Computer Science OCR (9-1) Exam 1 – J276/01 Exam 2 – J276/02 –

Email - computing@unity.fcat.org.uk

Computer Science

GCSE Resources

Knowledge organisers:

Exam 1

1.1 CPU
1.2 Memory
1.3 Storage
1.4 Networks
1.5 Topologies and Protocols
1.6 System Security
1.7 System Software
1.8 Issues!

Exam 2

2.1 Algorithms
2.2 Programming
2.3 Robust Programs
2.4 Logic Gates
2.5 Languages
2.5 2.6 Data Representation

All knowledge organisers have been sent out in paper form via post or available on google classroom

Y9 Code – xgnzwfp
Y10 – Code - xnvz3b2

YouTube

- **Mr Weirs Computer Science**
  - OCR GCSE Playlist
- **Computer Science Tutor.**
  - How to revise computer science
  - OCR walking talking mock.

Quizizz Codes

27th April - May 26th

1.1 CPU - **713528**
1.2 Memory - **815721**
1.3 Tiers of storage - **130143**
1.3 Secondary Storage - **316446**
1.4 Networks - **285361**
1.5 Topologies and Protocols – **244606**
1.6 System Security -**549380**
1.7 System Software -**401676**
1.8 Issues! –**382648**
2.1 Algorithms - **580761**
2.2 Programming - **241058**
2.3 Robust Programs - **029431**
2.4 Logic Gates - **034310**
2.5 – Languages - **033750**
2.6 Data Representation - **490025**

Seneca Assignments

Make sure you are part of the class – class code - **xi1uplrn42**

GCSE POD

gcsepod 2.0 education anywhere

- Assignments set ***OR***
- Create your own playlist of podcasts you want to listen to.

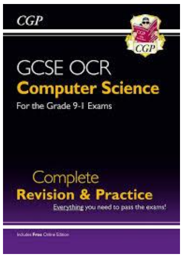
Username – lastname + initial (e.g. boydl)
Password (#iuws)

to do list

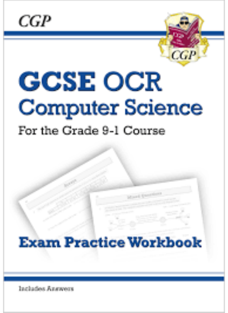
□ Complete recall questions and exam questions on knowledge organisers.

□ Take a Quizizz quiz. Record your score. Write up any of the questions you got wrong in your workbook.

□ Complete the assignments on Seneca

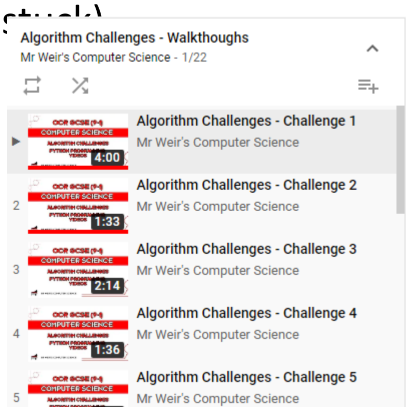


□ Read and make notes from your CGP revision guide then answer some of the exam questions or revision questions in at the end of the topic/chapter. Or complete the exam questions in the white workbook.



□ Listen to the YouTube clips or GCSEPod podcasts and take notes then attempt one of the past-papers in the back of your revision guide.

□ Work your way through the 40 Pseudocode Algorithm challenges- (use Mr Weirs videos to help you if you get stuck)


Algorithm Challenges - Walkthoughs
Mr Weir's Computer Science - 1/22

Algorithm Challenges - Challenge 1
Mr Weir's Computer Science
4:00

2 Algorithm Challenges - Challenge 2
Mr Weir's Computer Science
1:33

3 Algorithm Challenges - Challenge 3
Mr Weir's Computer Science
2:14

4 Algorithm Challenges - Challenge 4
Mr Weir's Computer Science
1:36

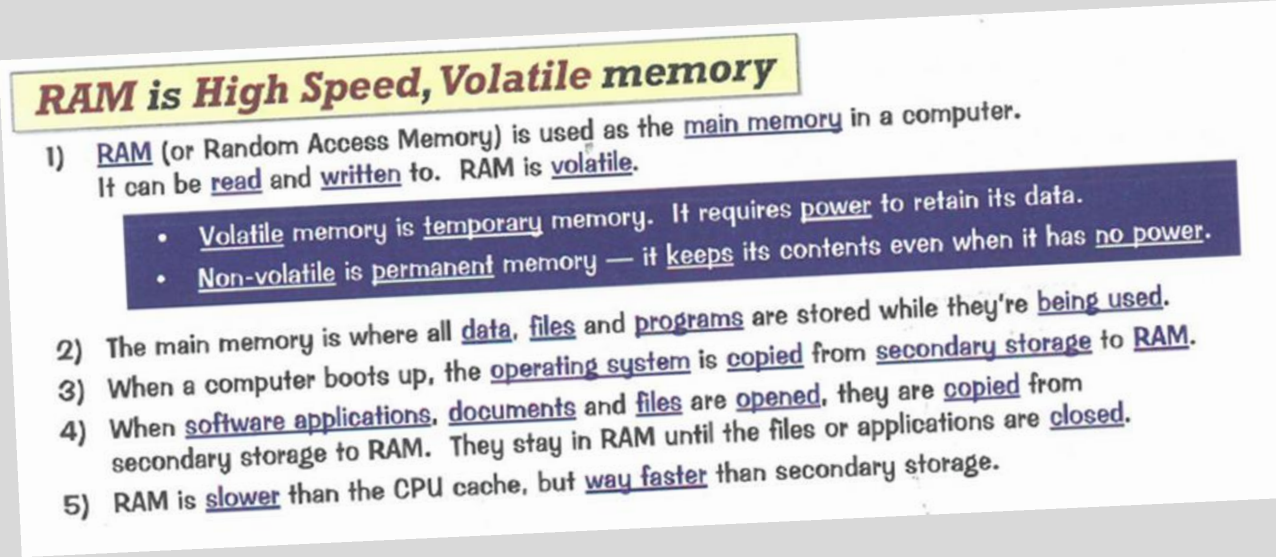
5 Algorithm Challenges - Challenge 5
Mr Weir's Computer Science

□ Complete a topic of revision on Bitesize. Take notes. Watch a video. Then take a test.

Cracking Computing Command verbs

State	Define	Describe	Explain
Give a brief answer *without explanation.*	Give the precise meaning of the word/ term / phrase.	Give a **detailed account** of a picture, situation, event or process. ***provide facts**	Give a **detailed** account including **reasons or causes** ***provide facts with reasons**
State the two categories of computer system. Embedded System General Purpose computer system.	**Define** embedded system and general purpose system, An embedded system is a dedicated device, built into a larger system to control it. A general purpose system is a computer system that can perform multiple tasks. It is programmable by the user.	**Describe** why embedded systems are used in devices rather than general purpose computers. Embedded systems are used as they are easier to design, cheaper to produce and more efficient at doing their job.	**Explain** why embedded systems are used in devices rather than general purpose computers. Embedded systems are cheaper to produce as they are restricted by price, if there were no restrictions , the price of the device they are embedded in would soar making them unaffordable, so embedded systems are made as cheaply as possible. No large amounts of storage, memory or processing required so the price can be kept low. Embedded systems are only designed to do one job, they are not programmable by the end user this makes them more efficient at doing their job as they only have that job to do. Finally as embedded systems only complete one job / small number or jobs and are not programmable by the user, they are much easier to design in terms of hardware and are also simpler to program

Cracking Computing Command verbs



RAM is High Speed, Volatile memory

1) RAM (or Random Access Memory) is used as the main memory in a computer. It can be read and written to. RAM is volatile.

- Volatile memory is temporary memory. It requires power to retain its data.
- Non-volatile is permanent memory — it keeps its contents even when it has no power.

2) The main memory is where all data, files and programs are stored while they're being used.

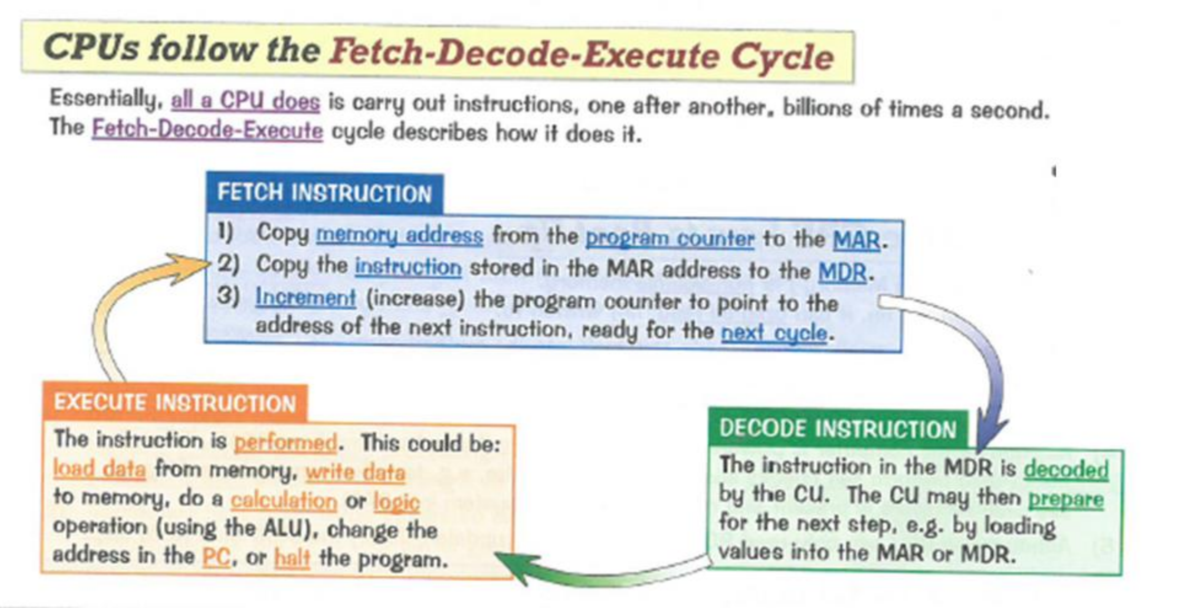
3) When a computer boots up, the operating system is copied from secondary storage to RAM.

4) When software applications, documents and files are opened, they are copied from secondary storage to RAM. They stay in RAM until the files or applications are closed.

5) RAM is slower than the CPU cache, but way faster than secondary storage.

Tasks
State what RAM stands for.
Define 'main memory'.
Describe the characteristics of RAM.
Explain the characteristics of RAM.
Describe how RAM is used in a computer system.

Tasks
State the name of the cycle the CPU follows.
State what happens at each stage of the FDE cycle.
Describe each stage of the FDE cycle.



CPUs follow the Fetch-Decode-Execute Cycle

Essentially, all a CPU does is carry out instructions, one after another, billions of times a second. The Fetch-Decode-Execute cycle describes how it does it.

FETCH INSTRUCTION

1) Copy memory address from the program counter to the MAR.
2) Copy the instruction stored in the MAR address to the MDR.
3) Increment (increase) the program counter to point to the address of the next instruction, ready for the next cycle.

DECODE INSTRUCTION

The instruction in the MDR is decoded by the CU. The CU may then prepare for the next step, e.g. by loading values into the MAR or MDR.

EXECUTE INSTRUCTION

The instruction is performed. This could be: load data from memory, write data to memory, do a calculation or logic operation (using the ALU), change the address in the PC, or halt the program.

GCSE Computer Science
Topic 1.1 Systems Architecture

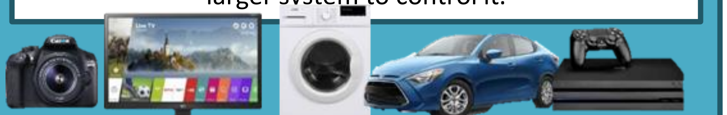
Von Neumann designed the first 'stored program' computer, where data and instructions are stored **together** in memory.

The *Central Processing Unit* processes data and instructions following the FDE cycle.

A computer systems is a combination of *hardware* and *software* that work together to process data.

Hardware: physical components that make up a computer system.
Software: programs/applications that run on a computer.

An *embedded system*: a dedicated system built into a larger system to control it.

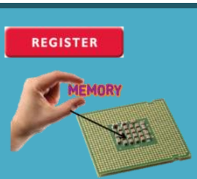


Embedded systems are restricted by price and physical size. They are not programmable.

