7.1 Internal hardware components

Name: _____

Class: _____

Date: _____

Time: **274 minutes**

Marks: **211 marks**

Comments:

Q1.

Employees at a bank use client computers to access data that is stored on a database server.

The database server uses software to query and modify data stored in a database on hard disk drives. It returns the results of these queries to the clients over the bank's computer network.

The performance of the system is unsatisfactory: the time-delay between a client sending a query to the server and the client receiving the results is unacceptably long.

Explain how the performance of the system might be improved. You should consider the following factors that might be affecting the performance:

- the hardware of the server
- the design of the computer network
- the database and software running on the server.

In your answer you will be assessed on your ability to follow a line of reasoning to produce a coherent, relevant and structured response.

(Total 12 marks)

Q2.

(a) Complete the table below and draw the symbol for an AND gate in the box.

Truth table for an AND gate

Input A	Input B	Output

AND gate symbol

(2)

(b) Using the laws of Boolean algebra, simplify the following Boolean expression.

A.B. (A + B)

_____

_____

_____

_____

_____

Answer _____

(3)

(c) Using the laws of Boolean algebra, simplify the following Boolean expression.

$$(X + Y).(X + \overline{Y})$$

_____

_____

_____

_____

_____

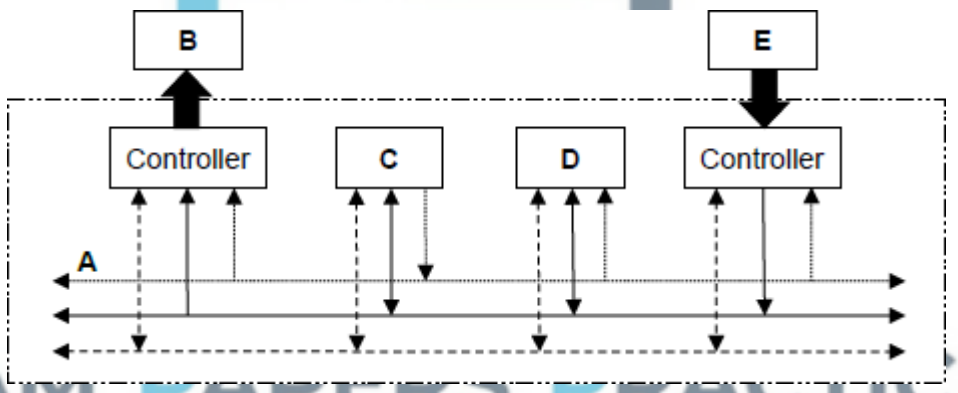
Answer _____

(3)

(Total 8 marks)

Q3.

The diagram below shows how some of the components of a computer system can be connected together.



The table below lists the names of six components in the column headings and the five letters (**A-E**) from the diagram in the row headings.

For each row in the table, shade **one** lozenge, in the appropriate column, to indicate which component in the diagram has been labelled with the row letter.

As an example, the first row has been completed for you, to indicate that component **A** in the diagram is the Address bus.

	Processor	Address bus	Data bus	Main memory	Keyboard	Visual display unit
A	⬭	⬬	⬭	⬭	⬭	⬭
B	⬭	⬭	⬭	⬭	⬭	⬭
C	⬭	⬭	⬭	⬭	⬭	⬭

D	⬭	⬭	⬭	⬭	⬭	⬭
E	⬭	⬭	⬭	⬭	⬭	⬭

(Total 4 marks)

Q4.

An integrated circuit manufacturer is looking to develop a new processor.

(a) What would be the direct consequence on potential performance of

increasing the width of the data bus? _____

_____

increasing the width of the address bus? _____

_____

increasing the clock speed? _____

_____

(3)

(b) A company has designed a new peripheral and is developing the I / O controller for it.

(i) What do we mean by the term peripheral?

_____

_____

(1)

(ii) The I / O controller is an electronic circuit consisting of three parts. One of these parts is known as the I / O port.

What is the role of the I / O port?

_____

_____

(1)

(iii) Describe another part of the I / O controller.

_____

_____

(1)

(iv) Peripheral devices are not directly connected to the processor but make use of the system bus.

Give **two** reasons why it is **not** sensible to connect peripherals directly to the processor.

Reason 1 _____

_____

Reason 2 _____

_____

(2)

(Total 8 marks)

Q5.

(a) State the names of the logic gates represented by each of the three truth tables below.

Input A	Input B	Output
0	0	0
0	1	0
1	0	0
1	1	1

Logic gate name _____

Input A	Input B	Output
0	0	1
0	1	0
1	0	0
1	1	0

Logic gate name _____

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	0

Logic gate name _____

(3)

(b) Simplify the following Boolean expressions.

(i) $B . (A+\bar{A})$

_____

_____

(1)

(ii) A . B + B

_____

_____

(1)

