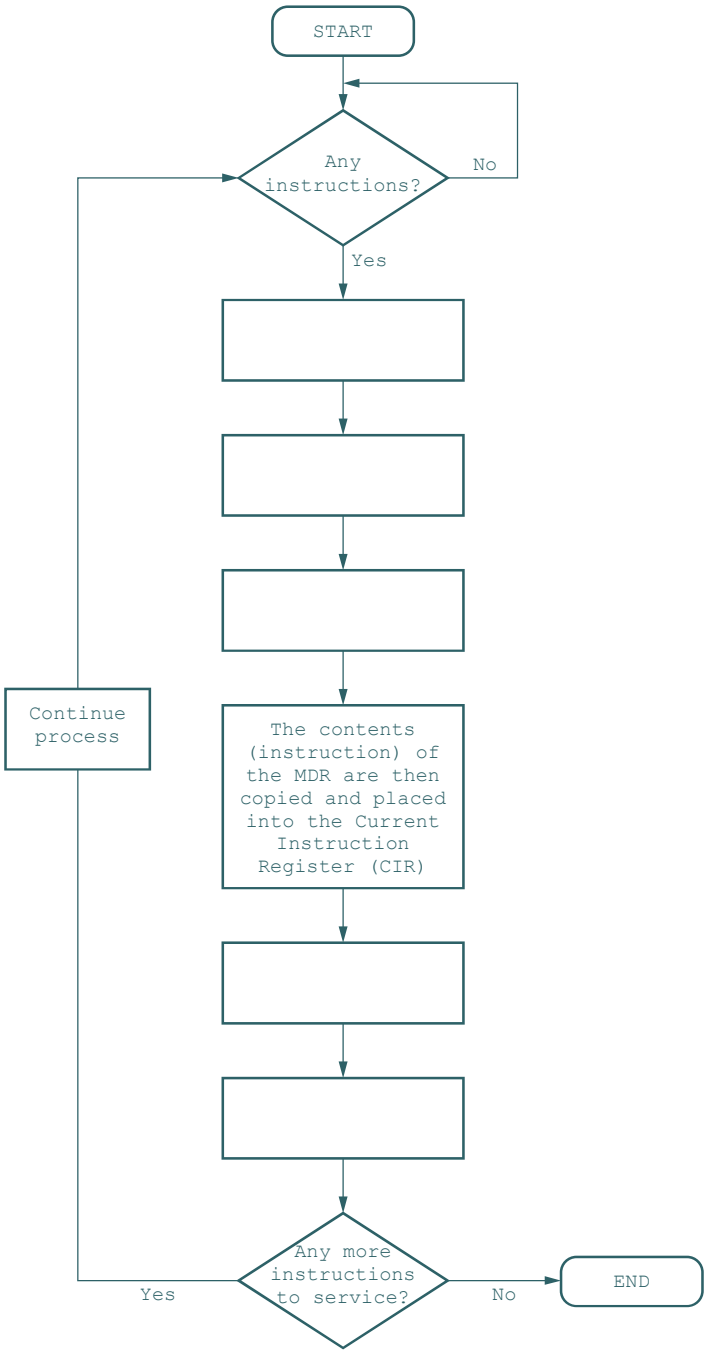
3 Hardware

1 The diagram shows a typical fetch-decode-execute cycle. However, five of the stages have been omitted. Complete the fetch-decode-execute diagram using the following stages. Write the **number** of the stage **only** in the diagram.



Stage	Description of stage
1	Address is then copied from the program counter (PC) to the memory address register (MAR) via the address bus
2	Contents of memory location contained in MAR are then copied into MDR
3	Instruction is decoded and then executed by sending out signals via the control bus to the computer components
4	The PC contains the address of the memory location of the next instruction to be fetched
5	Value of the PC is incremented by 1 so it now points to the next instruction to be fetched

2 a Name **three** types of bus used in the von Neumann architecture.