Benefits of embedded systems:

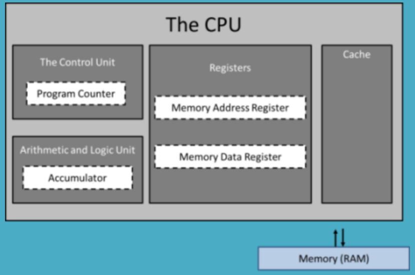
- ✓ Easier to design.
- ✓ Cheaper to produce.
- ✓ More **efficient** at doing their job.

Registers are the smallest & fastest type of memory in a computer system. **They hold data the CPU needs immediately.**



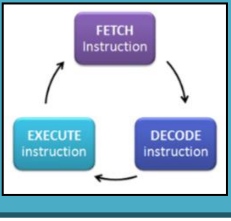
The *PC* holds the address of the next instruction to be fetched.

The *Accumulator* holds the results of any calculations done by the ALU.



The *MAR* holds the address of the memory location to fetch the data from / write to for the current cycle.

The *MDR* holds the data fetched from memory.



The CU copies the memory address from the Program Counter to the MAR.

The CU requests the instruction or data stored in the address held in the MAR, to be brought to the MDR.

The CU updates the Program Counter with the address of the next instruction, ready for the next cycle.

The instruction in the MDR is decoded by the Control Unit(decoder).

The CU carries out the instruction using the ALU for any calculations (and stores the results in the Accumulator).

Clock Speed: the number of instructions single processor can process per second.
The HIGHER the clock speed, the faster the data can be processed.

Number of cores:
each core in the CPU can process data independently.
The MORE cores, the FASTER the data can be processed.

The *cache* is memory inside the CPU. The MORE cache, the faster data can be fetched to be processed.

- The *control Unit* is in overall control of the CPU.
- Its main job is to execute instructions by following the FDE cycle.
- It also controls the flow of data inside and outside the CPU.
- The control unit contains the decoder.

- The *Arithmetic Logic Unit* performs all the calculations.
- It completes arithmetic operations (+ , - , *, /).
- It also completes logic operations using logic gates.
- The ALU contains the accumulator register.

- *Cache* is very fast memory.
- It is slower than the registers but faster than RAM.
- It stores regularly used data so that the CPU can access it quickly next time it is needed.
- If the data is not in cache, it will be fetched from RAM.
- Caches have very low capacity and are expensive compared to RAM.

GCSE Computer Science - Topic 1.1 Systems Architecture

What I need to know:

State the purpose of the CPU.

What does CPU stand for ?

Describe the Von Neumann architecture.

Define register

What does MAR stand for? State what data the MAR holds.

What does MDR stand for? State what data the MDR holds.

What does PC stand for? State what data the PC holds.

State what data the Accumulator holds and which component the accumulator is within.

Common CPU components and their function:

What does ALU stand for? Describe the function of the ALU.

What does CU stand for? Describe the function of the CU.

Define cache memory? Describe the function of cache memory.

What does FDE stand for?

State what happens each stage of the FDE Cycle.

Explain what happens at each stage of the FDE Cycle.

How common characteristics of CPUs affect their performance:

Define clock speed. Explain how clock speed affects the speed of processing.

Explain how the amount of cache affects the speed of fetching data.

Explain how the number of cores affect the speed of processing

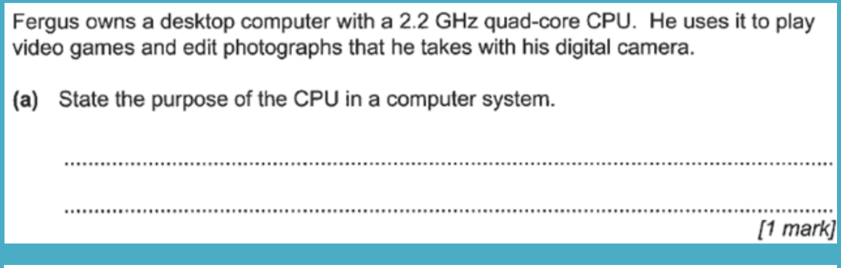
What is an computer system?

Define the terms hardware and software.

Define embedded system.

Explain the benefits of using embedded systems over general purpose systems.

Give 3 examples of embedded systems.



Fergus owns a desktop computer with a 2.2 GHz quad-core CPU. He uses it to play video games and edit photographs that he takes with his digital camera.

(a) State the purpose of the CPU in a computer system.

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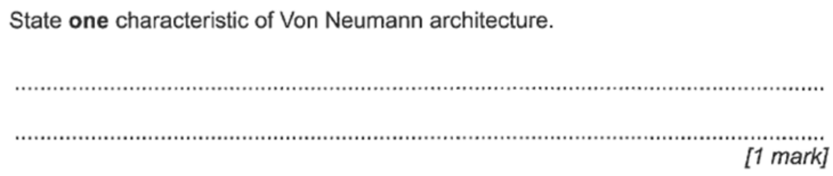
[1 mark]



State **one** characteristic of Von Neumann architecture.

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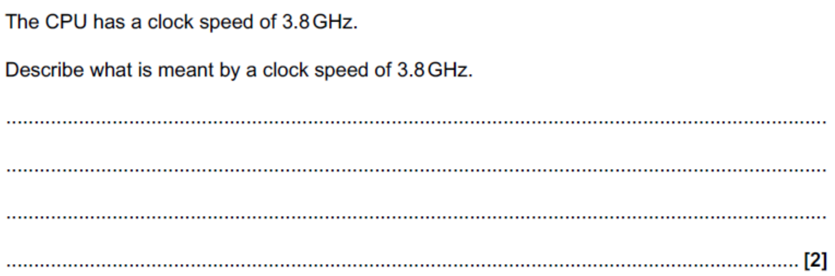
[1 mark]



The CPU has a clock speed of 3.8 GHz.

Describe what is meant by a clock speed of 3.8 GHz.

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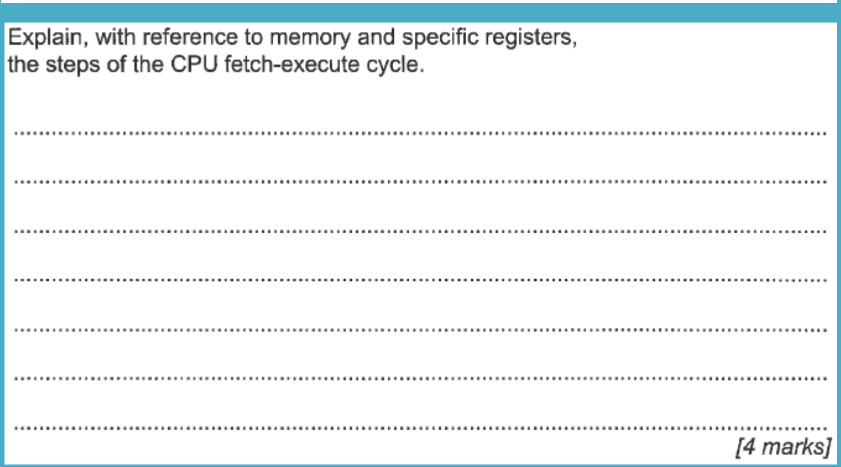

Explain, with reference to memory and specific registers, the steps of the CPU fetch-execute cycle.

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[4 marks]

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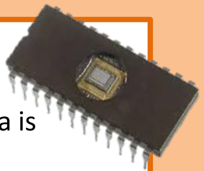
GCSE Computer Science
Topic 1.2 Memory

Computer memory is a physical device capable of storing information temporarily or permanently.



ROM stands for Read Only Memory.

ROM is non-volatile. This means that without power, data is retained (safe/stored).

ROM is read-only. This means that the data inside ROM is fixed. It can only be read, not written to.

ROM stores the instructions required to boot up the computer.

These instructions are called the BIOS (Basic Input Output System).

The BIOS checks the hardware is functioning and loads the operating system into RAM.

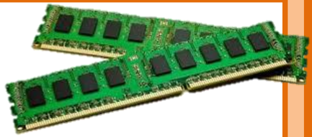
Virtual memory is an area of the hard-drive used as temporary RAM, when RAM is full.

DISADVANTAGE

The read-write speeds of a hard drive is much slower than RAM. Therefore it takes longer to fetch data to the CPU to be processed.

There will be a significant drop in system performance if the system has to rely heavily on virtual memory.

If the OS is constantly swapping data between RAM and the hard drive, programs will run more SLOWLY. *This is called disc thrashing.*



RAM stands for Random Access Memory.

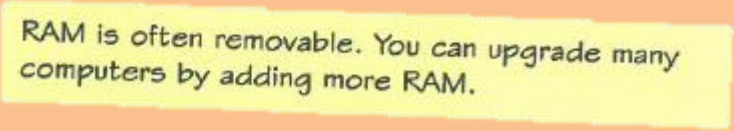
RAM is volatile, this means that without power, data is lost.

RAM is editable, this means that what is stored in RAM read from and written to. e.g. data moved in and out.

RAM stores the Operating System once the computer has booted up.

RAM also stores any program instructions and data that are open / running or in use.

**any program/app that is open on your computer system is moved into RAM.*



RAM is often removable. You can upgrade many computers by adding more RAM.

WHY?

If there are too many programs open at once or a particularly memory intensive program is open, there may not be enough space in RAM to hold all of the program data.

The OS swaps out some of the data from RAM to secondary storage (hard drive) to make room for the new data.
If there was no virtual memory the OS would have to say: *"Sorry, you can not load any more applications. Please close another application to load a new one."*

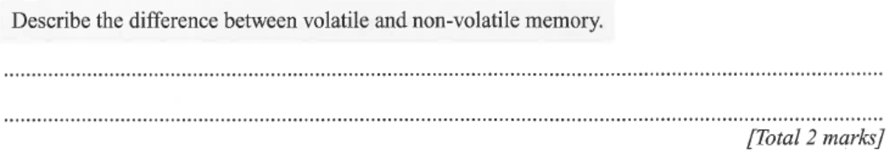
Usually the LEAST recently used data is swapped out to virtual memory. When the data is needed again it is transferred back to RAM to be accessed by the CPU.

The more RAM a computer system has, the less virtual memory will be needed. ***Adding more RAM can significantly improve the performance of a computer***.

GCSE Computer Science - Topic 1.2 Memory

What I need to know:

Define memory.
State what RAM stands for.
State what ROM stands for.
Describe the main differences between ROM and RAM.
Explain RAM's purpose in a computer system.
Explain ROM's purpose in a computer system.
Define virtual memory.
Explain why virtual memory is needed.
Describe the main disadvantage of using virtual memory.
Explain why adding more RAM could improve the performance of a computer system.



Describe the difference between volatile and non-volatile memory.

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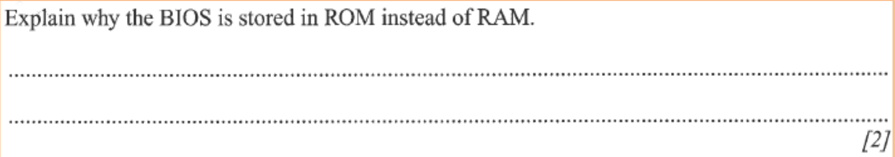
[Total 2 marks]



Explain why the BIOS is stored in ROM instead of RAM.

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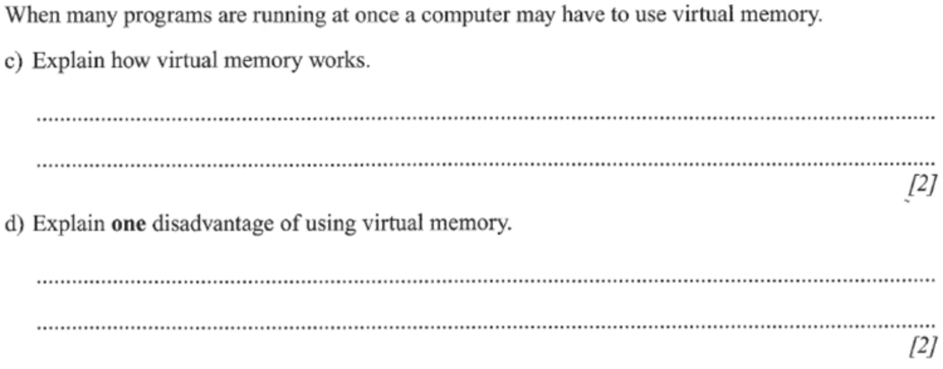
[2]



When many programs are running at once a computer may have to use virtual memory.

c) Explain how virtual memory works.

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[2]

d) Explain **one** disadvantage of using virtual memory.