(iii) $\overline{B} \cdot \overline{(\overline{A}+\overline{B})}$

_____

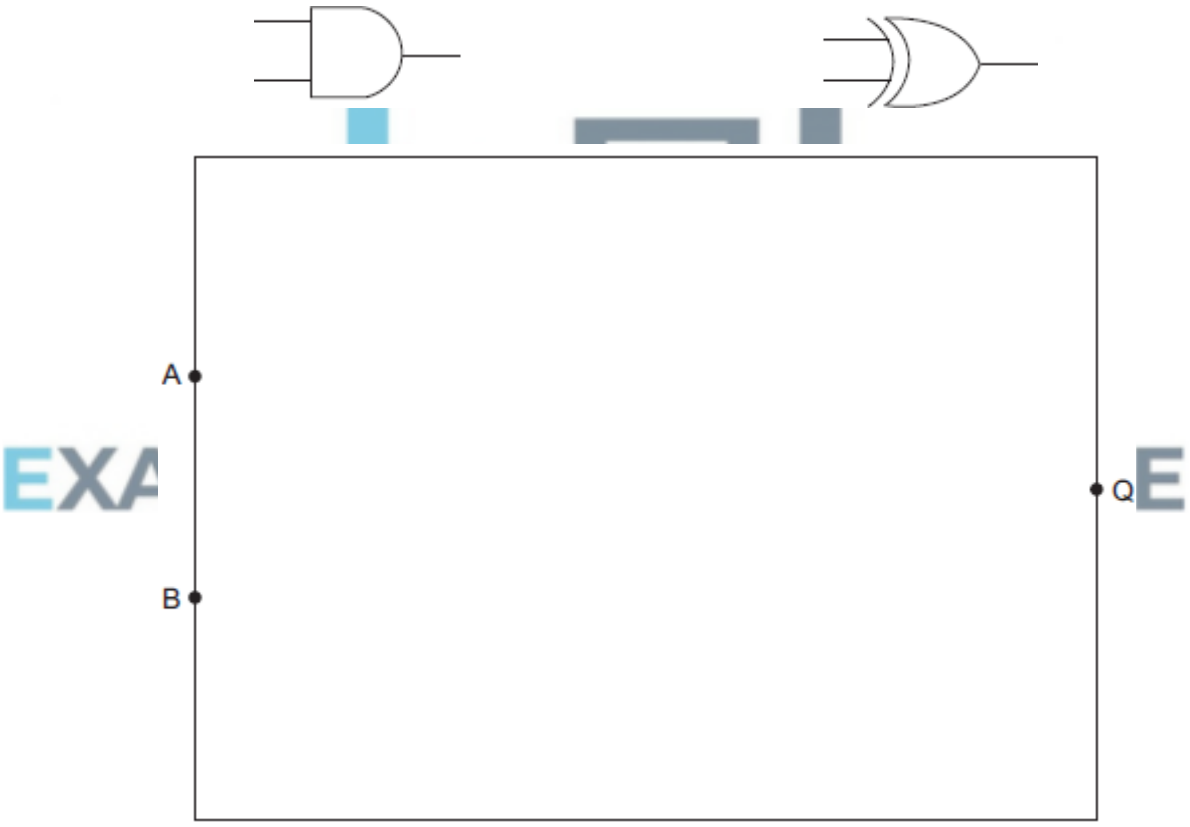
_____

(2)

(c) Draw a logic circuit for the following Boolean expression:

$$Q = (A \oplus B) \cdot B$$

You will need to make use of the symbols below when drawing your logic circuit.



(2)

(Total 9 marks)

Q6.

The data bus, control bus and address bus are three important parts of a modern computer.

(a) In this context, explain what is meant by the term *bus*.

_____

_____

_____

(2)

(b) Fill in the gaps in the paragraph below.

The data bus can be used to transfer data and _____ between the main memory and the processor. The control bus carries control signals.

An example of a control signal is _____

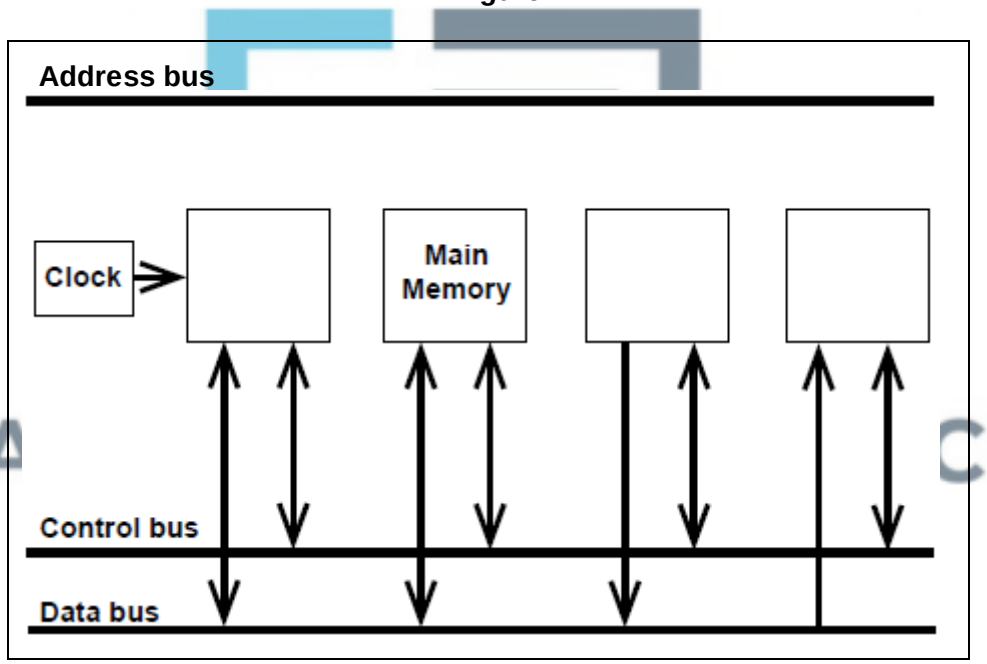
_____

_____

(2)

(c) **Figure 1** shows some of the internal components of a computer system.

Figure 1



On **Figure 1** label the following components.

Processor, Keyboard controller, Graphics controller

Draw **all** the connections between the address bus and the components. Make sure that you **clearly** show the direction of each connection.

(5)

(Total 9 marks)

Q7.

The internal components of a computer system are connected together by three buses.

(a) State the name of the only unidirectional bus.

_____

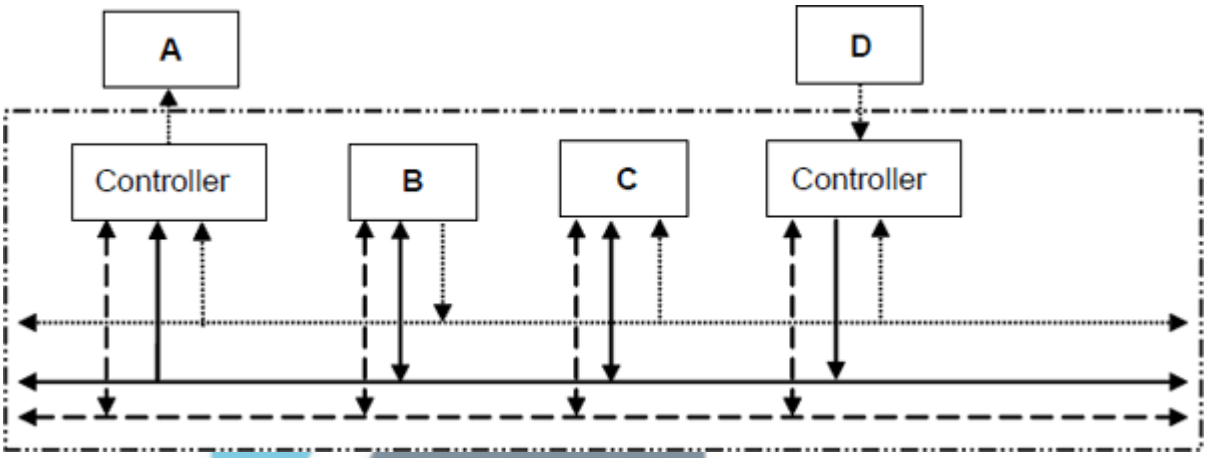
(1)

(b) If a computer has a 32-bit address bus, of 32 lines, it can access **4 gigabytes** of main memory for all forms of internal use.

How many additional lines does the address bus need for it to be capable of addressing up to **8 gigabytes** of main memory? Write your answer in the box below.

(1)

(c) The diagram below shows how components of a computer system can be connected.



