. The product should be increased by 10,- € if the value of the order is smaller than 100,00 €.

Write a Python program using lambda and map.

```
# Accounting routine with lambda and map

orders = [
    [34587, "Learning Python, Mark Lutz", 4, 40.95],
    [98762, "Programming Python, Mark Lutz", 5, 56.80],
    [77226, "Head First Python, Paul Barry", 3, 32.95],
    [88112, "Einführung in Python3, Bernd Klein", 3, 24.99]
]

# Using lambda + map
result = list(map(lambda order: (
    order[0],
    round(order[2] * order[3] if order[2] * order[3] >= 100 else order[2] * order[3] + 10, 2
), orders))

print(result)
```

```
[(34587, 163.8), (98762, 284.0), (77226, 108.85), (88112, 84.97)]
```