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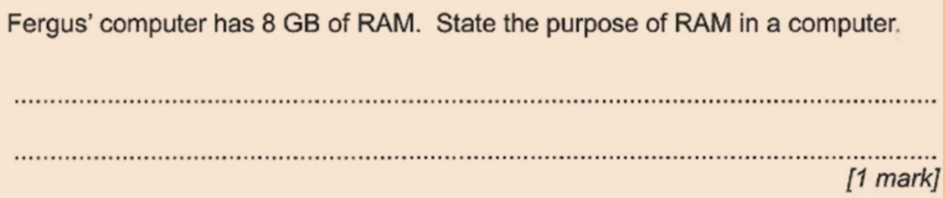
[2]



Fergus' computer has 8 GB of RAM. State the purpose of RAM in a computer.

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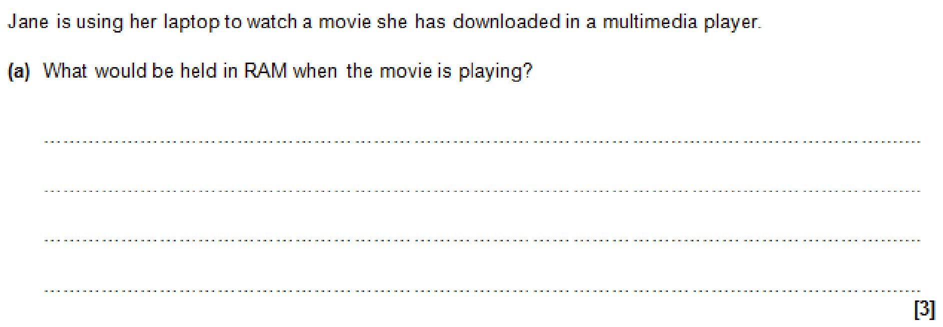
[1 mark]



Jane is using her laptop to watch a movie she has downloaded in a multimedia player.

(a) What would be held in RAM when the movie is playing?

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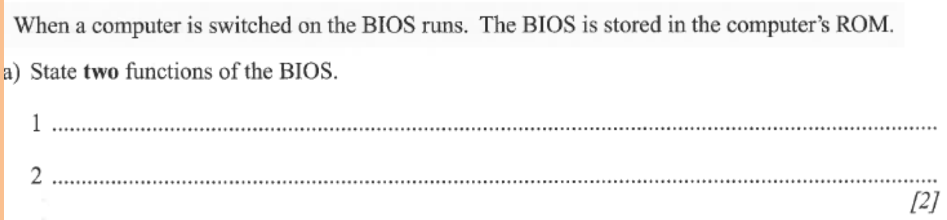
[3]



When a computer is switched on the BIOS runs. The BIOS is stored in the computer's ROM.

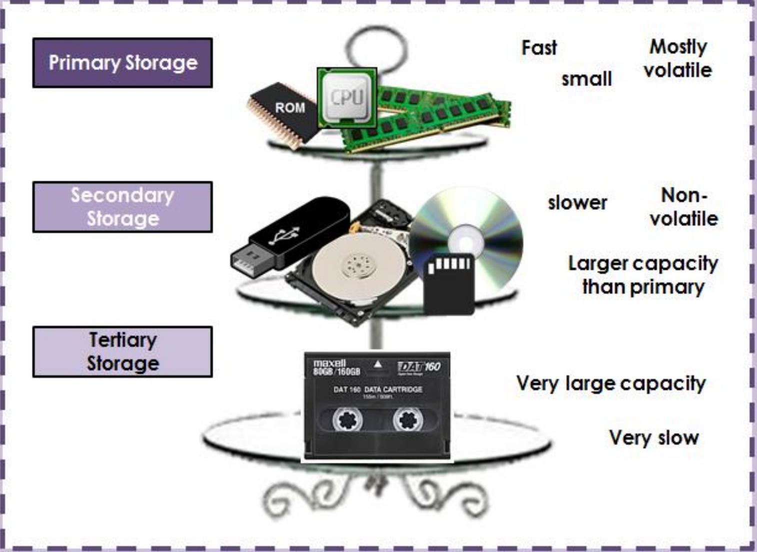
a) State **two** functions of the BIOS.

1 ....

2 ....

[2]

GCSE Computer Science
Topic 1.3 Storage



Primary Storage is memory that can be accessed directly by the CPU: Registers, Cache, RAM, ROM.

Secondary storage is non-volatile hardware where data is stored when it is NOT in use.

The CPU can’t access secondary storage directly, so program data is swapped into primary storage when opened.

Tertiary storage is HIGH capacity, non-volatile hardware used for storing data long term (i.e. back up data).

Bit, Nibble, Byte, Kilobyte, Megabyte, Gigabyte, Terabyte, Petabyte.

1 Kilobyte =	1000 Bytes
1 Megabyte =	1000 Kilobytes
1 Gigabyte =	1000 Megabytes
1 Terabyte =	1000 Gigabytes

÷ ×

Capacity
How much data the storage device can store.

Read-Write Speeds
How fast data can be written to (saved) and read from (opened) the device .

Portability
How easy the device is to carry around.

Durability
How resistant to damage the device is.

Reliability
How long the device will last (life span).

Cost
How much money the device is to buy.

- **Optical** storage uses discs.
  - ➢ A CD (Compact disc) can hold up to 700Mb. (40p)
  - ➢ A DVD (Digital Versatile Disc) can hold 4.7 Gb.(80p)
  - ➢ A BLURAY disc can hold 25Gb. (£3)
- Optical discs use a laser to read and write data.
- The data is stored as a series of pits (laser burns) in a spiral track running from the inside to the outside of the disc.

✓ Portable
✓ Waterproof
✓ Shockproof
✓ Cheap

✘ Low capacity
✘ Scratched easy
✘ Very slow read-write speeds

- Hard disk drives are the traditional internal storage in PCs and laptops.
- A hard disk drive is made up of magnetic metal disks which spin very fast (5,400 – 15,000 revolutions per minute).
- Data is stored magnetically in small areas called sectors.
- The read write head on a moving arm reads data from and writes data to the sectors on the disk.
- External hard disk drives are also available.

£50 2TB

✓ Reliable
✓ Cheap
✓ High capacity
✓ Fast read-write speeds.

✘ Not very durable.

- Solid state memory is made of flash memory.
- Flash memory is non-volatile memory that can be electronically erased and reprogrammed.
- Flash memory uses transistors (switches) that can either be ON (1) or OFF (0).
- Data is stored as binary on flash memory.
- 8 GB of flash memory requires 32billion transistors.

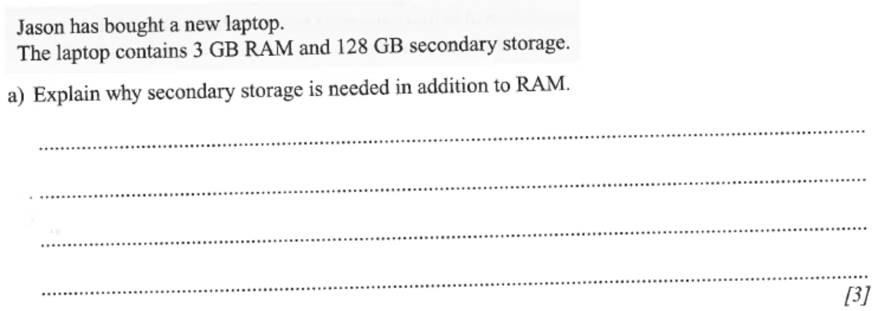
✓ Fast
✓ Durable
✓ Portable
✓ Moderate capacity

✘ Expensive for high capacity
✘ Limited life span.

GCSE Computer Science - Topic 1.3 Storage

What I need to know:

Define primary storage
Define secondary storage
Define tertiary storage
Describe the differences between primary, secondary and tertiary storage.
Describe how data is stored /read on optical storage.
Explain the advantages and disadvantages of optical storage
Describe how data is stored/read on magnetic storage.
Explain the advantages and disadvantages of magnetic storage
Describe how data is stored/ read on solid state storage.
Explain the advantages and disadvantages of solid state storage.
Define capacity. State which storage devices have the highest and lowest capacity.
Define read-write speed. State which storage devices have the highest and lowest read-write speed.
Define portability. State which storage devices are the most and least portable.
Define durability. State which storage devices are the most and least durable.
Define reliability. State which storage devices are the most and least reliable.
Define cost. State which storage devices are the most and least expensive.
List the order of binary units from smallest to largest
Calculate how many Kb are in 6.7Mb. Show your working.
Calculate how much data 3 CD-ROMs can hold in MB. State how many Gb this is.
Calculate how many Kb are in 2Tb.



Jason has bought a new laptop.
The laptop contains 3 GB RAM and 128 GB secondary storage.

a) Explain why secondary storage is needed in addition to RAM.

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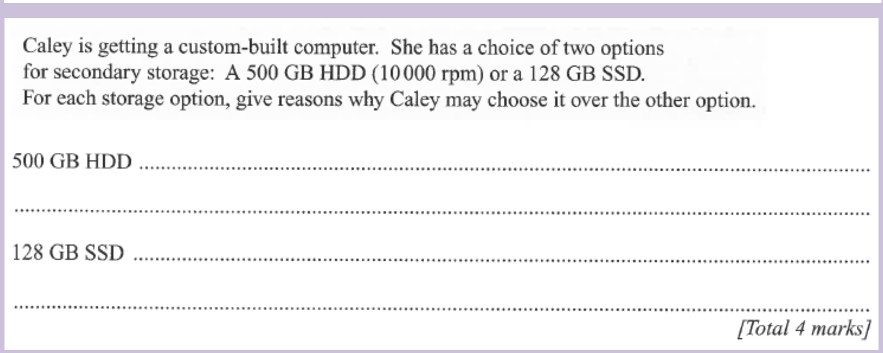


Caley is getting a custom-built computer. She has a choice of two options for secondary storage: A 500 GB HDD (10 000 rpm) or a 128 GB SSD.
For each storage option, give reasons why Caley may choose it over the other option.

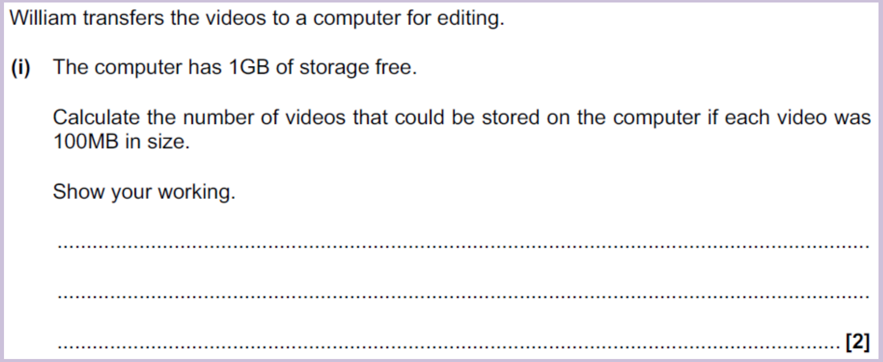
500 GB HDD ....

....

128 GB SSD ....

....

[Total 4 marks]



William transfers the videos to a computer for editing.

(i) The computer has 1GB of storage free.

Calculate the number of videos that could be stored on the computer if each video was 100MB in size.

Show your working.

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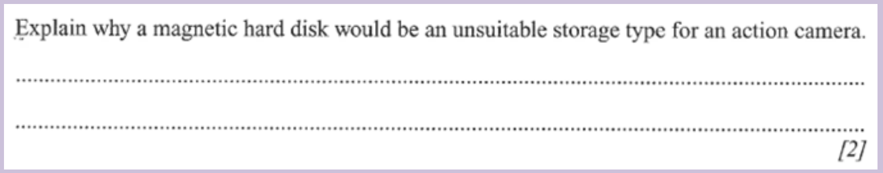

Explain why a magnetic hard disk would be an unsuitable storage type for an action camera.

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GCSE Computer Science
Topic 1.4 Networks

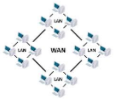
A network is 2 or more devices connected to share data.

A LAN is 2 or more devices connected to share data ***in a SMALL geographical area.***
LANs are found in homes, schools and offices.
LANs are managed by a individual person or small group of technicians. The hardware in a LAN is owned by the company using it.

The 3 main benefits of creating networks are to:
- ✓ Share data
- ✓ Share internet connection
- ✓ Share hardware.

Switches connect devices together on a LAN to allow them to share data.
Switches send and receive data in frames and use MAC addresses to direct data to the correct computer.

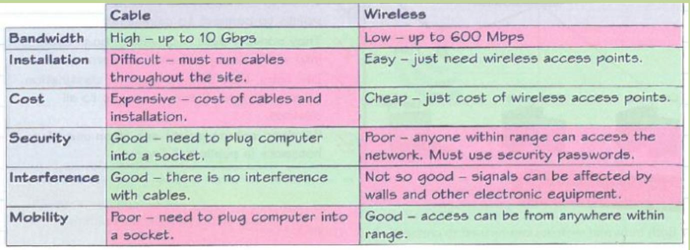
A WAN is 2 or more LANs connected over a LARGE geographical area to create a network of networks.
A WAN allows computers in one geographical area to connect with computers in another.
The internet is a WAN.
The infrastructure required to create a WAN is **hired**.