Write the correct name for each of **A, B, C** and **D** from the diagram above using only the following:

Processor, Address Bus, Data Bus, Main Memory, Keyboard and Visual Display Unit

A _____

B _____

C _____

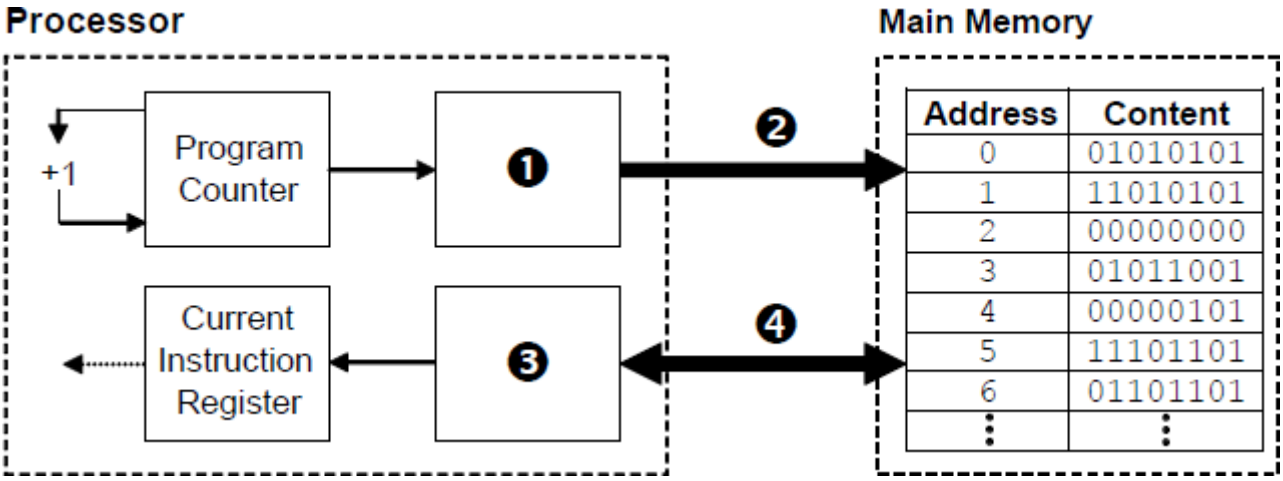
D _____

(4)

(Total 6 marks)

Q8.

The diagram below shows the processor registers and busses that are used during the fetch part of the fetch-execute cycle, together with the main memory. The values stored in memory locations 0 to 6 in the main memory are machine code instructions.



(a) Name the components that are labelled with the numbers 1 to 4. In the case of register names, the full names must be stated.

Number	Component Name
1	
2	
3	
4	

(4)

(b) Explain what happens during the decode and execute stages of the fetch-execute cycle.

(3)

(c) The machine code instructions in the main memory in the diagram above are shown in binary.
When programmers look at machine code instructions they usually prefer to view them in hexadecimal.

State **one** reason why this is the case.

(1)

(d) The machine code instructions in the main memory in the diagram above were produced when an assembly language program was translated into machine code.

(i) What type of program translator was used to do this?

_____

(1)

(ii) Most computer programs are initially written in an imperative high level language rather than assembly language.

Explain why this is the case.

_____

_____

_____

_____

_____

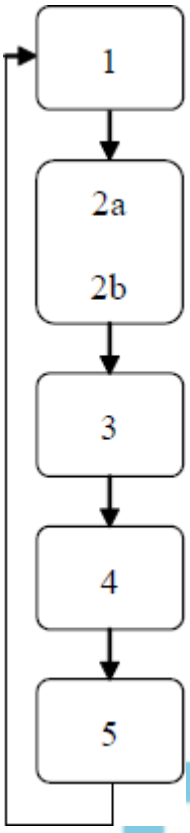
_____

(3)

(Total 12 marks)

Q9.

The figure below shows the fetch-execute cycle. Steps 2a and 2b occur at the same time.



Step 1: MAR ← [PC]

Step 2a: PC ← [PC] + 1

Step 2b: MBR ← $[Memory]_{addressed}$

Step 3: CIR ← [MBR]

Step 4: Decode Instruction

Step 5: Execute Instruction

(a) State the full names of **two** of the special purpose registers that are used in the fetch part of the fetch-execute cycle.

Register 1: _____

Register 2: _____

(2)

(b) Explain the role of the address bus, data bus and main memory during Steps 1 and 2b.

_____

_____

_____

_____

_____

(2)

(c) Give **one** reason why Steps 2a and 2b are able to occur at the same time.

_____

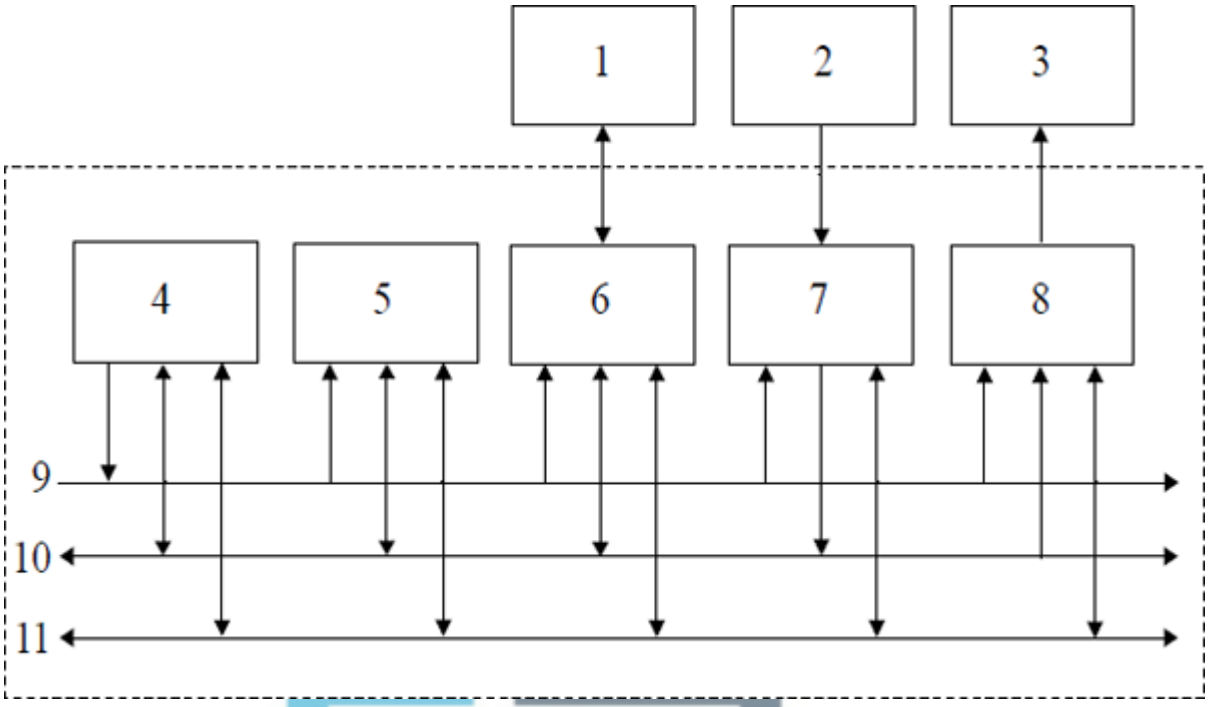
_____

(1)

(Total 5 marks)

Q10.

The diagram below is a diagram of some of the components of a computer system.