.....

.....

.....

b The contents at a number of addresses are shown below.

Address	Contents
1000 0000	0111 1100
1000 0001	1000 0011
1000 0010	1111 1101
1000 0011	0111 1110
1000 0100	1100 1101
↓	↓
1111 1100	
1111 1101	0110 0011
1111 1110	1010 0111
1111 1111	1111 0011

i Show the contents of the MAR and MDR if we READ the contents of memory location 1 1 1 1 1 1 1 0.

MAR:								

MDR:								

ii Show the contents of the MAR and MDR if we wish to write 1 1 0 0 1 1 0 1 into memory location 1 0 0 0 0 1 0 0.

MAR:								

MDR:								

iii If MAR contains 1 1 1 1 1 1 0 0 and MDR contains 0 0 1 1 1 1 0 0, complete the memory contents diagram above.

c Four registers are shown in the following table. For each register, give its full name and explain its function in the fetch-decode-execute cycle.

Register	Full name of register	Function of register
CIR	.....	.....
MAR	.....	.....
MDR	.....	.....
PC	.....	.....

3 a Explain the meaning of the following terms, with reference to the CPU.

i (system) clock cycle: .....

.....

.....

ii cache: .....

.....

.....

b Discuss how changes to the clock speed and to the number of cores can affect the performance of the CPU. Include any advantages and disadvantages, due to these changes, in your discussion.

.....

.....

.....

.....

.....

.....

.....

.....

4 a i Define what is meant by an embedded system.

.....

.....

.....

.....

ii State **four** of the features you would expect to find in any embedded system.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

4 .....

.....

.....

iii Describe **three** applications that use embedded systems.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

b A games console is controlled by an embedded system in the form of a microcontroller. New games are supplied on a memory stick or via an internet connection. Various devices, such as a steering wheel, are connected to the console.

i Describe the inputs needed by the embedded system and describe what outputs you would expect to be produced. You may find it helpful to draw a diagram of your system.

.....

.....

.....

.....

.....

.....

.....

.....

ii Updates to the internal software in the games console are required every six months. Explain how the device software is updated without the need to send the games console back to the manufacturer every six months.

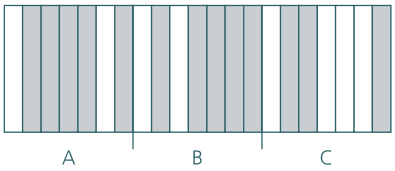
.....

.....

.....

.....

5



a A barcode showing three digits, A, B and C, is shown above. Each dark bar represents a 1-value and each light bar represents a 0-value.

Give the 7-bit binary value for each of the three digits.

A .....

B .....

C .....

b A supermarket uses barcodes on all its items. When a customer goes to checkout, a number of input and output devices may be used.

Name two input devices and two output devices. Give a different use for each named device.

input device 1: .....

use: .....

.....

input device 2: .....

use: .....

.....

output device 1: .....

use: .....

.....

output device 2: .....

use: .....

.....

c Give **two** benefits to the supermarket manager and **two** benefits to customers of using barcodes on all items.

Manager

1 .....

.....

2 .....

.....

Customer

1 .....

.....

2 .....

.....

6 A camera uses an embedded system.

a Name **three** of the tasks controlled by the embedded system in the camera.

1 .....

2 .....

3 .....

b Name **two** applications where a digital camera could be used.

1 .....

.....

2 .....

.....

7 Choose the most suitable input device for each of the following applications. A different device must be given in each case.

Application	Most suitable input device
Entering text and numbers into a word processor or spreadsheet	
Selecting an option or icon from an on-screen menu	
Inputting a user's voice into a computer as part of a voice recognition system	
Converting a hard copy document into an electronic form to be stored in a computer	
Reading a QR code using a smartphone or tablet	
Keying in digits from a barcode which did not scan correctly	
Reading data directly from the surroundings, such as taking a temperature	

8 Mobile phone touch screens can use three different types of touchscreen technology:
- capacitive
- infrared
- resistive

In the following table, give the advantages and disadvantages of all three types of touchscreen technology, when compared to each other.