Many factors affect the performance of a network.
Performance relates to speed and stability.

The bandwidth is the amount of data that can be transmitted per second.
MORE BANDWIDTH = FASTER NETWORK.

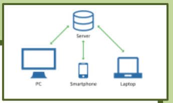
The bandwidth of a network is SHARED between it's users…
MORE USERS = LESS BANDWIDTH PER USER = SLOWER NETWORK.
Too many users can cause congestion;
packets of data gets queued, the network becomes slow.



	Cable	Wireless
Bandwidth	High – up to 10 Gbps	Low – up to 600 Mbps
Installation	Difficult – must run cables throughout the site.	Easy – just need wireless access points.
Cost	Expensive – cost of cables and installation.	Cheap – just cost of wireless access points.
Security	Good – need to plug computer into a socket.	Poor – anyone within range can access the network. Must use security passwords.
Interference	Good – there is no interference with cables.	Not so good – signals can be affected by walls and other electronic equipment.
Mobility	Poor – need to plug computer into a socket.	Good – access can be from anywhere within range.

All computers must have a Network Interface Card to connect to a network.
Each NIC has a MAC address which is the unique address of the computer so data can be directed.

Client Server

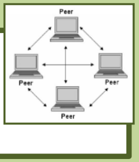


- 2 or more devices connected to a ***central*** server.
- The server manages the network, processing data requests from the client machines.
- Users log into the server to access files and programs stored on them.

- ✓ Files are all stored in one place.
- ✓ Servers are reliable (and always on).
- ✓ Central back up.
- ✓ Central installation / updates.
- ✓ Security (user access levels / antivirus).

- ✘ Servers are expensive.
- ✘ Technician needed to manage network.
- ✘ Dependent on server.
- ✘ Server can be overloaded.

Peer to Peer

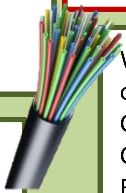


- 2 or more devices connected directly to each other w**<u>ithout</u>** a central server.
- All devices are equal.
- Files are stored on individual computers and shared with other computers.

- ✓ No technician needed.
- ✓ No expensive hardware needed.
- ✓ Not reliant on server.

- ✘ Peer machines are less reliable.
- ✘ Peer machines aren't always on.
- ✘ Sharing files causes duplicates.
- ✘ Software installed on each machine.
- ✘ Peer machines slow down when others access them.
- ✘ All files stored on individual machines.
- ✘ Back ups done individually.

Wireless Access Points allow **wireless** devices to connect to other devices on a LAN to share data.
WAPs send data through radio waves.



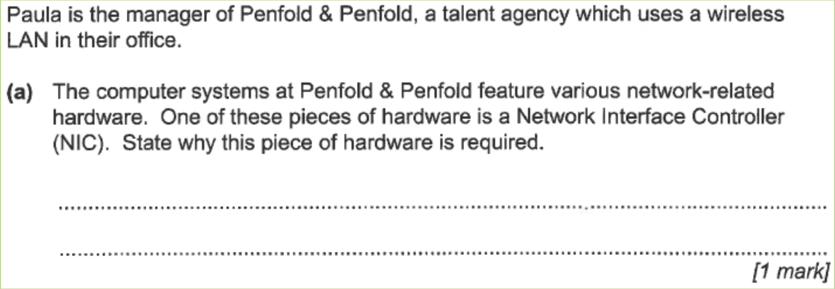
Wired networks usually use copper or fibre optic cable.
Copper cable sends data as electric signals.
Copper cable is cheaper than fibre optic.
Fibre optic sends data as pulses of light.
Fibre optic transmits data over longer distances at faster speeds than copper cabling.

Routers connect different networks together.
They use IP addresses to send data to the correct network.
Routers in home networks connect your LAN to the internet.

GCSE Computer Science - Topic 1.4 Networks

What I need to know:

Define the term network
State what LAN stands for.
Define the term Local Area Network.
State what WAN stands for.
Define the term Wide Area Network.
State 3 benefits of creating a network
Describe the term network performance.
State 3 factors that affect network performance.
Define the term bandwidth.
Describe how bandwidth affects network performance.
Describe how the number of users affect network performance.
State the difference between a wired and wireless network connection.
Describe a client server network.
Explain the advantages and disadvantages of a client-server network.
Describe a peer-to-peer network.
Explain the advantages and disadvantages of a peer to peer network.
Describe the function of a Wireless Access Point.
Describe the function of a switch.
Describe the function of a router.
State what NIC stands for.
State the function of a NIC.
Describe the differences between fibre optic and copper cable.



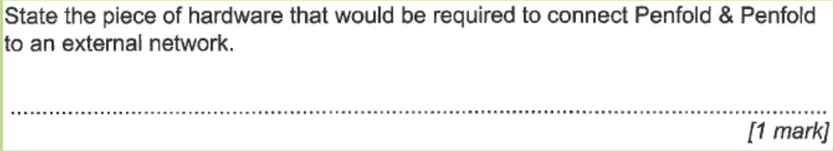
Paula is the manager of Penfold & Penfold, a talent agency which uses a wireless LAN in their office.

(a) The computer systems at Penfold & Penfold feature various network-related hardware. One of these pieces of hardware is a Network Interface Controller (NIC). State why this piece of hardware is required.

....

....

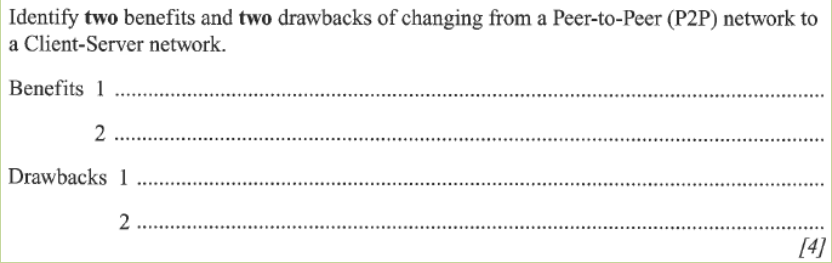
[1 mark]



State the piece of hardware that would be required to connect Penfold & Penfold to an external network.

....

[1 mark]



Identify **two** benefits and **two** drawbacks of changing from a Peer-to-Peer (P2P) network to a Client-Server network.

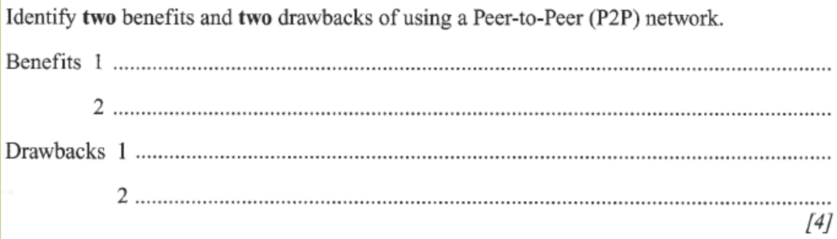
Benefits 1 ....

2 ....

Drawbacks 1 ....

2 ....

[4]



Identify **two** benefits and **two** drawbacks of using a Peer-to-Peer (P2P) network.

Benefits 1 ....

2 ....

Drawbacks 1 ....

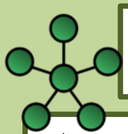
2 ....

[4]

** Identify means the same as state.*
No explanation needed.

GCSE Computer Science
Topic 1.5 Topologies & Protocols 1

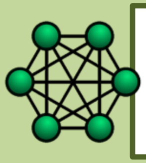
A topology describes how the devices in a network are arranged / laid-out.



In a star topology, all devices are connected to a central switch or server.

- ✓ If one device fails the rest of networks is unaffected.
- ✓ It's easy to add more devices.
- ✓ All devices can send data at the same time (faster than RING).
- ✓ There are few collisions than the BUS).

- ✗ In wired networks, each device needs a cable which can be expensive.
- ✗ If there is a problem with the switch or the server, the whole network fails.



In a mesh topology, every device is directly or indirectly connected to every other device without a central switch or server.

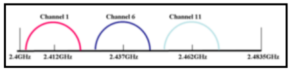
- ✓ Data can be sent from different devices simultaneously.
- ✓ Decentralised (not reliant on one switch or sever in the centre).
- ✓ Each device connected to every other one – lots of routes to send data.
- ✓ Mesh networks send data along the fastest route.
- ✓ Can handle high volumes of data.

- ✗ Wired mesh = expensive.
- ✗ Difficult to manage - requires a network technician.
- ✗ Each device connected directly to every other one – **adding new devices is complicated.**

A network protocol is a set of rules for how devices communicate and transmit data.

The **Wi-Fi protocols** are responsible for sending and receiving data wirelessly using radio waves.

2.4GHz Frequency



- Passes through objects well.
- Range 100 metres.
- **Interference prone.**
- 13 channels but ONLY 3 channels do NOT overlap.
- NOT effective at supporting many networks at the same time.

5GHz Frequency
- Not as good at passing through objects.
- Range 30 metres.
- Faster due to less interference.
- 24 NON OVERLAPPING channels.
- More effective at supporting a high number of networks.

- As there is no PHYSICAL way of protecting the radio waves of data travelling in a wireless network, protection is required.
- WEP – weakest protection as it just requires a password to join the network. Data not encrypted.
- WPA – stronger - requires a password to join network and encrypts data using an encryption algorithm so only devices with decryption key can read the data.
- WPA2 – stronger algorithm used than WPA – making data harder to be read by unauthorised users.

Domain Name Service (DNS) is the Internet's equivalent of a phone book. **Name severs** maintain a directory of domain names and translate them to Internet Protocol (IP) addresses.

When you type in a URL, the ISP looks up the domain name, finds the matching IP address and sends it back.

The web browser sends a request straight to that IP address for the page or file that you are looking for and sends the information back to your computers IP address.

Ethernet is a set of protocols responsible for sending and receiving data along a network cable.

The **internet** is a world wide connection of interconnected networks.

The **www** is a collection of websites that are hosted on web servers and accessed via the internet.

- Web **hosting** companies rent space on their servers for websites.
- The hosting companies handle all of the back-ups and security issues.
- Host computers must always be on.

THE CLOUD: this is where users can store their personal files on line on a **host** computer.
There is also online software available now through 'the cloud' which is also stored on a remote computer and accessed through the internet.

Virtual Network =
A software based network.
Virtual networks use the hardware and bandwidth of the physical network it is created on.
The virtual network can only be accessed by using certain software and log-in information.

- ✓ Users can access resources from anywhere around the world as though they were physically connected to the local network.
- ✓ Virtual networking makes it possible to communicate with a computer from any other computer/device on the *internet*.

GCSE Computer Science - Topic 1.5 Topologies & Protocols (1)

What I need to know:

Define the term topology.

Describe, with the aid of a diagram the star topology.

State the advantages and disadvantages of a star topology.

Describe the mesh topology.

State the advantages and disadvantages of a mesh topology.

Define the term ‘network protocol’.

State the function of the Wi-Fi protocol.

Describe the two frequencies of Wi-Fi.

State how many channels are available on the 2.4GHz frequency and how many of these are non-overlapping.

State the advantages and disadvantages of using the 2.4GHz frequency.

State how many non-overlapping channels are available on the 5GHz frequency.

State the advantages and disadvantages of the 5GHz frequency.

Describe the 3 protection methods available to protect data being sent via radio waves.

Define the term ‘Ethernet’

Define the term ‘internet’.

Define the term ‘World Wide Web’.

Describe the function of Domain Name Service.

Describe what is meant by ‘hosting’.

State what is meant by ‘the cloud’

Describe a virtual network?

State the advantages of using virtual networks?

Explain **one** advantage and **one** disadvantage of mesh topologies compared to star topologies.

Advantage ....

....

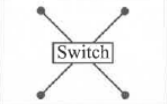
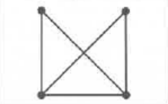
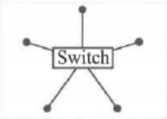
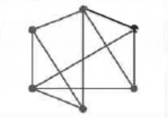
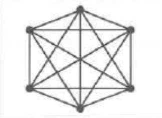
Disadvantage ....

.... *[4]*

The table below shows star topologies, partial mesh topologies and full mesh topologies for different numbers of nodes.

Nodes are the dots on the diagrams used to represent network devices.

a) Complete the table by correctly connecting the nodes in the white cells.