Match the component names to the numbers shown in the diagram above by completing the tables below. Some of the numbers have already been written in for you.

Internal Components	
Data Bus	
Address Bus	
Control Bus	11
VDU Controller	
Disk Controller	6
Keyboard Controller	
Main Memory	
Processor	

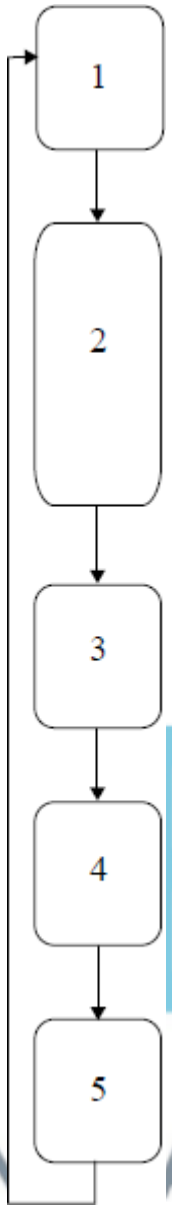
External Components	
Keyboard	
Visual Display Unit	
Secondary Storage	1

(Total 6 marks)

Q11.

The diagram below shows the fetch-execute cycle. Some of the steps have been described.

(a) Describe the missing steps 1, 2b and 4 using either register transfer notation or a written description. Steps 2a and 2b occur at the same time.



Step 1: _____

_____

Step 2a: PC ← [PC] + 1
(Increment contents of Program Counter Register)

Step 2b: _____

_____

Step 3: CIR ← [MBR]
(Transfer contents of Memory Buffer Register into Current Instruction Register)

Step 4: _____

_____

Step 5: Execute Instruction

(3)

(b) What would be the effect on the performance of the computer system of increasing the

(i) width of the data bus? _____

_____

_____

(ii) width of the address bus? _____

_____

_____

(iii) clock speed? _____

_____

_____

(3)

(Total 6 marks)

Q12.

You want to improve the performance of your PC by upgrading certain components, whilst retaining the same motherboard.

What upgraded/additional components would bring about the following improvements? Your components for parts (a), (b) and (c) **must** be different.

(a) Increasing the speed at which application programs are executed.

Component: _____

Explanation: _____

_____

(2)

(b) Avoiding the need to continually archive picture and music files to CD storage.

Component: _____

Explanation: _____

_____

(2)

(c) Having several additional devices connected at the same time to your computer. For example, a digital camera and memory card reader.

Component: _____

Explanation: _____

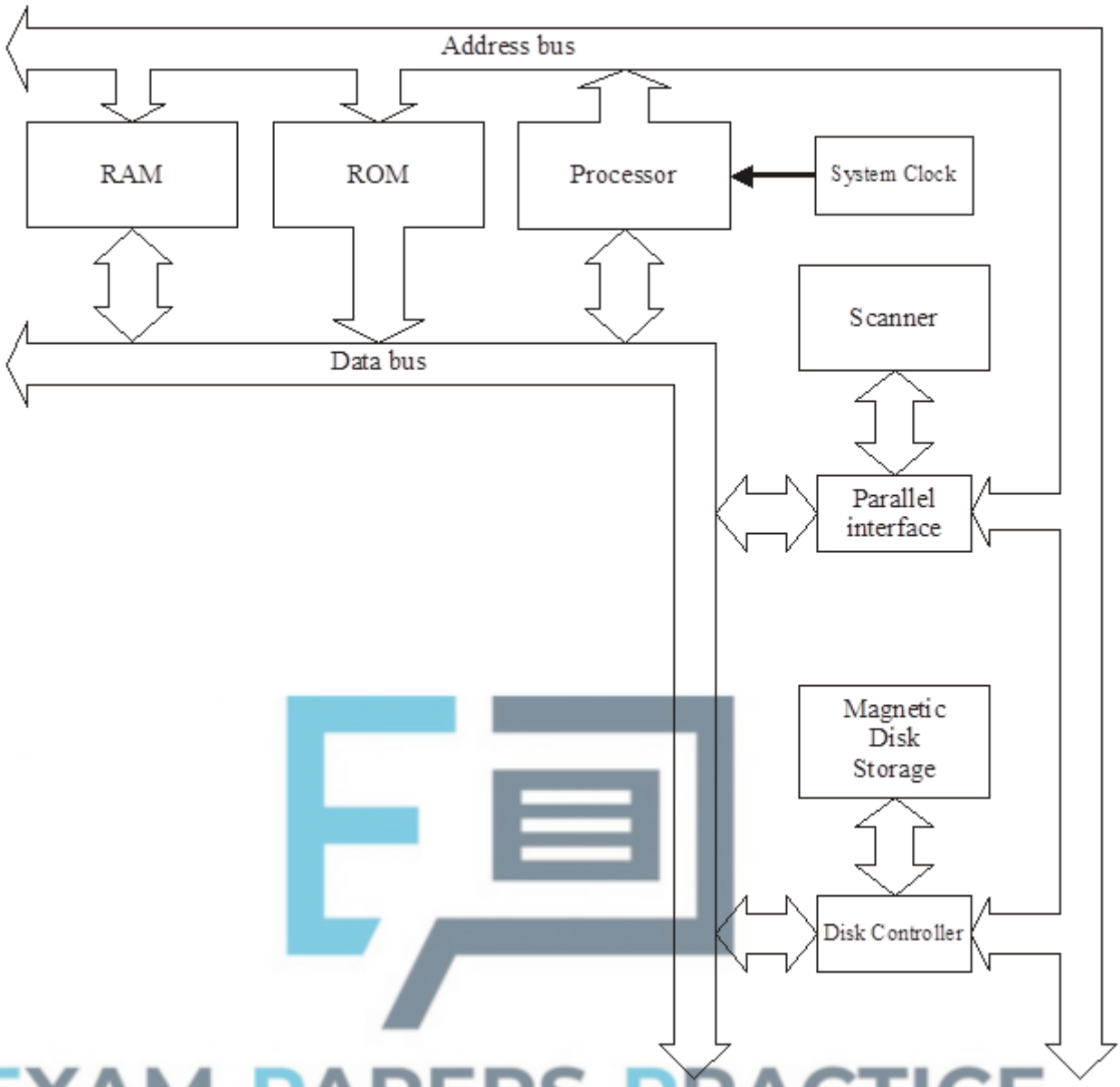
_____

(2)

(Total 6 marks)

Q13.

The figure below shows an incomplete diagram of a typical computer system architecture.



(a) Two of the components shown in the figure for a typical PC, are the RAM and the Magnetic Disk Storage. Select from the list below a typical specification value for each component.

300 GB 2 MHz 1 GB 128 kbps 3.0 MHz

(i) RAM _____

(1)

(ii) Magnetic Disk Storage _____

(1)

(b) A third bus has been omitted from the diagram in the figure above.

Name this bus. _____

(1)

(c) Explain why the data bus is bi-directional, but the address bus is one-way only.

