E8.5 Flowchart, program and simulation

LEARNING INTENTION

We are learning to move between a flowchart, a program and a simulation, and to test that they match.

SUCCESS CRITERIA — I CAN

- ☐ read a simple program line by line
- ☐ draw the flowchart for a program
- ☐ find delays, loops and decisions in a program
- ☐ test a simulation and record results that match

Reading a program

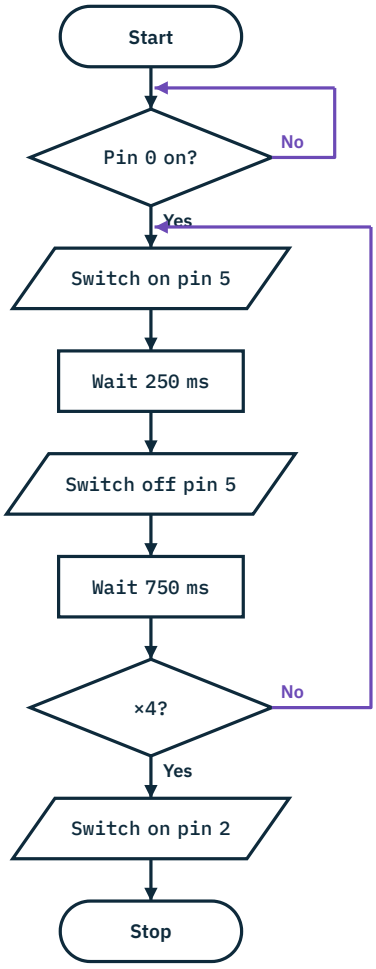
Exam programs use simple words. You read them; you do not write them.

```
line  program
1     main:     if input0 is on then label_1
2               goto main
3     label_1:  let count = 0
4     label_2:  switch on pin 5
5               pause 250
6               switch off pin 5
7               pause 750
8               let count = count + 1
9               if count = 4 then label_3
10              goto label_2
11    label_3:  switch on pin 2
12              end
```

Word	Meaning	Flowchart symbol
switch on pin 5	output on	Input/Output
pause 250	wait 250 ms	Process
if … then …	decision	Decision
goto …	jump (loop)	flow line with arrow
let count = …	counter	Process
end	stop	Terminator

Flowchart, program and simulation

From program to flowchart



Flowchart for the program

WORKED EXAMPLE **Reading the program**

1 GIVEN	2 FIND	3 FORMULA	4 SUBSTITUTE	5 ANSWER + UNIT
the program above	what it does	lines 1–2: wait for input 0 lines 3–10: fixed loop line 11: final output	waits for pin 0 flashes pin 5 four times (on 250 ms, off 750 ms) then switches on pin 2	**4 flashes, then pin 2 on** Time for the flashes = 4 × 1 s = 4 s

pause is in ms: pause 250 = 0.25 s.

Flowchart, program and simulation

The same idea in three languages

PICAXE BASIC

```
main:
 if pinC.0 = 1 then go
 goto main
go:
 for b0 = 1 to 4
  high B.5 : pause 250
  low B.5 : pause 750
 next b0
 high B.2
 end
```

Arduino C++

```
while (digitalRead(0) == LOW) {}
for (int i = 0; i < 4; i++) {
  digitalWrite(5, HIGH);
delay(250);
  digitalWrite(5, LOW);
delay(750);
}
digitalWrite(2, HIGH);
```

micro:bit Python

```
while pin0.read_digital() == 0:
    pass
for i in range(4):
    pin5.write_digital(1);
sleep(250)
    pin5.write_digital(0);
sleep(750)
pin2.write_digital(1)
```

Simulate and test

Build the flowchart and circuit in a simulator. Run it. Record what happens in a results table. Change one thing at a time and test again.

SHORT CIRCUIT

× WHAT EXAMINERS SAW

Test results were not given for the simulated flowchart and circuit, or did not match the simulation.

✓ THE FIX

Run the simulation. Record what each output did and when. Your results must match what the simulation shows.