Number of nodes	Star	Partial Mesh	Full Mesh
4			
5			
6			

[4]

A leisure centre has a Local Area Network (LAN) consisting of five computers and a central server connected in a star topology.

a) Draw a diagram of the leisure centre’s star network.

[2]

b) Identify **three** advantages of the star topology.

A good way to think about the advantages of a star topology is to compare it to a bus or ring topology.

1 ....

2 ....

3 .... *[3]*

GCSE Computer Science
Topic 1.5 Topologies & Protocols 2

On each **NIC** is a **MAC address** (*assigned to the hardware*)
The **switch** reads the MAC address to send the data frames to the right device on the **LAN**.
A MAC address can be described as ***a unique identifier*** which is used by switches on LANs to direct data to the right device on a network.

Each network has an **IP Address**

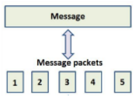
Between networks (over the internet) data is sent in **packets** and directed by routers using IP addresses.

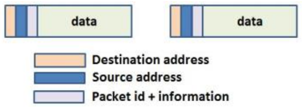
- Used by routers on WANs.
- NOT linked to hardware.
- Can be static or dynamic.

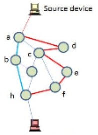
- Packet switching is where files are split into smaller packets and are then passed from router to router, using IP addresses, to get to the desired network.
- Packet switching gets data to the destination quickly due to the small file sizes of the packets which each take the fastest route.
- Packets often do not arrive in the correct order.
- If a packet is missing or corrupted then the message will instead be sent asking for that particular packet to be resent.

Each packet has a header which contains 3 important pieces of information:

✓ a **return IP address** to say where the packet originated from
✓ a **destination IP address** to tell the packet where it has to go
✓ a **sequence number** so that the individual data packets can be reassembled in the correct order once they have all safely arrived at their destination.







When the packet is received an error check is performed. The error check makes use of a calculation called a 'check sum number'. If any errors are found then the destination computer knows that the packet has been corrupted and will send a request for that packet to be resent.

PROTOCOL	LAYER:	ACRONYM STANDS FOR:	FUNCTION
TCP	3	**Transmission Control Protocol**	Splits the data into packets before sending, then reassembles data once arrived.
IP	2	**Internet Protocol**	Responsible for packet switching.
HTTP	4	**Hyper Text Transfer Protocol**	Used by browsers to display webpages and used to transfer websites from webservers.
HTTPS	4	**Hyper Text Transfer Protocol (secure)**	A more secure version of HTTP (as the data, when transferred, is encrypted).
FTP	4	**File Transfer Protocol**	Used to transfer, access and edit files.
SMTP	4	**Simple Mail transfer Protocol**	Used to send emails and transfer them between mail servers.
POP3	4	**Post Office Protocol (version 3)**	Used to retrieve emails from a sever. *When they are downloaded by the user, they are deleted from the server.*
IMAP	4	**Internet Message Access Protocol.**	Used to retrieve emails from a sever. *Only a copy of the email is downloaded, only when the user deletes the email, is it deleted from the server.*

A **layer of protocols** is a group of protocols that do a similar job/ function.

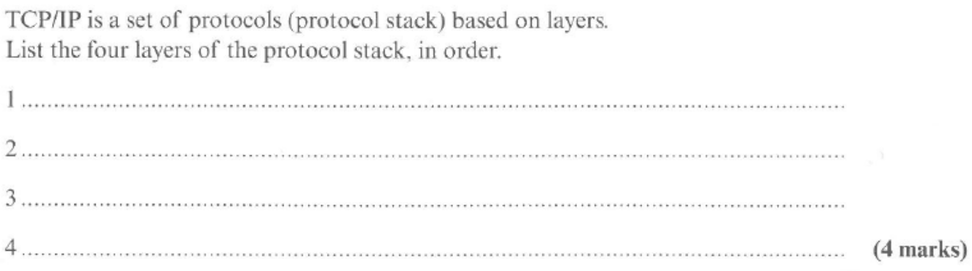
4. Application Layer	3. Transport Layer	2 Network Layer	1. Link Layer
Turns data into websites, emails OR files once it has arrived.	Splits data into packets and reassembling them.	Sends data between networks. (over the internet)	Sends data in a LAN.

We use layers because it can be difficult to conceptualise a complex system such as network communication. By dividing the system of protocols into layers we can focus on a particular area individually without worrying too much about the other layers.
The layer model is useful for manufacturers so that when they are developing new hardware they can ensure that it is compatible with existing protocols
We can map how layers relate and interact with one another.
We can recognise roughly what a protocol does by knowing which layer it resides within.
When a new protocol is developed, it can be slotted into the appropriate layer.

GCSE Computer Science - Topic 1.5 Topologies & Protocols 2

What I need to know:

Explain what a MAC address is needed for.
Explain what an IP address is needed for.
Explain the process of packet switching.
State what is included in a packet of data.
State what TCP stands for, which layer it is in and it's function.
State what IP stands for, which layer it is in and it's function.
State what HTTP stands for, which layer it is in and it's function.
State what HTTPS stands for, which layer it is in and it's function.
State what FTP stands for, which layer it is in and it's function.
State what POP stands for, which layer it is in and it's function.
State what IMAP stands for, which layer it is in and it's function.
State what SMTP stands for, which layer it is in and it's function.
State what is meant by a *layer* of protocols.
State the names of the 4 layers.
State the function of each layer.
List the benefits of using layers.



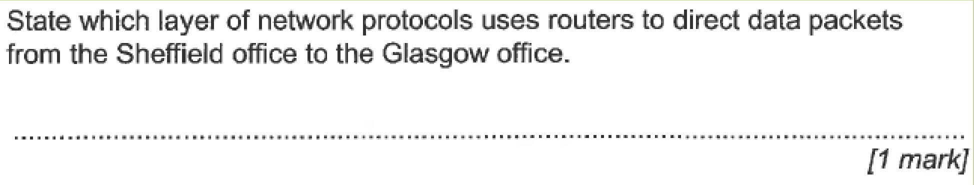
TCP/IP is a set of protocols (protocol stack) based on layers.
List the four layers of the protocol stack, in order.

1 ....

2 ....

3 ....

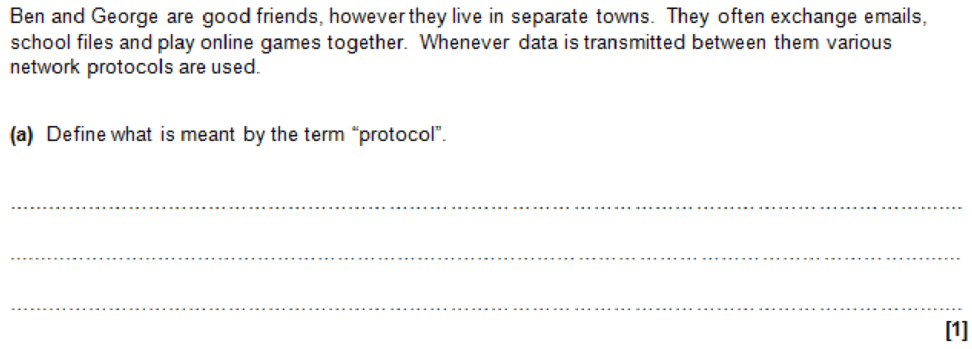
4 .... **(4 marks)**



State which layer of network protocols uses routers to direct data packets from the Sheffield office to the Glasgow office.

....

[1 mark]



Ben and George are good friends, however they live in separate towns. They often exchange emails, school files and play online games together. Whenever data is transmitted between them various network protocols are used.

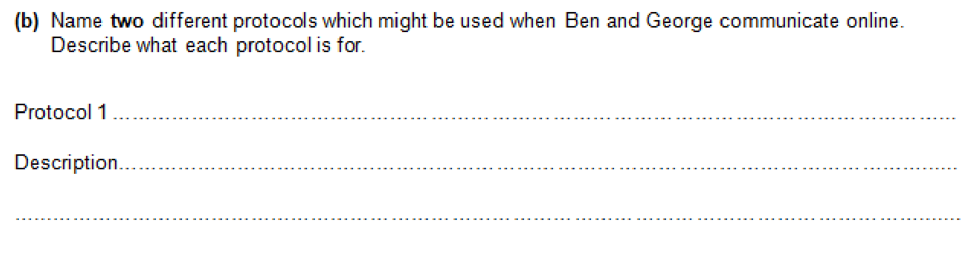
(a) Define what is meant by the term "protocol".

....

....

....

[1]



(b) Name **two** different protocols which might be used when Ben and George communicate online. Describe what each protocol is for.

Protocol 1 ....

Description..

....

GCSE Computer Science
Topic 1.6 System Security (1)

An attack is an information security threat that involves an attempt to obtain, alter, destroy, remove, implant or reveal information without *authorised* access.

Network attacks bypass users and attack the network operating system and security:

PASSIVE ATTACK: hackers monitor the data travelling on a network and intercept any sensitive information they find (login details, passwords, credit card details etc.).
They use network-monitoring tools such as packet sniffers.
DEFENSE: ENCRYPTION

ACTIVE ATTACK: A network attack performed using malware.
MALWARE is designed to disrupt the function of a computer or collect information.
DEFENSE: FIREWALL /ANTIVIRUS SOFTWARE

INSIDER ATTACK: this is where someone inside the organisation EXPLOITS their network access to steal information.
DEFENSE: USER ACCESS LEVELS

BRUTE FORCE: involves gaining information / access to a network through cracking passwords.
Brute force attacks use automated software which produces hundreds of likely passwords.
DEFENSE: SECURE PASSWORDS/ LOCKING ACCOUNTS

DOS attacks overload a network or website by flooding it with network communications such as login requests.
(Making the network/website extremely slow or unavailable).
DEFENSE: FIREWALLS

Many forms of attack target USERS by getting them to install MALWARE (harmful software) on their computers, which cause damage to / disrupt systems in different ways:

MALicious soft**WARE**
Is software that can harm devices.
It is installed on someone's device without their knowledge or consent.

SCAREWARE : malware that tells the user that their device is infected with lots of viruses.
It scares them into clicking on MALICIOUS links or paying for fictional problems to be fixed.

RANSOMWARE: malware which locks/ encrypts files.
The user receives a message demanding a large sum of money for the decryption key.

SPYWARE malware which stays hidden / out of view and is designed to spy on your computer, looking for personal information, passwords etc.

It does this by using a key logger to record every key pressed on the keyboard. It might also take screen shots. This information is then sent secretly over the internet to the criminals.

ROOTKITS are malware which give other people admin-permissions and access to your computer, allowing them to take it over remotely and do whatever they like.

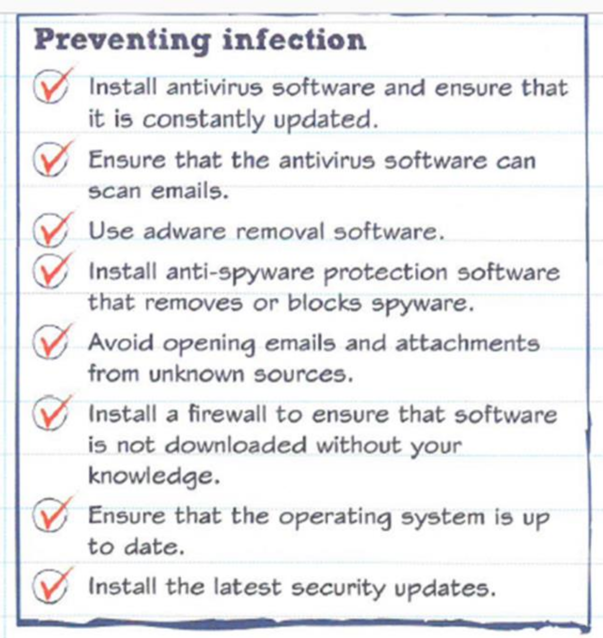
It is designed to run even before the operating system itself is booted up and it continues to stay active in the background while you are using the computer.

VIRUSES: malware which attaches (by copying themselves) to certain files. E.g. .exe files

When users open the files they activate them, then the viruses spread onto other files on their system.

WORMS: malware. like viruses, but they SELF REPLICATE without any user help.
They spread very quickly.

TROJANS: malware that is disguised as legitimate software.
They don’t replicate themselves, users install them, not realising they have a hidden purpose.