_____

_____

_____

_____

(2)

(d) The processor performs different types of operations; for example, arithmetic operations.

Name **one** other type of operation. _____

_____

(1)

(e) Explain the **stored program concept**. _____

_____

_____

_____

(3)

(Total 9 marks)

Q14.

A computer system has a clock speed of 1 GHz, a 16-bit data bus and a 24-bit address bus. What would be the precise effect of

(a) increasing the clock speed to 2 GHz?

_____

_____

_____

(1)

(b) increasing the size of the data bus to 32 bits?

_____

_____

_____

(1)

(c) increasing the width of the address bus to 32 bits?

_____

_____

_____

_____

(2)
(Total 4 marks)

Q15.

(a) Define the term hardware.

_____

(1)

(b) You buy a second-hand PC from a friend and immediately decide to upgrade some of the internal components of the computer system. Name **two** of the internal components, and explain **one** different benefit for each which should result from the upgrade.

Component _____

Benefit _____

_____

Component _____

Benefit _____

(4)

(c) Some months later you add a component that requires inserting an additional printed circuit board inside the computer. Name the component and explain the new feature/benefit which will result.

Your component should be different from those given for part (b).

Component _____

_____

Benefit _____

_____

(2)
(Total 7 marks)

Q16.

The figure below shows the main memory and processor of a computer system. Data moves between these **two** components along the data bus which uses parallel data transmission.

(a) (i) Show the binary representation for the denary value 59.

_____

(1)

(ii) Add to the diagram in the figure an 8-bit data bus connecting the components showing the value 59 in its binary form being transferred from the main memory to the processor.

(2)

(b) Give **three** possible interpretations of the byte being read in part (a) (ii).

1. _____

2. _____

3. _____

(3)

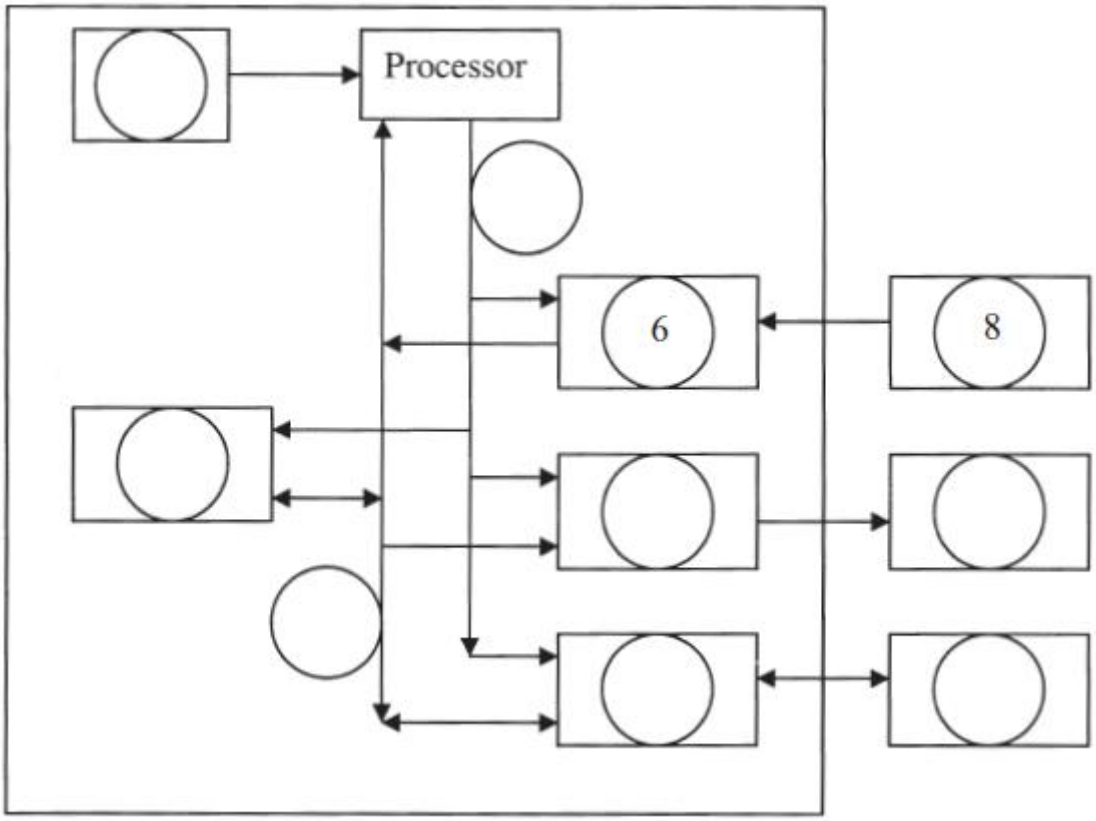
(Total 6 marks)

Q17.

Some of the components of a computer system are

Internal components	
Clock	1
Data Bus	2
Address Bus	3
Main Memory	4
VDU Controller	5
Keyboard Controller	6
Disk Controller	7
Peripherals	
Keyboard	8
Monitor	9
Secondary Storage	10

(a) The figure below is partially filled in. Complete the figure by writing a number from the list above, in **each** empty circle.



(6)

(b) The above computer system uses the *stored program concept*. Explain this term.

_____

_____

_____

_____

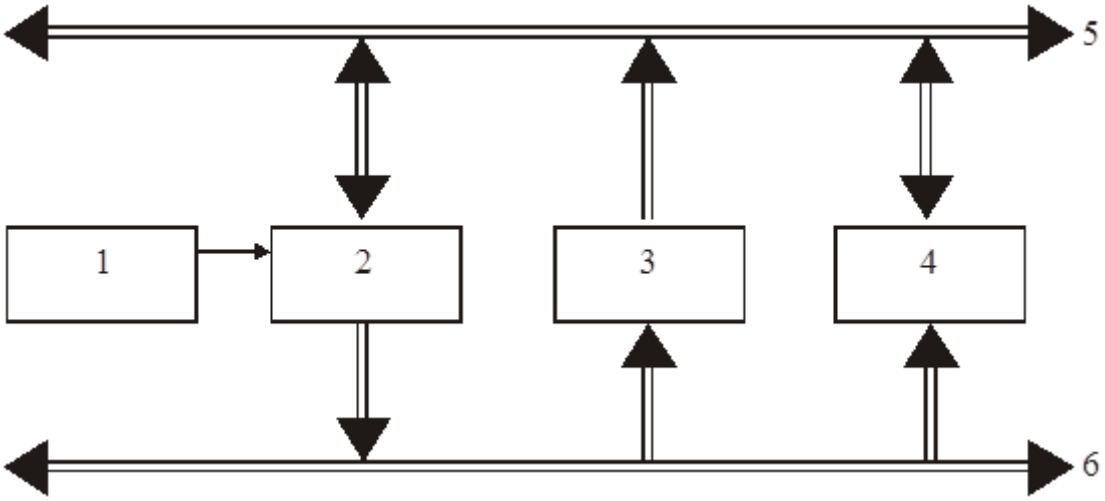
(1)

(Total 7 marks)

Q18.