Touch screen technology	Advantages	Disadvantages
Capacitive	.....	.....
Infrared	.....	.....
Resistive	.....	.....

9 a Give **three** advantages of using digital light projectors when compared to LCD projectors.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

b Give **two** disadvantages of using digital light projectors when compared to LCD projectors.

1 .....

.....

.....

2 .....

.....

.....

10 Inkjet printers and laser printers are used in many offices.

a Give **one** advantage and **one** disadvantage of each type of printer when compared to each other.

Inkjet printer:

Advantage: .....

.....

.....

Disadvantage: .....

.....

.....

Laser printer:

Advantage:.....

.....

.....

Disadvantage: .....

.....

.....

b Three tasks are given below. For each task, name the most suitable type of printer and give a reason for your choice.

i Printing 20 000 colour leaflets to advertise a new pizza shop.

Printer: .....

Reason for choice: .....

.....

.....

ii Printing a single high gloss photograph in colour.

Printer: .....

Reason for choice: .....

.....

.....

iii Printing out physical replicas of coins for sale in a museum shop.

Printer: .....

Reason for choice: .....

.....

.....

11 a A car enthusiast has bought a car made in 1921. Unfortunately, none of the parts for the car are still made.

Explain how 3D technology could be used to create any part for this car.

.....

.....

.....

.....

.....

.....

.....

b Describe **three** other uses of 3D printers.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

12 Eight types of sensor are shown on the left and eight potential sensor applications on the right.

Draw lines to connect each sensor to an appropriate application. Only one application can be assigned to each sensor.

Level sensor	Control/monitor the amount of water in the soil in a greenhouse
Moisture sensor	Used by a mobile phone to change between portrait and landscape modes
Light sensor	Monitor the amount of fuel in a car's petrol tank
Infrared (active) sensor	Turn on the windscreen wipers automatically when rain is detected
Pressure sensor	Used in the anti-lock braking systems in an aeroplane under-carriage
Acoustic sensor	Switch vehicle headlights on or off automatically
Magnetic field sensor	Measuring the weight of a lorry or van at a weigh station
Accelerometer	Pick up the noise of breaking glass in a security system

13 A security system uses three different types of sensor to detect intruders.

a Name **three** types of sensor that could be used.

1 .....

2 .....

3 .....

b Describe how the sensors and microprocessor are used in the security system. The output is the operation of a siren and flashing lights if an intruder is detected.

.....

.....

.....

.....

.....

.....

.....

14 a Explain the differences between primary memory and secondary storage.

.....

.....

.....

.....

.....

.....

b In the following table, tick (✓) which description refers to RAM and which refers to ROM.

Description	RAM (✓)	ROM (✓)
Temporary memory device		
Non-volatile memory		
Data stored in this memory cannot be altered		
Permanent memory device		
Stores data and part of the operating system currently in use		
Can be increased in size to improve the operational speed of a computer		

c A model radio-controlled car contains RAM, ROM and also has a USB connection. The operation of the car is controlled by a remote control which communicates using radio waves.

i State what data or information would be stored on the ROM chip.

.....

.....

.....

.....

ii State what data or information would be stored on the RAM chip.

.....

.....

.....

.....

iii Explain why a USB port has also been included in the model car.

.....

.....

.....

.....

15 Backing storage makes use of magnetic, optical or solid-state technology.

Seven descriptions are given in the table below. Indicate with a tick (✓) which statements refer to magnetic, optical or solid-state technology.