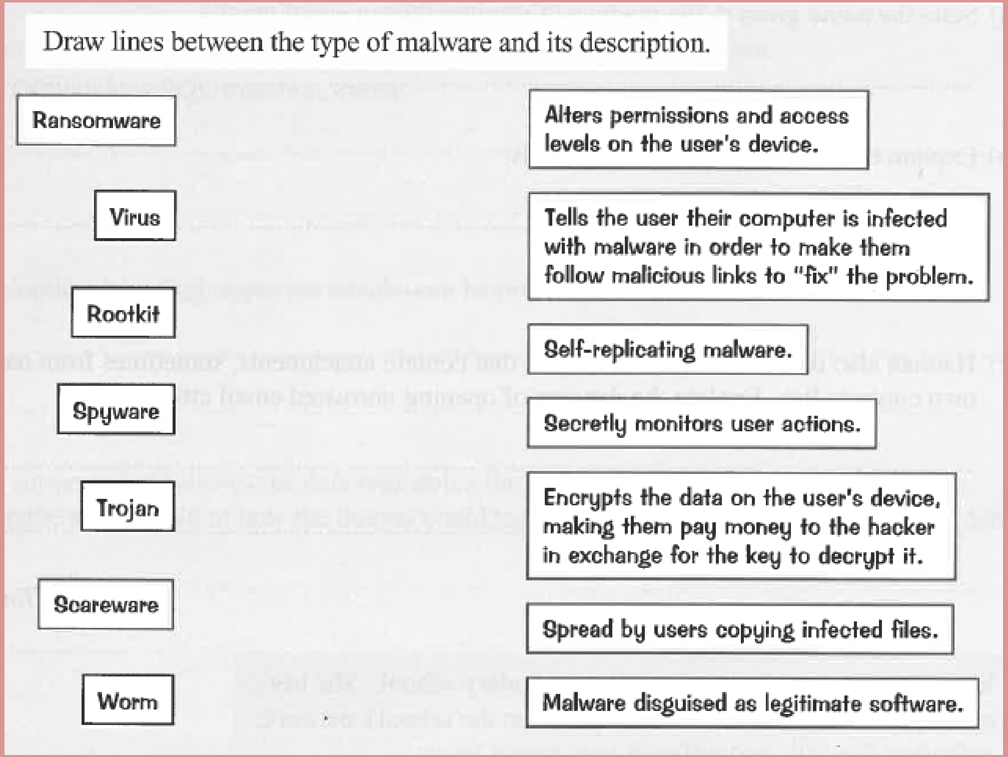
Preventing infection

- ✓ Install antivirus software and ensure that it is constantly updated.
- ✓ Ensure that the antivirus software can scan emails.
- ✓ Use adware removal software.
- ✓ Install anti-spyware protection software that removes or blocks spyware.
- ✓ Avoid opening emails and attachments from unknown sources.
- ✓ Install a firewall to ensure that software is not downloaded without your knowledge.
- ✓ Ensure that the operating system is up to date.
- ✓ Install the latest security updates.

GCSE Computer Science - Topic 1.6 System Security (1)

What I need to know:

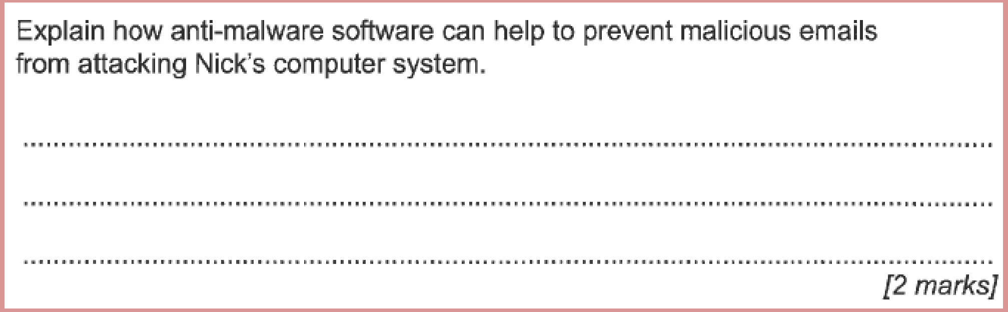
Describe what is meant by an attack.
Describe how a network attack works.
State the name of the 5 main forms of NETWORK attack.
Describe a passive NETWORK attack.
Describe an active NETWORK attack.
Describe an insider NETWORK attack.
Describe a brute force NETWORK attack.
Describe a DOS NETWORK attack .
Define malware.
Describe how a malware attack works.
Describe scareware.
Describe ransomware.
Describe spyware.
Describe rootkit malware.
Describe virus malware.
Describe worm malware.
Describe Trojan horse malware.
Describe some actions that can be taken to protect against the infection of malware.



Draw lines between the type of malware and its description.

- Ransomware
- Virus
- Rootkit
- Spyware
- Trojan
- Scareware
- Worm

- Alters permissions and access levels on the user's device.
- Tells the user their computer is infected with malware in order to make them follow malicious links to "fix" the problem.
- Self-replicating malware.
- Secretly monitors user actions.
- Encrypts the data on the user's device, making them pay money to the hacker in exchange for the key to decrypt it.
- Spread by users copying infected files.
- Malware disguised as legitimate software.



Explain how anti-malware software can help to prevent malicious emails from attacking Nick's computer system.

....

....

....

[2 marks]

GCSE Computer Science
Topic 1.6 System Security (2)

Users (people who use computers) are often described as the ***weak point*** in terms of security.
Some network attacks target people.
This form of attack is called social engineering.

SOCIAL ENGINEERING is a way of gathering sensitive information or illegal access to networks by influencing / manipulating / tricking people.

PHISHING is a social engineering technique which involves sending emails or text messages (SMs) claiming or appearing to be from a bank/ e-commerce site asking for personal details.

SHOULDERING is a social engineering technique which involves finding passwords and pins by *watching people* enter them. This could happen in a busy office or at a distance using binoculars or recording equipment.

BLAGGING is a social engineering technique which involves a criminal inventing a scenario to persuade a victim to give out information.

Organisations should have **acceptable use policies** which employees must read, sign and abide by.

It should include some of the following terms/ conditions:

- Users must not use their own devices as they may contain malware (e.g. USB drives).
- Users should not download files from the internet (as they may contain malware).
- Users must have strong passwords which should be changed frequently to prevent brute force attacks.
- Users should not leave themselves logged on.

PEN TESTING: testing a computer system to find weaknesses that a hacker could exploit.
Testers take the role of hackers to gain unauthorised access.
Assess the security awareness of users and tests the effectiveness of network policies.

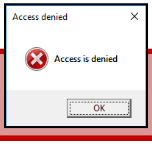
ANTI-MALWARE software is designed to detect and block attacks from malware. Anti-malware software scans computers and quarantines any malware found.

Norton by Symantec McAfee Proven Security AVG Anti-Virus

A **firewall** monitors connections to and from your computer. If it detects a suspicious connection the firewall closes the connection.

Most operating systems include a firewall and it should be turned on by default.

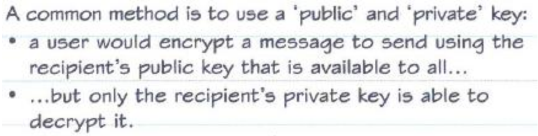
USER ACCESS LEVELS: controls which parts of the network different users or groups of network users can access /edit.



Access denied

Access is denied

ENCRYPTION: encoding data into an unreadable format so that unauthorised users cannot read it. Can only decoded with a decryption key. Essential for sending data securely.



A common method is to use a 'public' and 'private' key:

- a user would encrypt a message to send using the recipient's public key that is available to all…
- …but only the recipient's private key is able to decrypt it.

Employee training /education on how to spot social engineering attempts and how to protect themselves / the network is the most effective way to prevent social engineering.

Every company should have a network policy that the ICT technicians should enforce.

PASSWORDS are like UNDERWEAR
1. Change them regularly
2. Don't leave them on your desk
3. Don't loan them to anyone

NETWORK FORENSICS: Monitoring, recording and analysis of network activity

- Who has logged on
- How many unsuccessful attempts have been made
- What users have done
- What has been deleted.

Network forensics can be used as legal evidence if illegal activity is detected.

*** To conduct network forensics a company must have a system of capturing data packings as they enter a network.**

A GOOD NETWORK POLICY:

- ❑Use passwords.
- ❑Enforce user access levels.
- ❑Encrypt sensitive data.
- ❑Regularly test the network to find & fix weaknesses.
- ❑Install anti-malware & firewall software.

GCSE Computer Science - Topic 1.6 System Security (2)

What I need to know:

Define social engineering.

State the 3 common methods of social engineering.

Describe the social engineering technique phishing.

Describe the social engineering technique shouldering.

Describe the social engineering technique blagging.

Describe how best to prevent against social engineering.

Describe an ‘acceptable use policy’.

Explain some of the terms and conditions that should be included in an acceptable use policy/why they are beneficial to network security.

Describe how to create a strong password.

Explain pen-testing and how it can help protect a network.

Describe network forensics and explain how it can help protect a network.

Describe the function of antimalware software.

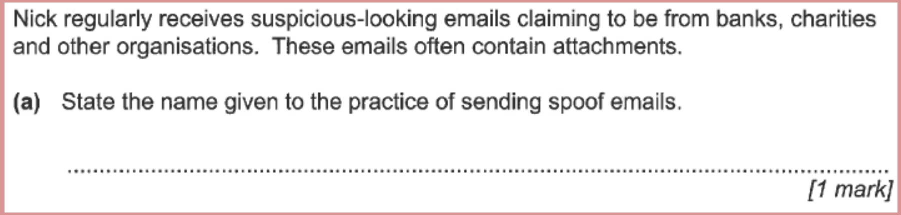
Describe the function of a firewall.

Describe how user access levels can help protect a network.

Explain how encryption can help secure the data on a network.

State the five elements required for a good network policy.

Explain how the different elements of a good network policy help protect the security of a network.

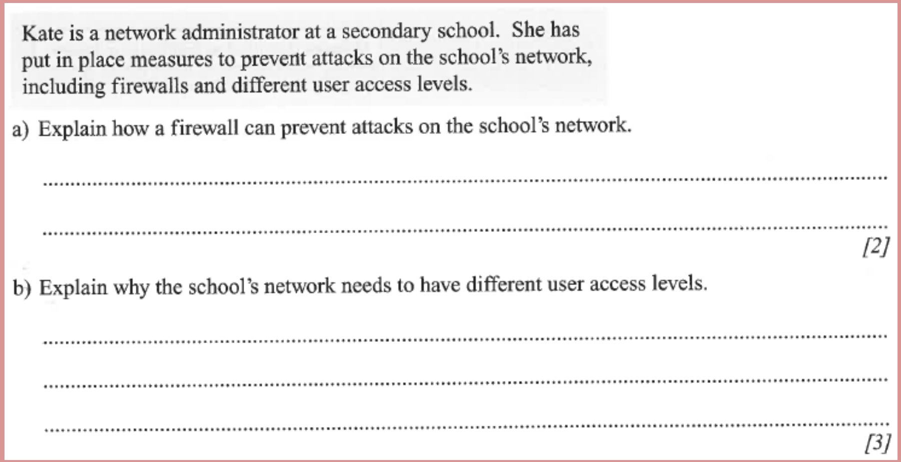


Nick regularly receives suspicious-looking emails claiming to be from banks, charities and other organisations. These emails often contain attachments.

(a) State the name given to the practice of sending spoof emails.

....

[1 mark]



Kate is a network administrator at a secondary school. She has put in place measures to prevent attacks on the school’s network, including firewalls and different user access levels.

a) Explain how a firewall can prevent attacks on the school’s network.

....

....

[2]

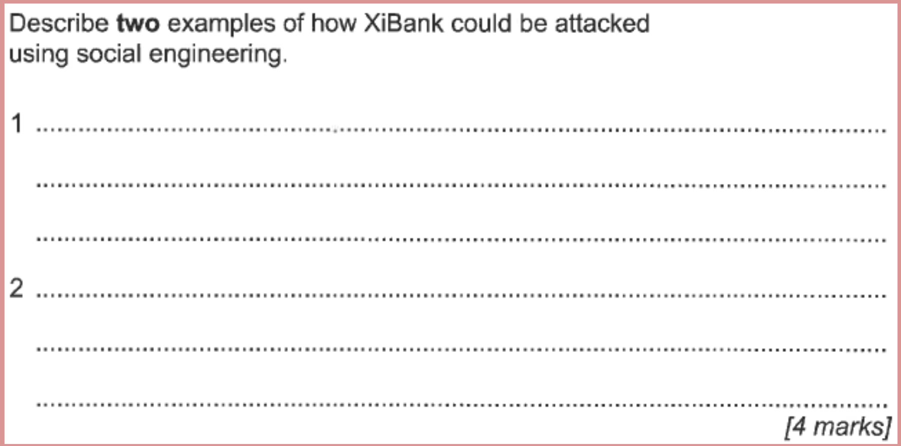
b) Explain why the school’s network needs to have different user access levels.

....

....

....

[3]



Describe **two** examples of how XiBank could be attacked using social engineering.