Some of the internal components of a computer system are processor, read only memory, random access memory, address bus, data bus, clock.

The diagram below shows how these are connected.



(a) Give the correct name for **each** of the following as labelled in the diagram above:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

(6)

(b) Which **one** of the above components limits the number of memory locations?

_____

(1)

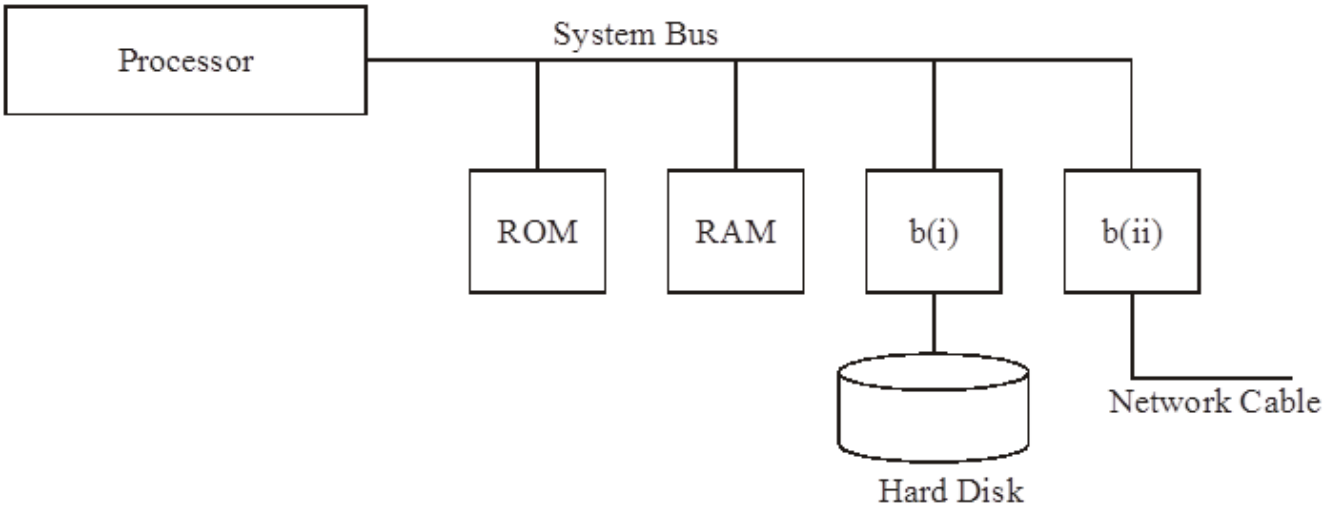
(c) Which **one** of the above components limits the amount of data that can be transferred in one go?

_____

(1)

(Total 8 marks)

Q19.



(a) The diagram above represents part of a computer system. Give the full name of **each** of the following:

(i) ROM _____

(1)

(ii) RAM _____

(1)

(b) In the diagram above, what are the parts labelled (b)(i) and (b)(ii)?

(i) _____

(1)

(ii) _____

(1)

(c) The system bus normally consists of three buses. Give the names of each of these **three** buses.

1. _____

2. _____

3. _____

(3)

(d) What is meant by the stored program concept?

_____

_____

_____

_____

(2)

(e) Parity bits are used to ensure the accuracy of stored data.

(i) What is meant by even parity?

_____

_____

(1)

(ii) Briefly describe how parity bits are used.

_____

_____

_____

(2)

(Total 12 marks)

Q20.

(a) Two of the components of a computer system are a processor and main memory which are connected together by three buses. Name **each** of these buses and explain their purpose.

1. Name _____

Purpose _____

_____

2. Name _____

Purpose _____

_____

3. Name _____

Purpose _____

_____

(6)

(b) In order to connect the computer system to a local area network (LAN) an additional piece of hardware is required. Name this piece of hardware and explain its purpose.

Name _____

Purpose _____

_____

(2)

(c) A printer is connected to the computer system using parallel transmission. Give **one** reason why parallel transmission may be more appropriate than serial transmission.

_____

_____

(1)

(d) Give **one** reason why serial transmission is more appropriate for the local area network.

_____

_____

(1)

(Total 10 marks)

Q21.

Some of the components of a computer system are:

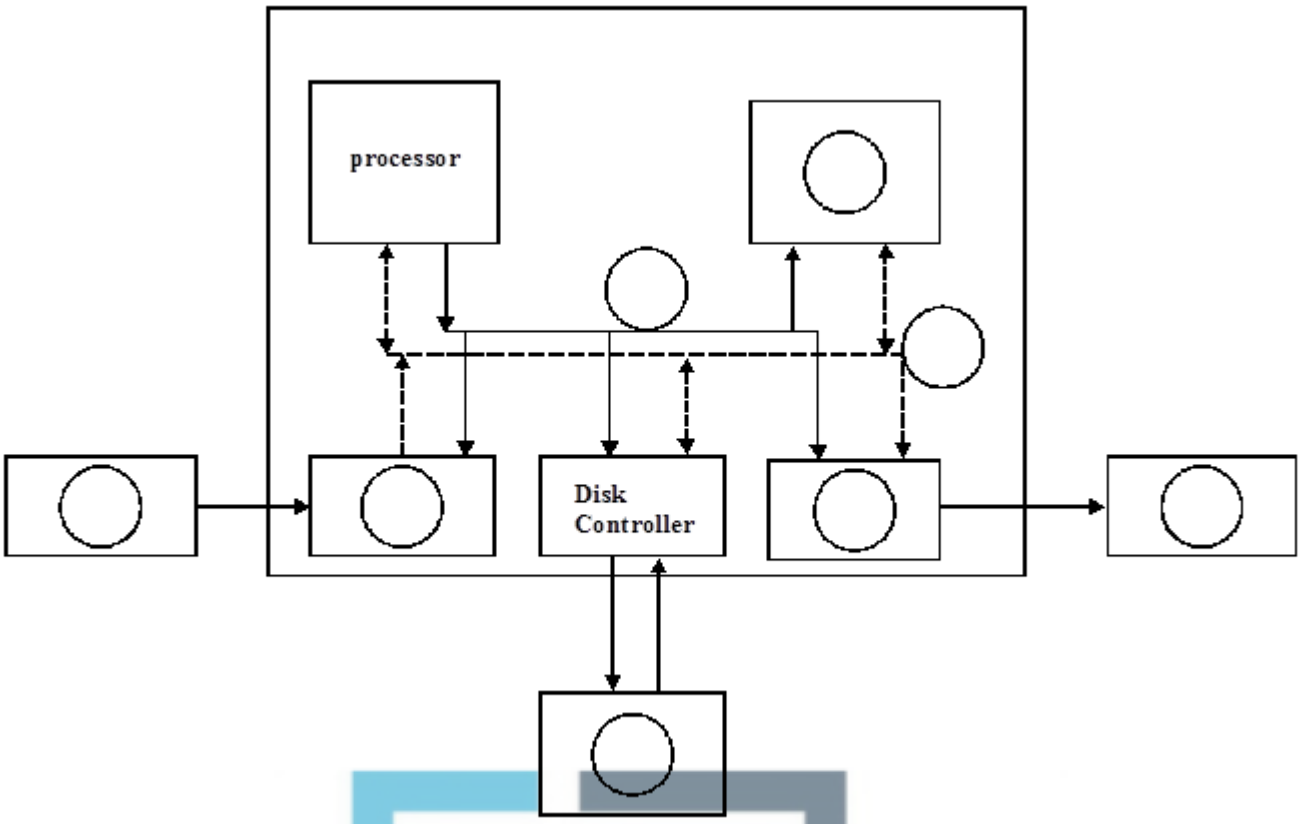
Peripherals:
- keyboard 1
- monitor 2

1/0 Ports:
- VDU controller 3
- keyboard controller 4

Memory:
- main memory 5
- secondary storage 6

System Bus:
- Data Bus 7
- Address Bus 8

(a) In the diagram below, identify each component by writing its number, given in the list above, in the appropriate circle.



(6)

(b) The above computer system uses the *stored program concept*. Explain this term.

_____

_____

_____

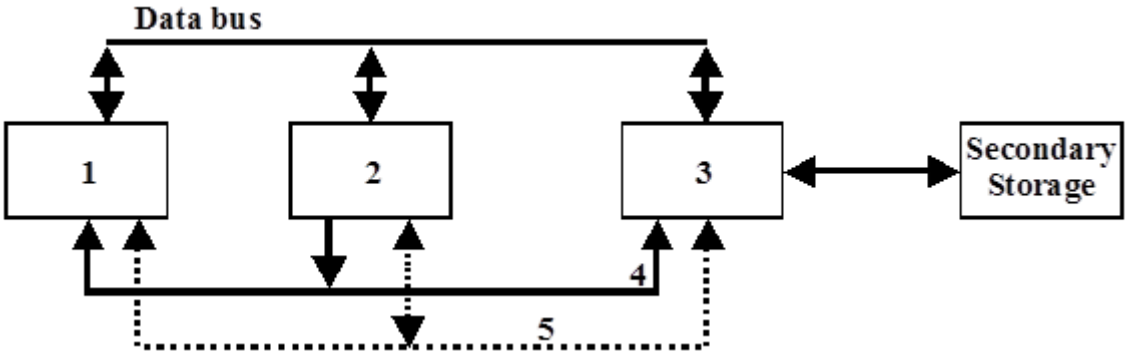
_____

(2)

(Total 8 marks)

Q22.

Some of the components of a computer system are processor, main memory, address bus, data bus, control bus, I/O port and secondary storage.



The diagram above shows how these components are connected.

(a) Name each of the following:

1. _____

2. _____

3. _____

4. _____

5. _____

(5)

(b) (i) What is the function of the following components:

processor; _____

_____

main memory; _____

_____

secondary storage? _____

(3)

(ii) Give **two** examples of a signal carried by the control bus.

1. _____

2. _____

(2)

(iii) Apart from data, what else is carried on the data bus?

_____

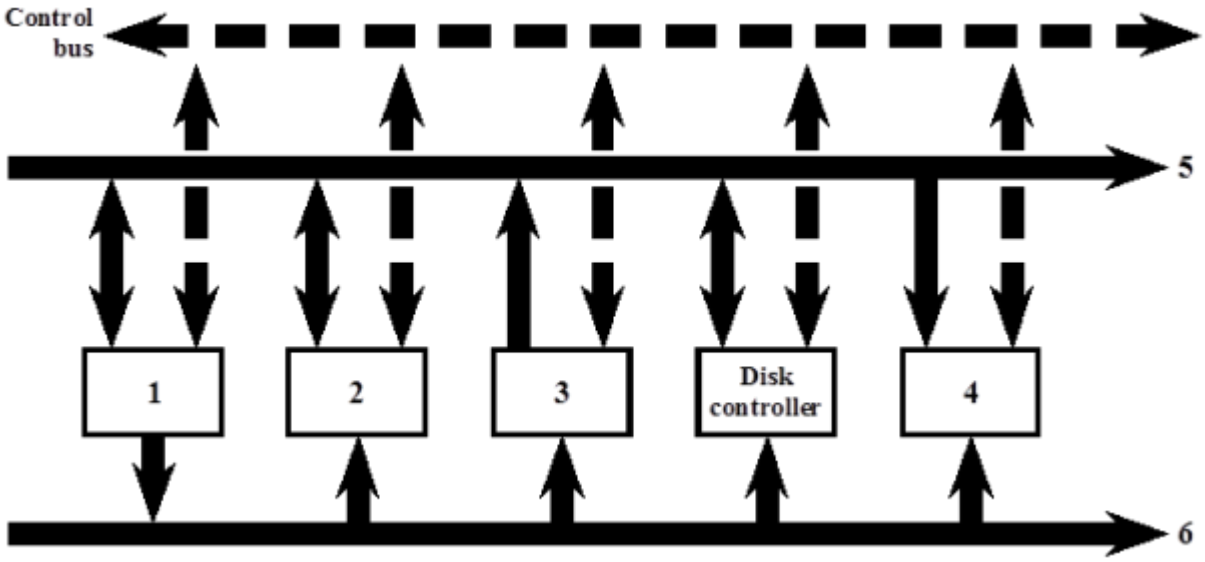
(1)

(Total 11 marks)

Q23.

Some of the internal components of a computer system are processor, main memory, control bus, address bus, data bus, keyboard controller, VDU controller, disk controller.

The diagram below shows how these are connected.



(a) Give the correct name for each of the following as labelled in the diagram above:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

(6)

(b) If the data bus consists of 8 lines what is the largest denary value which could be transferred in one go?

_____

(1)

(c) Computer systems built using the von Neumann architecture use the stored program concept.

(i) Where is a program stored while it is being executed?

