6.1 Data types, strings, exceptions and trace tables

Name: _____ Class: _____ Date: _____ **Total: 29 marks**

KEY WORDS data type • casting • syntax error • runtime error • logic error • trace table

Objective

Build the skills to answer exam questions on **programming fundamentals** – data types, strings, exceptions and trace tables, in Python.

You must be able to:

- choose a suitable **data type** for a value, and **cast** between types
- use string indexing, slicing and methods, and state what they return
- tell a **syntax error** from a **runtime error** and a **logic error**
- handle invalid input with `try … except`
- complete a **trace table** for code with a loop and selection

1 Key knowledge and worked examples

Study these first. Each one shows the method for a question type used later.

■ **Key knowledge: types and strings**

Type	Python	Example
integer	`int`	`42`
real	`float`	`3.75`
Boolean	`bool`	`True`
string	`str`	`"Ada"`

- `input()` always returns a string: `int(input())` casts it to an integer.
- `7 / 2` is `3.5`; `7 // 2` is `3`; `7 % 2` is `1`.

For `s = "network"` (indexes 0 to 6):

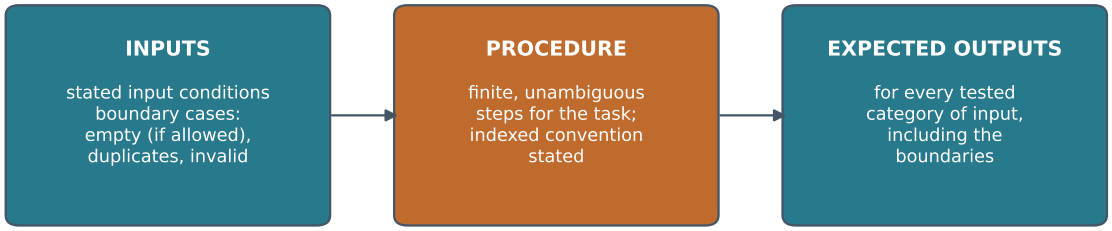
Expression	Value	Rule
`len(s)`	`7`	number of characters
`s[0]`	`"n"`	the first index is 0
`s[3:7]`	`"work"`	from 3 up to, not including, 7
`s.find("w")`	`3`	first index, or -1 if absent
`s.upper()`	`"NETWORK"`	a new string; `s` is unchanged

- **Key knowledge: three kinds of error**

Kind	When it shows	Example
syntax	before the program runs	`if x > 0` with no colon
runtime	while it runs: an **exception**	`int("two")` raises `ValueError`
logic	never reported: wrong output	`<` where `<=` was meant

- **Worked example: handling bad input**

A program contract: inputs, procedure, expected outputs



A failure is diagnosed as a wrong algorithm, a wrong implementation, or an incomplete requirement.

A program asks for an age from 0 to 120 and must not crash.

```
while True:
    try:
        age = int(input("Age: "))
        if 0 <= age <= 120:
            break
        print("Out of range.")
    except ValueError:
        print("Enter a whole number.")
```

1. `int("abc")` raises `ValueError`: the `except` block prints a message and the loop repeats.
2. `int("150")` succeeds, but 150 fails the range check: the loop repeats.
3. `int("17")` passes both: `break` leaves the loop with `age` = 17.
4. Test data: normal (17), **boundary** (0 and 120), invalid (-1, 121, `"abc"`).

Worked example: a trace table

```
n = 13
steps = 0
while n != 1:
    if n % 2 == 0:
        n = n // 2
    else:
        n = n - 1
    steps = steps + 1
print(steps)
```

n	n % 2 == 0	steps
13		0
12	False	1
6	True	2
3	True	3
2	False	4
1	True	5

Output: **5**. Write one row each time a variable changes; stop when the `while` condition is false.

2 Practice

2.1 State the most suitable data type for: (i) the number of seats in a cinema; (ii) the price of a ticket, 8.50; (iii) whether a seat is booked; (iv) a booking reference such as `"K7-204"`. [4]

2.2 Evaluate: (i) `17 // 5`; (ii) `17 % 5`; (iii) `17 / 5`. [3]

2.3 `code = "IB2027CS"`. State: (i) `len(code)`; (ii) `code[2:6]`; (iii) `code.find("C")`; (iv) `code[-1]`. [4]

2.4 Classify each error as syntax, runtime or logic. [3]

(i) `print("Total:", total` with no closing bracket

(ii) an average calculated as `total / 10` when there are 12 items

(iii) `marks[5]` when `marks` has 5 items

3 Exam-style questions

3.1 What is printed by `print("3" + "4")`? [1]

- **A** `7`
- **B** `34`
- **C** `"3" + "4"`
- **D** an error message

3.2 `word = "python"`. Which expression gives `"tho"`? [1]

- **A** `word[2:4]`
- **B** `word[2:5]`
- **C** `word[3:5]`
- **D** `word[3:6]`

3.3 Which input makes `int(input())` raise a `ValueError`? [1]

- **A** `42`
- **B** `-7`
- **C** `007`
- **D** `4.5`

3.4 A program reads temperatures until the user enters `x`.

```
count = 0
total = 0
high = -100
t = input()
while t != "x":
    v = int(t)
    count = count + 1
    total = total + v
    if v > high:
        high = v
    t = input()
print(total / count, high)
```

(a) Complete a trace table for the inputs `18`, `23`, `19`, `x`, with columns `t`, `count`, `total` and `high`, and state the output. [4]

(b) State the output if the first input is `x`, and explain why. [2]

(c) Explain why the program crashes if the user types `twenty`, and describe how `try … except` would prevent it. [3]

(d) Give **three** test inputs for the temperature, one normal, one boundary and one invalid, for a sensor that reads from -40 to 50. [3]

Solutions

Each answer shows the steps, then the **result**.

2.1

- (i) **integer**
- (ii) **real** (float)
- (iii) **Boolean**
- (iv) **string**: it holds letters and a hyphen

2.2

- (i) **3**
- (ii) **2**
- (iii) **3.4**

2.3

- (i) **8**
- (ii) indexes 2 to 5: `"2027"`
- (iii) **6**
- (iv) the last character, `"S"`

2.4

- (i) **syntax**
- (ii) **logic**: it runs but gives the wrong answer
- (iii) **runtime**: an index error, as valid indexes are 0 to 4

3.1 B

- `+` joins two strings

3.2 B

- indexes 2, 3, 4: `t`, `h`, `o`

3.3 D

- `int` cannot convert text with a decimal point

3.4
(a)

`t`	`count`	`total`	`high`
`"18"`	0	0	-100
	1	18	18
`"23"`	2	41	23
`"19"`	3	60	23
`"x"`			

- `count` and `total` correct
- `high` correct
- loop ends at `x`
- output **20.0 23**

(b)

- the loop body never runs, so `count` is 0
- `total / count` divides by zero: a **`ZeroDivisionError`**, and nothing is printed

(c)

- `int("twenty")` raises a `ValueError`
- put the cast inside `try`
- the `except ValueError` block prints a message and asks again instead of stopping

(d)

- normal: e.g. 21
- boundary: -40 or 50
- invalid: e.g. 51, -41 or `"abc"`