1 ....

....

....

2 ....

....

....

[4 marks]

GCSE Computer Science
Topic 1.7 System Software (1)

A computer system is a combination of hardware and software that work together to process data.

Hardware is physical components that make up a computer system. **Internal hardware** is inside the case. **Peripheral** hardware is external to the case and connected to the computer.

Software is programs or applications that run on a computer.

APPLICATION SOFTWARE : software that is designed to assist the user to complete specific tasks.

SYSTEM SOFTWARE : software designed to run and maintain a computer system.

Operating System
A piece of software responsible for running the computer, managing hardware, applications, users and resources.

Utility Software
Software designed to help maintain / optimise a computer system.

5 main jobs:

1. Peripheral management
2. Provides a user interface
3. Memory management & multi-tasking
4. User management
5. File management

1

Computer systems use peripheral devices to input and output data.

- All peripherals are controlled by the operating system using programs called device drivers.
- The drivers carry out translations to allow the OS and the peripherals to communicate correctly.

2

The operating system provides a user-interface.

- The user interface is the way that the user interacts/ communicates with the computer.
- GUI / CLI are the two most common user interfaces.

4

On shared and networked computers, the OS manages users.

- User names and passwords are used to allocate permissions for access to files and folders.

This is used to prevent open access to all data and areas of the computer system.

5

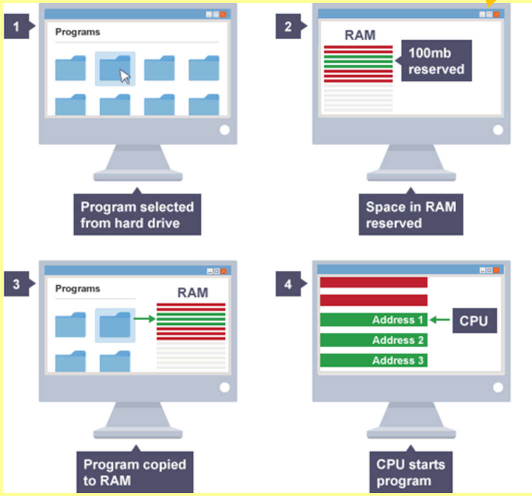
The OS creates a folder and file structure for data. This makes it easier for users to organise and find data.

- On networks and shared computers, file permissions are used.
- File permissions controls who can see/open a file, edit or delete a file.

3

When you open a program, the OS has to find the program files on the hard-disk drive, move them into main memory (RAM) , and instruct the CPU to start executing the program from the beginning.

- The OS checks there is enough room in RAM, if not it will make room by moving some data to virtual memory.
- The OS also makes it possible to run several programs at once (multitasking).
- Several programs can be stored in RAM at the same time, however only one program at a time is processed by the CPU.
- The CPU allocates each process a CPU time-slot so that all the programs can be processed in turn.



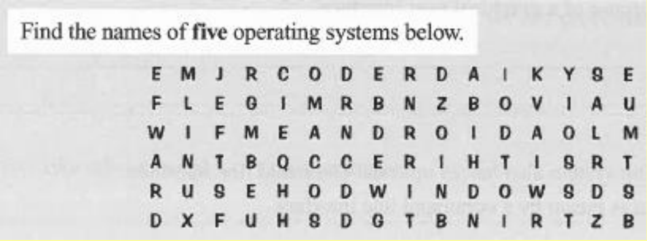
An operating system usually comes with some security utility features:

- Anti-virus software - detects and blocks viruses.
- Firewall - examines all data entering and leaving the network and block any potential threats.

GCSE Computer Science - Topic 1.7 System Software (1)

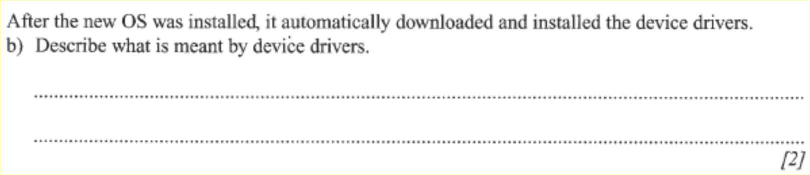
What I need to know:

Define 'computer system'.
Define 'hardware'.
Define 'software'.
Define 'application software'.
Define 'system software'.
Define 'operating system'.
Define 'utility software'.
List the 5 main jobs of an operating system.
Describe what the OS does to manage peripheral devices.
Describe what is meant by a user interface.
State the two main types of user interface.
Describe how the OS manages memory and multi-tasking.
Describe how the OS manages users on shared/network computers.
Describe how the OS manages files.
State which two security utility programs are often included with the OS.
Describe the function of anti-virus software.
Describe the function of firewall software.



Find the names of **five** operating systems below.

E	M	J	R	C	O	D	E	R	D	A	I	K	Y	S	E
F	L	E	G	I	M	R	B	N	Z	B	O	V	I	A	U
W	I	F	M	E	A	N	D	R	O	I	D	A	O	L	M
A	N	T	B	Q	C	C	E	R	I	H	T	I	S	R	T
R	U	S	E	H	O	D	W	I	N	D	O	W	S	D	S
D	X	F	U	H	S	D	G	T	B	N	I	R	T	Z	B

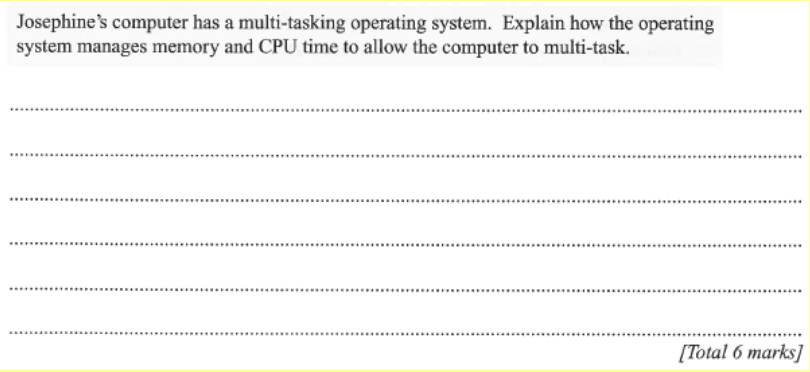


After the new OS was installed, it automatically downloaded and installed the device drivers.

b) Describe what is meant by device drivers.

....

.... [2]



Josephine's computer has a multi-tasking operating system. Explain how the operating system manages memory and CPU time to allow the computer to multi-task.

....

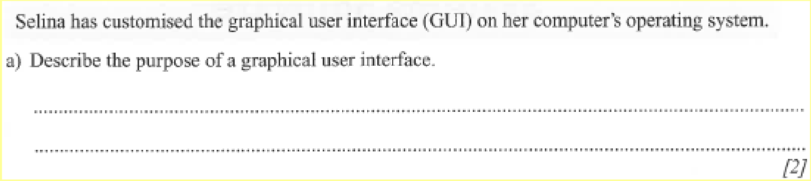
....

....

....

....

.... [Total 6 marks]

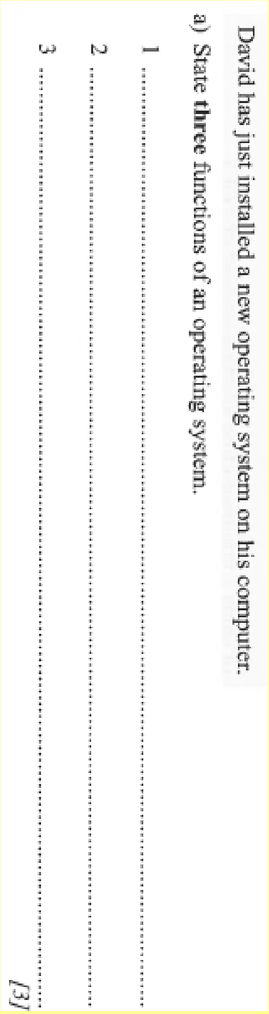


Selina has customised the graphical user interface (GUI) on her computer's operating system.

a) Describe the purpose of a graphical user interface.

....

.... [2]



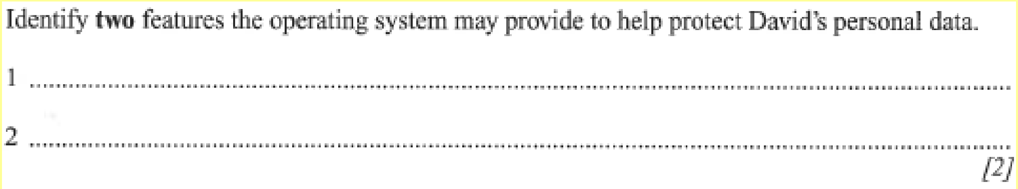
David has just installed a new operating system on his computer.

a) State **three** functions of an operating system.

1 ....

2 ....

3 .... [3]



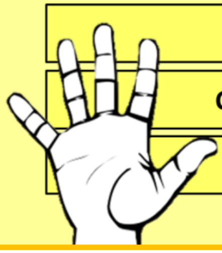
Identify **two** features the operating system may provide to help protect David's personal data.

1 ....

2 .... [2]

GCSE Computer Science
Topic 1.7 System Software (2)

UTILITY SOFTWARE: software designed to help maintain / optimise a computer system.



- **Defragmentation**
- **Disk Clean-up**
- **Backup**
- **Compression**
- **Encryption**

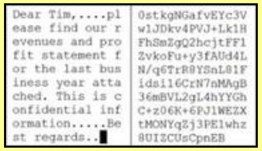
COMPRESSION software reduces the size of files so they take up less disk space.

Files are often compressed when uploaded to the internet so they can be downloaded quicker.

There are two types of compression: lossy and lossless.

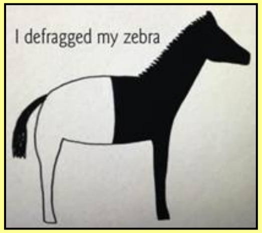
Lossy – works by permanently removing data from the file. This limits the number of bits needed to store the file.	Lossless –temporarily removes data to store the file then restores the data when it is opened.
✓ Greatly reduces file size. ✓ Take up less bandwidth. ✓ Commonly used – compatible with lots of software.	✓ Data only removed temporarily – no reduction in quality. ✓ Can decompress – getting original file back. ✓ Can be used on text files /software.
× Loses data – cant be restored × Cant be used on text files/ software. × Result in poorer quality (but not often noticeable)	× Only a slight reduction of file size (so still require a lot of storage space)

ENCRYPTED data is scrambled (unreadable) to unauthorised users.
A decryption key is required to make sense of the data.



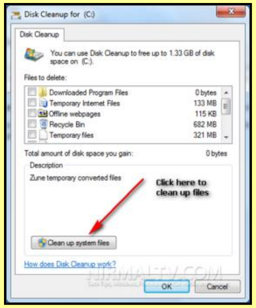
Dear Tim,....pl ease find our r evenues and pro fit statement f or the last bus iness year atta ched. This is c onfidential inf ormation.....Be st regards..	0stkgNGafvEYc3V w1JDkv4PVJ+Lk1H FhSmZgQ2hcjtFF1 ZvkoFu+y3fAUd4L N/q6TrR8YSnL81F idsil6CrN7nMAgB 36mBVL2gL4hYYGh C+z06K+6PJ1WEZX tMONYqZj3PE1whz 8UIZCUsCpnEB

DEFRAGMENTATION: reorganising data on a hard drive to put broken-up files back together and collect up the free space.



DISK CLEAN-UP is a utility that frees up disk space on a computer's hard drive.

The utility first searches and analyses the hard drive for files that are no longer of any use and then removes the unnecessary files.



Disk Cleanup for (C:)

Disk Cleanup

You can use Disk Cleanup to free up to 1.33 GB of disk space on (C:).

Files to delete:

□ Downloaded Program Files	0 bytes
□ Temporary Internet Files	133 MB
□ Offline webpages	115 KB
□ Recycle Bin	682 MB
□ Temporary files	321 MB

Total amount of disk space you gain: 0 bytes

Description

Zune temporary converted files

A BACK UP is a copy of a computer's files and settings stored externally.
This means data can be recovered in the event of data loss.

Malware
file, delete
heh heh heh

FULL BACKUP:
A copy is taken of every file on the system.

- Take up a lot of storage space.
- Take a long time to create.
- Faster to restore from.

INCREMENTAL BACKUP:
Only the files created or edited since the last back up are copied.

