Solutions

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

2.1

- a sensor is the input of an automated system
- it **measures a physical quantity and sends the data**

2.2

- an actuator **receives a signal and causes movement or action**

2.3

- a value **outside the range of the real data**, used to stop a loop
- e.g. -1 for a mark out of 100

2.4

- add the new mark to the running total
- `Total ← Total + Mark`

2.5

- otherwise the variable starts with whatever value was left in it
- the total would be **wrong from the first addition**

3.1 B

- the **microprocessor** compares the data and decides
- A only measures; C only moves; D is the output device

3.2

(a)

- the temperature sensor sends the reading to the microprocessor
- the microprocessor compares it with the stored value
- it signals an actuator to **open a window**

(b)

- any **one** of: high cost / can break down / may replace jobs / cannot react to unplanned situations

3.3

(a)

- -99 °C never occurs in the real data, so it cannot be confused with a genuine reading

(b)

- initialise `Total`, `Count` and `Highest`; input before the loop; `WHILE Temp <> -99`; add and count; update `Highest`; input again inside; output total, average and highest after

```
Total ← 0
Count ← 0
Highest ← -1000
INPUT Temp
WHILE Temp <> -99
    Total ← Total + Temp
    Count ← Count + 1
    IF Temp > Highest
      THEN
        Highest ← Temp
    ENDIF
    INPUT Temp
ENDWHILE
OUTPUT Total
OUTPUT Total / Count
OUTPUT Highest
```

(c)

- if no temperatures were entered, `Count` is **zero**
- dividing by zero would **crash** the program

(d)

Mark	Total	Count	Highest	OUTPUT
12	12	1	12	
15	27	2	15	
9	36	3	15	
−99				36, 12, 15

- rows 12 / 15 / 9 / −99 with output **36, 12, 15**

(e)

- the flow of control, especially **branches and the loop**, can be seen at a glance