



4.7.1 Internal Hardware Components

- 1) A particular computer system uses a 32-bit address bus and a 32-bit data bus. Each addressed memory location can store one byte of data.

- a) What is the maximum amount of memory, in bytes, that could be accessed?

[1 mark]

- 2^{32} bytes

- b) A different computer system has a wider data bus; this will speed up the execution of programs.

Explain how the wider data bus has resulted in this effect.

[1 mark]

- It increases the number of bits that can be transferred at one time
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- 2) Explain what a register is.

[1 mark]

- A memory/storage location inside the processor
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- 3) The control unit is an important component of a processor.

Describe the role of the control unit.

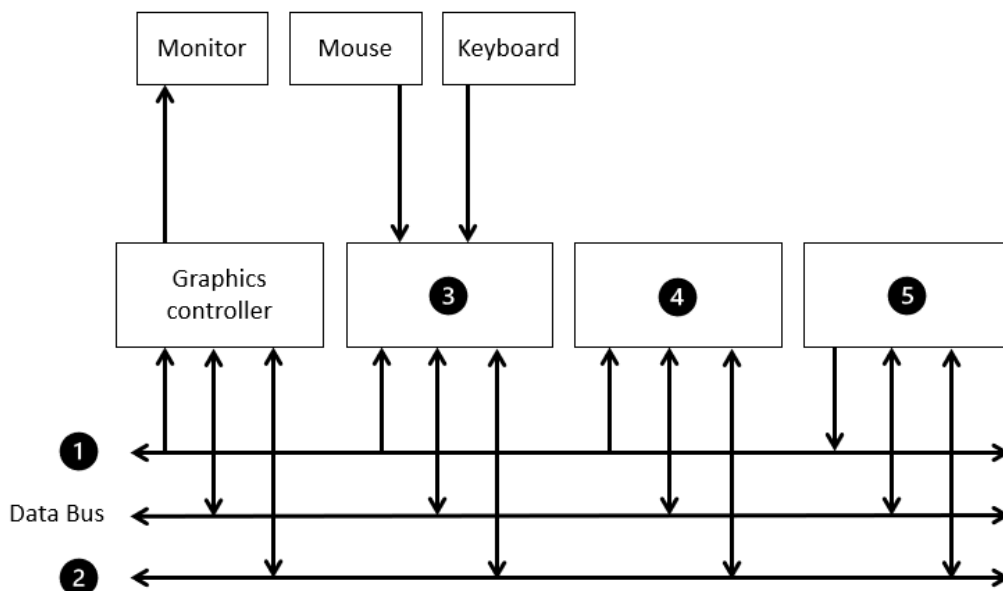
[3 marks]

- To control the operation of the FDE cycle
 - Controls fetching/reading/writing operations
 - Decodes instructions
 - To execute (some) instructions
 - To synchronise the operation of the processor
 - To send control signals to other components
 - To control the transfer of data between registers
 - To handle interrupts
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- 4) **Figure 1** shows how some of the components inside a computer are connected. The computer uses the von Neumann architecture. Some of the names of components have been omitted from **Figure 1**.

Figure 1



Complete the table below by entering numbers that correspond with the components from **Figure 1**.

Component Name	Component Number (1-5)
Address Bus	1
Control Bus	2
Main Memory	4
Processor	5
USB I/O Controller	3

[2 marks]





5) A tablet computer uses the Harvard architecture. Describe **two** advantages of using the Harvard architecture compared to the von Neumann architecture.

[2 marks]

- Instructions and data can be accessed simultaneously
 - Reduces the bottleneck of a single set of data/address buses
 - Avoids possibility of data being executed as code
 - Can use different types of memory for instructions and data, e.g. ROM for instructions and RAM for data.
 - Instructions could use ROM to prevent the program being modified/hacked
 - Instructions and data can have different word lengths
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6) Which of the statement below about a computer that uses the stored program concept is **false**.

A	Instructions are fetched and executed in sequence.
B	The computer can only be used with one program.
C	The data is stored in the main memory.
D	The program is stored in the main memory

[1 mark]

- B
-





7) A USB interface inside a computer is an example of an I/O controller.

a) Describe the role of an I/O controller.

[2 marks]

- Acts as an intermediary between the processor and peripheral devices;
- Allows peripheral to appear as a set of registers / memory locations to the processor;
- Translates signals received from a peripheral into a form that can be processed by the computer
// translate signals sent by the processor into a form that can be used by a peripheral;
- Buffer data being received from a peripheral;
- Allows new peripherals to be added without having to redesign the processor / computer hardware;
- Allows peripheral designers to create new peripherals to one common interface standard;
- To carry out some of the I/O related processing;
- Performs error detection on data received from peripherals;
- Implements the protocols used by I/O devices for communication;
- Generates an interrupt when data is ready to be transferred from an I/O device;

b) The computer's address bus uses 36 wires and each main memory location can hold a 16-bit value.

In gibibytes, express the maximum amount of main memory that could be installed in the computer, assuming the CPU could access all the memory using the address bus.

You should show your working.

[2 marks]

- $2^{36} \times 16 \text{ bits}$
- $2^{36} \times 16 / 8 / 2^{30} = 128$

c) State an example of how the control bus is used when the processor stores data into main memory.

[1 mark]

- Indicate that a memory write is occurring // cause data on the data bus to be written into the memory;
- Transfer clock signal // synchronise operation of processor and memory;
- Receive acknowledgement that data received by memory;
- Issue bus request;
- Receive bus grant;