_____

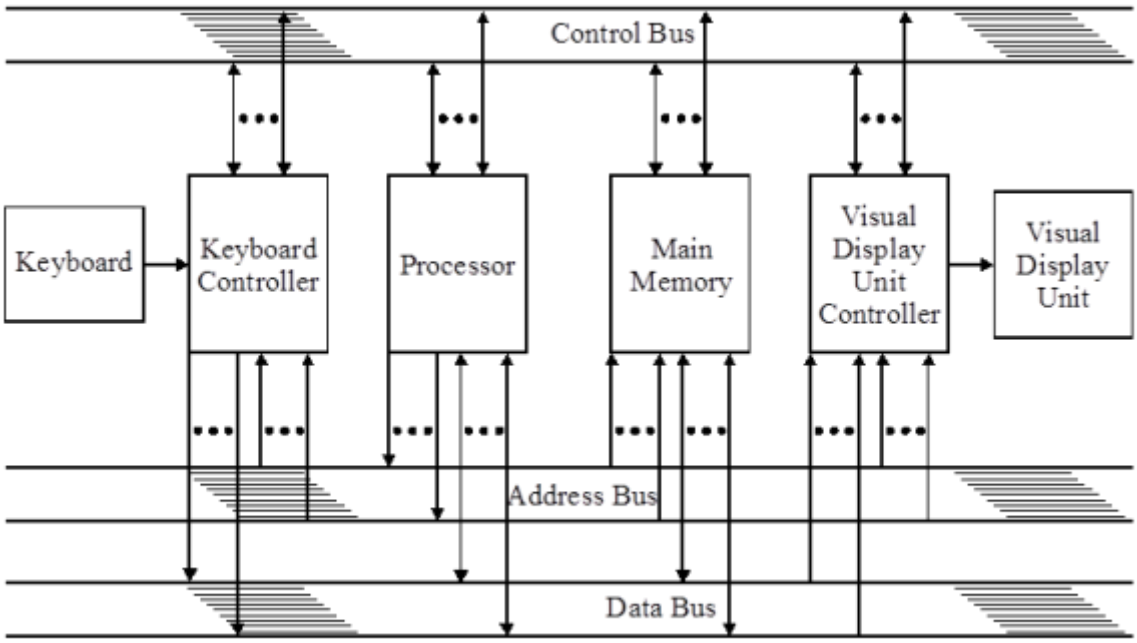
(1)

(ii) Where is the data stored? _____

(1)

(Total 9 marks)

Q24.



The figure above is a block diagram showing the bus architecture of a typical microcomputer. A device controller is a hardware unit which is attached to the bus system of the computer to provide a hardware interface between a computer and a device such as a keyboard.

(a) Why are devices **not** connected directly to the processor?

_____

_____

(2)

(b) Name **one** other device controller which may be found in a typical microcomputer.

_____

(1)

(c) The data bus carries data in both directions. Explain why the address bus only carries addresses in one direction.

_____

_____

(2)

(d) Name and describe the function of **two** signal lines that are usually present in a control bus.

1. Name _____

   Function _____

   _____

2. Name _____

Function _____

_____

(4)

(Total 9 marks)

Q25.

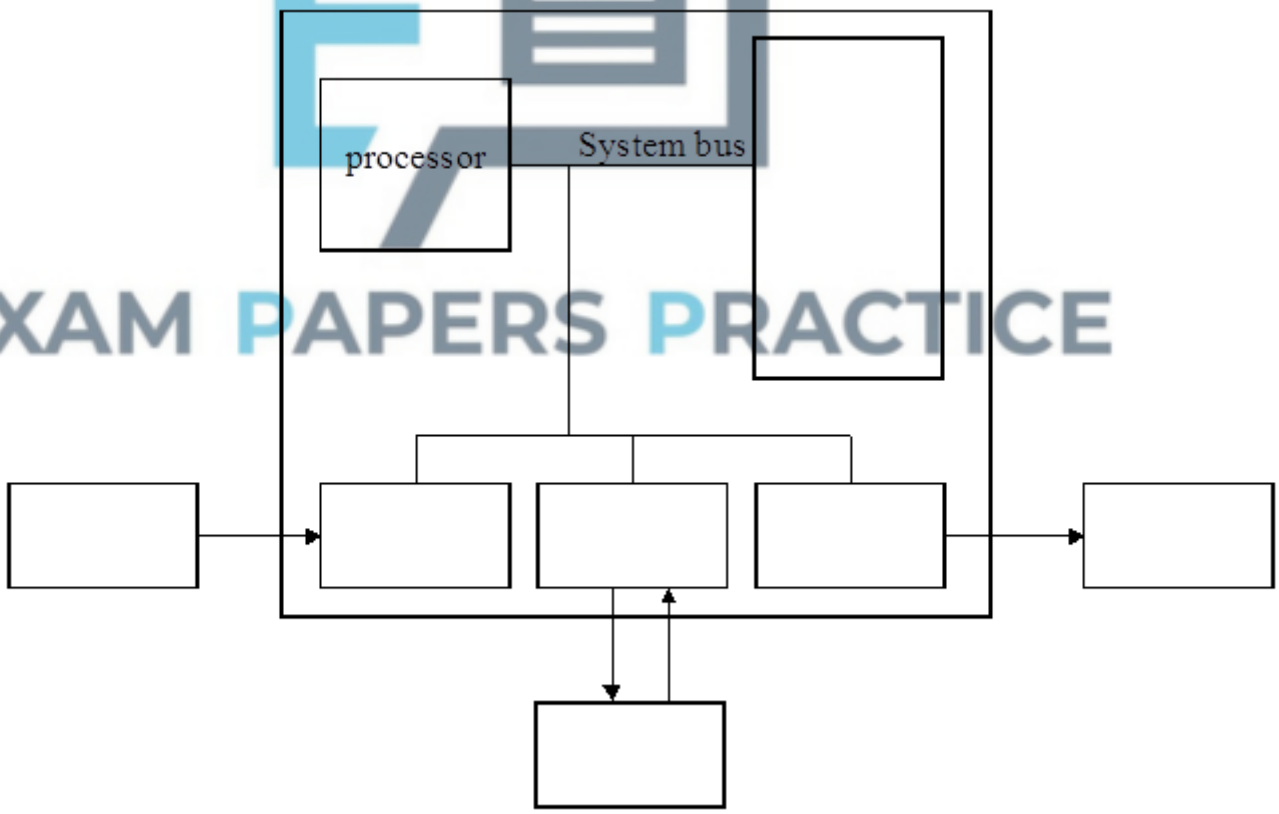
(a) Some of the components of a computer system are:

Memory:
- main memory 1

Peripherals:
- keyboard 2
- monitor 3
- hard disk drive 4

I/O Ports:
- keyboard controller 5
- disk controller 6
- VDU controller 7

In the diagram, name the components by writing the number into the appropriate box.



(4)

(b) The above computer system uses the *stored program concept.* Explain this term.

_____

_____

_____

_____

(2)

(c) Many computer systems and printers have both serial and parallel ports. Data can be sent to a printer from either port. What is meant by:

(i) serial transmission of data; _____

_____

(1)

(ii) parallel transmission of data. _____

_____

(1)

(d) (i) When could parallel data transmission be used?

_____

(1)

(ii) Justify the answer you have given in (d) (i). _____

_____

(1)

(e) Asynchronous data transmission is a method of data transmission in which a character is sent as soon as it becomes available, for example when a key is pressed on the keyboard. In this situation, what is the reason in having the start and stop bits?

_____

_____

_____

_____

(2)

(Total 12 marks)

Q26.

Two types of memory inside a computer are RAM and ROM.

(a) Describe what is meant by

(i) RAM,

_____

_____

_____

_____

(2)

(ii) ROM.

_____

_____

_____

_____

(2)

(b) Give **one** use of ROM inside a computer.

_____

_____

(1)

(c) Give **three** uses of RAM inside a computer.

_____

_____

_____

_____

_____

(3)

(Total 8 marks)