Course reports 2025 and 2026 (assignment testing tasks).

SHORT CIRCUIT

× WHAT EXAMINERS SAW

Some candidates renamed pins in their simulation to match the task, which then made their program wrong.

✓ THE FIX

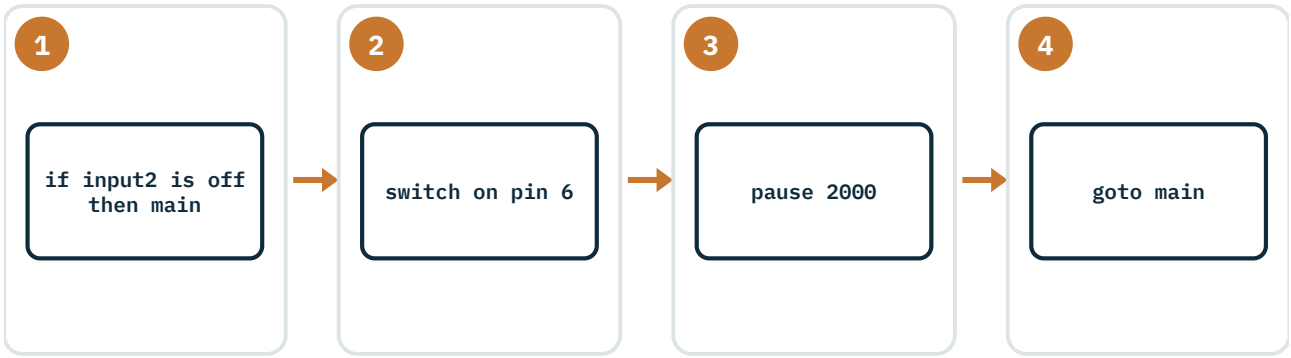
Choose a microcontroller in the simulator that has the pins in the task. Keep the pin numbers the same in the flowchart, circuit and program.

Course report 2024, assignment Task 2(a/b).

Flowchart, program and simulation

Translating line by line

PROGRAM LINE → FLOWCHART SYMBOL



Decision: Pin 2 on?

I/O: Switch on pin 6

Process: Wait 2 s

Arrow back up

WORKED EXAMPLE Program to flowchart

1 GIVEN	2 FIND	3 FORMULA	4 SUBSTITUTE	5 ANSWER + UNIT
main: if input2 is off then main switch on pin 6 · pause 2000 · switch off pin 6 · goto main	flowchart	if → decision pause → process goto → loop arrow	Pin 2 on? (No → back) Switch on pin 6, Wait 2 s, Switch off pin 6 loop back to the decision	**4 symbols + loop**

WORKED EXAMPLE Spotting a program error

1 GIVEN	2 FIND	3 FORMULA	4 SUBSTITUTE	5 ANSWER + UNIT
flash 5 times needed if count = 4 then done	error	count up to the target	the loop ends after 4 flashes	**Change 4 to 5**

Flowchart, program and simulation

WRONG

```
Sim: lamp 2 s.
Test result: 'it
worked'
```

Vague result with no evidence.

RIGHT

```
Sim: lamp 2 s on.
Test: lamp 2 s on
√ matches
```

Results name the output and timing, and match.

Cairnloch ski lift (fictional)



REAL ENGINEERING · KINBRAE LIGHTHOUSE FOG SIGNAL

Kinbrae (fictional) engineers simulate every new fog-signal program before it is uploaded.

The test log must show the same timings as the simulation, or the program is not signed off.

PROBE · QUICK CHECKS

1. pause 750 = ? s _____
2. What does 'goto' make? _____
3. Line with a decision? _____

Flowchart, program and simulation

EXAM READY · 5 MARKS

1 Use the program in the notes. **State** a line number that contains a time delay. **[1]**

2 **State** the number of times pin 5 turns on and off. **[1]**

3 **State** the name of the type of loop in lines 3–10. **[1]**

4 **Calculate** the total time pin 5 is switched on. **[2]**