# Homework 1 Internal computer architecture Answers

1. a) A low-cost von Neumann machine has an address bus of 16 bits. In this computer, a unit of addressable memory is two bytes. How many KiB of addressable memory can be used? [1]

216 = 64KiB \* 2 Bytes = 128KiB

b) (i) Explain the basic difference between von Neumann architecture and Harvard architecture. [2]

Von Neuman machines hold instructions and data in the same memory. Harvard architectures have separate memories for instructions and data.

(ii) Why is Harvard architecture potentially able to achieve higher processing speeds than von Neumann architecture? [1]

Data and instructions can be fetched in parallel instead of competing for the same bus.

2. I/O controllers are required to convert signals received from a peripheral device into a format the processor can understand, and vice versa.

a) Why are processors not designed to interface directly with peripheral devices? [1]

Processor would need to be designed for every possible item/model of hardware that could be used, which is impractical.

b) Give **three** examples of control signals that may be carried on the control bus. [3]

Memory write, Memory read, Bus request, Bus grant, Clock signal, Reset (resets all components).

3. What would be the effect on the performance of a computer system in increasing each of the following? Give a brief justification for each of your answers.

a) Width of the data bus [2]

If the word size and the data bus width are the same, this allows data transfers to and from memory to be carried out in a single operation. If the word size is say 32 bits and the data bus is 16 bits, two memory accesses will be required to fetch the data or instruction. Therefore, increasing the width of the data bus increases performance.

b) Width of the address bus [2]

The address bus determines how many memory addresses can be directly accessed, so the computer can have a larger memory with a wider address bus. More memory will mean that larger programs and more data can be held in memory, (e.g. if you are manipulating a large graphics file) indirectly resulting in better performance.

[Total 12 marks]