4 Processor Fundamentals – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
processor			
stored program			
arithmetic and logic unit			
control unit			
register			
Program Counter			
Accumulator			
memory address register			
memory data register			
current instruction register			
fetch–execute cycle			
data bus			
address bus			

Recall

At IGCSE you know the CPU runs programs. Bring this with you:

- The **processor** fetches and carries out instructions.
- Programs and data are stored in memory.

At AS we look inside the processor and at how it runs a single instruction – the cycle every computer repeats billions of times a second.

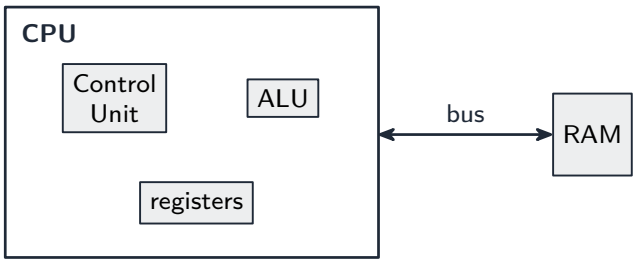
New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

1 Inside the processor

A computer keeps its instructions and data together in memory – the **stored program** idea. The processor contains:

- an **arithmetic and logic unit** that does the maths and logic;
- a **control unit** that directs everything;
- small, very fast stores called **register** cells.



Worked example. To work out $3 + 4$: the control unit fetches and decodes the "add" instruction, the ALU adds the two numbers, and a register holds the answer 7.

2 Two important registers

- the **Program Counter** holds the address of the next instruction to run;
- the **Accumulator** holds the result of a calculation.

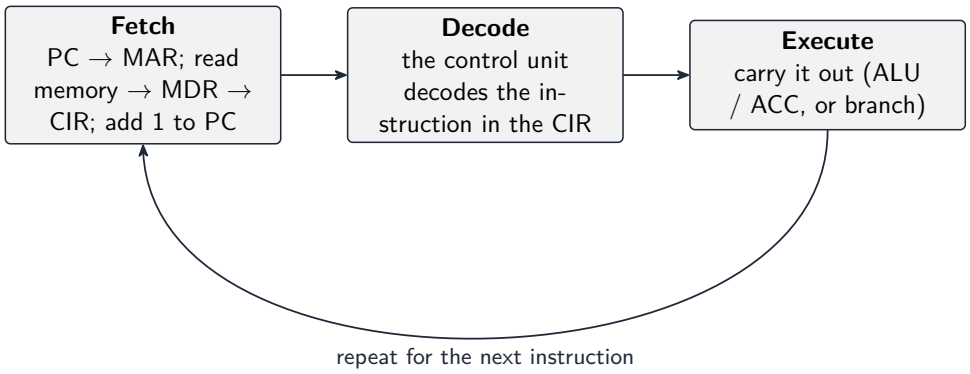
Worked example. Say the Program Counter holds 30. The CPU copies 30 into the **memory address register** (MAR) and reads memory location 30; the instruction arrives in the **memory data register** (MDR), then moves to the **current instruction register** (CIR), ready to be run.

Watch out: the Program Counter holds the *address* of the next instruction, not the instruction itself.

■ 3 The fetch–execute cycle

To run a program the processor repeats the **fetch–execute cycle** :

1. **fetch** the next instruction from memory,
2. **decode** it (work out what it means),
3. **execute** it (carry it out).



Inside, data travels on the **data bus** and memory addresses travel on the **address bus** .

Worked example. For "add the number at address 50": *fetch* the instruction from memory, *decode* it as an add, then *execute* it – the ALU adds the value stored at address 50 into the accumulator.

Practice

4.1 State what the Program Counter holds. [1]

4.2 State what travels on the address bus. [1]

4.3 Name the two main units inside the processor and say what each does. [2]

4.4 State, in order, the three steps of the fetch–execute cycle. [3]

4.5 Explain *why* the Program Counter must be increased during each fetch–execute cycle. [2]

4.6 Challenge. The Program Counter holds 30. Describe how the registers are used to fetch the instruction stored there. [3]