	Technology used		
Description	**Magnetic (✓)**	**Optical (✓)**	**Solid state (✓)**
Makes use of floating gate and control gate technology			
Disk surfaces are made up of tracks and sectors; storage relies on certain properties of the iron oxide coating			
Devices using this technology have no moving parts			
Data is stored in 'pits' and 'lands' on a single spiral track running from the centre outwards			
Disks use the properties of laser light to allow read and write operations			
Data is stored by controlling the movement of electrons within NAND chips			
This technology is affected by strong magnetic and radio fields			

16 There are ten statements in the table below. Indicate, using a tick (✓) whether each statement is true or false.

Statement	**True (✓)**	**False (✓)**
Devices using magnetic media have a very slow data transfer rate		
HDD platters can be made from ceramic, glass or aluminium coated in iron oxide		
HDD surfaces are split up into tracks and sectors		
HDDs use a more reliable technology than solid-state devices, such as SSDs		
DVD-Rs are used to read and write data several times		
DVD and Blu-ray disks can both use dual-layer technology		
SSDs suffer from a high degree of latency		
Solid-state devices, known as flash drives, use NAND chip technology		
SSD data access time is approximately 100 times less than the data access time for HDDs		
Memory cards (such as the SD and XD cards used in cameras) are examples of magnetic media		

17 Describe how virtual memory works. In your description, include the benefits and drawbacks of virtual memory.

18 a Describe cloud (storage). Include in your description why this type of storage makes use of data redundancy.

b Describe the differences between public clouds, private clouds and hybrid clouds.

.....

.....

.....

.....

.....

.....

c **i** Describe **three** benefits of using cloud storage.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

ii Describe **two** drawbacks of using cloud storage.

1 .....

.....

.....

2 .....

.....

.....

19 Five computer terms are shown on the left and five descriptions on the right.

Draw lines to connect each computer term to its correct description.

Thrashing	Storage environment where the client and remote storage provider are different companies
Swap space	High rate of HDD read/write operations causing a large number of head movements
Cloud storage	Space on HDD or SSD reserved for data used in virtual memory management
Thrash point	Where an HDD is so busy doing read/write operations that execution of a process is halted
Public cloud	Method of data storage where data is stored on hundreds of off-site servers

20 a State which network terms are being described.

i A circuit board or chip that allows a device to connect to a network:

.....

ii Type of address that uniquely identifies a device connected to a network:

.....

iii Address assigned by an ISP to a device each time it logs onto the internet:

.....

iv Hardware device that allows data packets to be moved between different networks:

.....

v Hardware or software that sits between a computer and an external network; it monitors traffic to and from the computer:

.....

b i Explain what is meant by a dynamic IP address.

.....

.....

.....

.....

.....

.....

.....

ii Describe **two** differences between a dynamic IP address and a static IP address.

.....

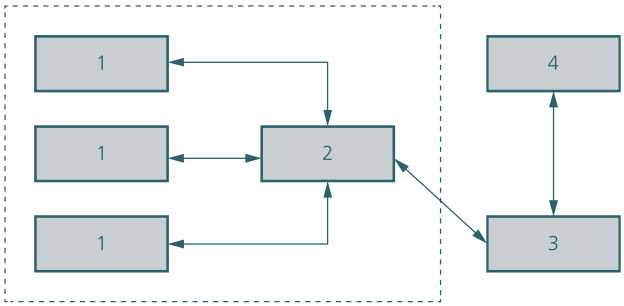
.....

.....

.....

.....

c



i Complete the diagram using the terms:
- computer
- external network
- router
- switch

1 .....

2 .....

3 .....

4 .....

ii Describe the function of a router in a network.

.....

.....

.....

.....

.....

.....

.....

.....

21 When devices connect to the internet they are given IP addresses supplied by an ISP. IP addresses are necessary since the operation of the internet is based on a number of protocols.

a State what is meant by an ISP.

.....

b State what is meant by a protocol.

.....

.....

c Two versions of IP addresses are called IPv4 and IPv6. Describe the differences between IPv4 and IPv6.

.....

.....

.....

.....

.....

.....

.....