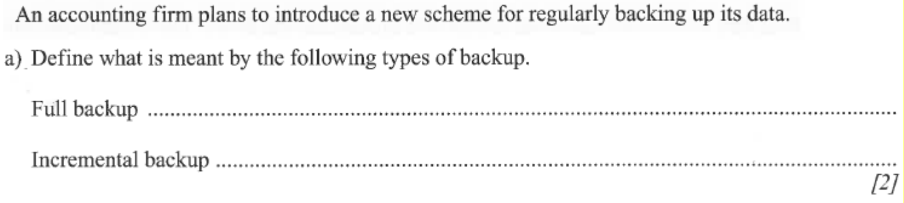
- Less storage space used.
- Quicker to create.
- Take longer to restore from as last FULL back up must be restored followed by every incremental back up since that point.

OTHER UTILITY SOFTWARE: system restore, file manager, automatic updating, system diagnosis, anti-virus, firewall, anti-spyware,

GCSE Computer Science - Topic 1.7 System Software (2)

What I need to know:

Define utility software.
Name the 5 pieces of utility software you need to know about.
Describe the purpose of compression software.
Name the two types of compression software.
Describe the difference between lossy and lossless compression.
Describe the purpose of encryption software.
Describe the purpose of defragmentation software.
Describe the purpose of disk-clean-up software.
Define the term ‘back up’.
List some reasons that data might be lost.
What are the two types of back up?
What are the main differences between full and incremental back-ups?
Name some storage devices that back up data may be stored on.
What precautions can be taken to keep back-up data safe?
Name two extra pieces of utility software that the user may wish to install.

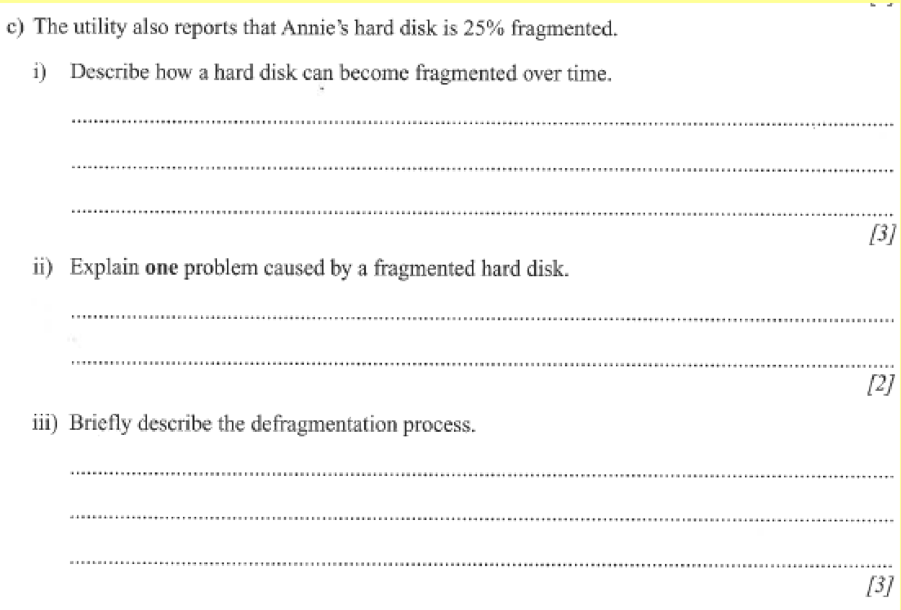


An accounting firm plans to introduce a new scheme for regularly backing up its data.

a) Define what is meant by the following types of backup.

Full backup ....

Incremental backup ....
[2]



c) The utility also reports that Annie’s hard disk is 25% fragmented.

i) Describe how a hard disk can become fragmented over time.

....

....

....
[3]

ii) Explain **one** problem caused by a fragmented hard disk.

....

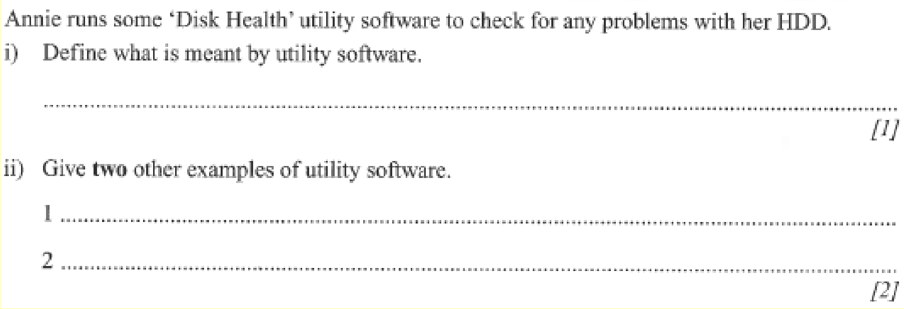
....
[2]

iii) Briefly describe the defragmentation process.

....

....

....
[3]



Annie runs some ‘Disk Health’ utility software to check for any problems with her HDD.

i) Define what is meant by utility software.

....
[1]

ii) Give **two** other examples of utility software.

1 ....

2 ....
[2]

GCSE Computing Topic 1.8 Issues

ETHICAL ISSUES: what is considered right or wrong by society.

LEGAL ISSUES: what is considered right or wrong in the eyes of the law.

CULTURAL ISSUES: how different cultures may be affected.

ENVIRONMENTAL ISSUES: how the planet is affected.

PRIVACY ISSUES: how our personal data is used and what risks to our privacy this poses.

STAKEHOLDER: someone or groups of people who have an interest in OR are affected by a particular scenario.

The **Digital Divide**: unequal access to computer science technologies due to financial, health or cultural issues.

DATA SUBJECT: someone who has data stored about them.

DPA: the act applies to all personal data held by organisations in paper or electronic form.
The Act was put into place to prevent the misuse of personal data.

CDPA: this act prevents peoples' original work being used without their consent.
The person who creates the work owns the copyright and is ***the only*** person who has the right to reproduce , adapt or sell it.

Data Protection Act Principles:

1. Keep data safe & secure.
2. Not ask for more data than necessary.
3. Not keep the data longer than necessary.
4. Keep the data accurate and up to date.
5. Not use the data for any other purpose without our consent.

Data Subject Rights:

1. Inspect and check the data held.
2. Demand that incorrect information is amended.
3. Demand that the data is not used in any way that could harm or distress.
4. Demand that any data held by the organisation is not used for direct marketing.

FOIA: the act creates a right of access to information held by public authorities including:

- Central and local government.
- The health service.
- Schools/colleges/universities.
- The police and courts.

Anyone can make a request for information. If the holder refuses, an appeal can be made to the Information Commissioner.

CMA: the Act was put into place to prevent the unauthorised access or modification of data. This law deals with hacking and cyber crime.
There are 3 levels of this law:

1. Unauthorised Access.
2. Unauthorised Modification.
3. Unauthorised Access *with intent*.

Create commons licenses give the public permission to share and use work under certain conditions without having to legal ask for permission from the creator. *People use CC licences when they want other people to share or build upon their work.*

Attribution - work can be shared, copied or modified but the creator has to be credited.
Non-commercial - nobody can use the work for profit.
No derivative - the work can be copied and distributed but cannot be edited or built upon.
Share alike - if you modify someone's work, you must share it under the same license terms as the original.

PROPRIETARY: software that is commercially produced, by an organisation, for profit. Only the compiled code is released. The source code is protected and there are restrictions on copying, modifying and redistributing.

- ✓ Professionally and carefully tested.
- ✓ Support is provided to keep customers happy.
- ✓ Regular updates and bug fixes.
- ✓ Come with warranties.
- ✗ Restrictions on how the software can be used and distributed.
- ✗ The source code cannot be accessed or modified.
- ✗ It is developed for a large audience, so may not suit individual needs.
- ✗ It has to be paid for, it is not free.

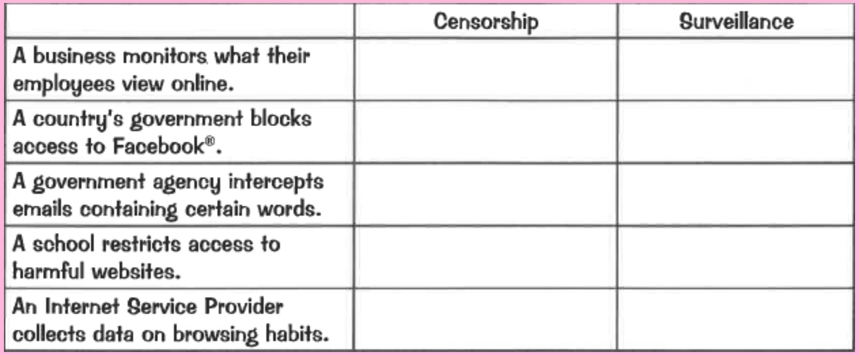
OPEN SOURCE: software whose source code is freely available to be modified / enhanced by anyone. Users can use the source code to create their own 'spin off' copies which can be shared under the same license as the original.

- ✓ Users can study the source code to see how the software works.
- ✓ Users can change and upgrade the software.
- ✓ Can share the software with other users for no charge.
- ✓ Software can be adapted to meet user's needs.
- ✓ A community of enthusiasts will provide support.
- ✗ May not seem as professional or have as friendly user interface.
- ✗ Specialist knowledge may be needed.
- ✗ Small projects may be buggy or have security holes.
- ✗ No warranties if anything goes wrong.
- ✗ There may be limited user documentation.

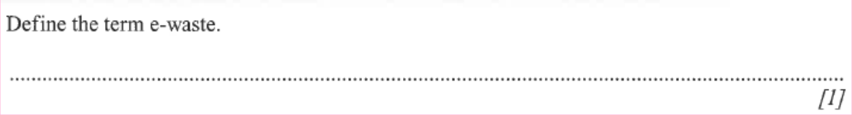
GCSE Computer Science - Topic 1.8 Issues

What I need to know:

Define ethical issues.
Define legal issues.
Define environmental issues.
Define cultural issues.
Define privacy issues.
Define stakeholder?
State what is meant by the digital divide.
Define data subject?
Outline the Data Protection Act (DPA).
Name the 5 DPA principles.
Outline the rights of the data subject under the DPA.
Outline the Copyright, Designs and Patents Act (CDPA).
Outline the Freedom of Information Act (FOIA).
Outline the Computer Misuse Act (CMA).
Outline the purpose of Creative Commons Licensing.
Describe the 4 types of Creative Commons license.
Explain what is meant by proprietary software.
List the pros and cons of proprietary software.
Explain what is meant by open-source software.
List the pros and cons of open-source software.

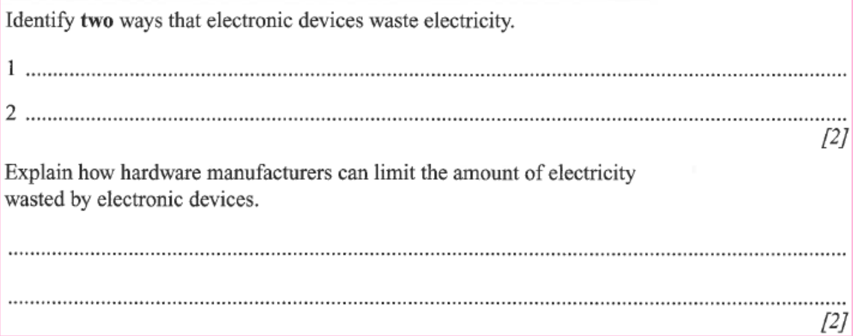


	Censorship	Surveillance
A business monitors what their employees view online.		
A country's government blocks access to Facebook®.		
A government agency intercepts emails containing certain words.		
A school restricts access to harmful websites.		
An Internet Service Provider collects data on browsing habits.		



Define the term e-waste.

.... *[1]*



Identify **two** ways that electronic devices waste electricity.

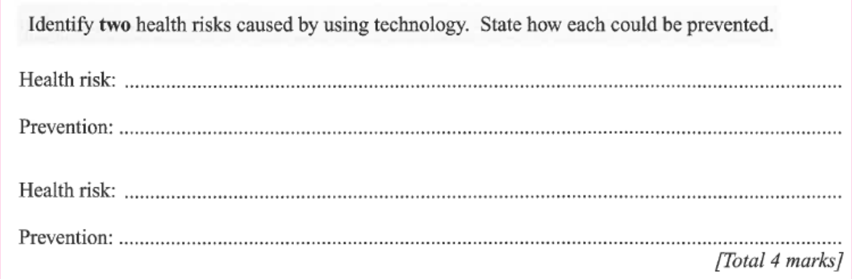
1 ....

2 .... *[2]*

Explain how hardware manufacturers can limit the amount of electricity wasted by electronic devices.

....

.... *[2]*



Identify **two** health risks caused by using technology. State how each could be prevented.

Health risk: ....

Prevention: ....

Health risk: ....

Prevention: .... *[Total 4 marks]*

GCSE Computer Science
Topic 2.1 Algorithms

To find middle item:
(amount of data items +1) / 2

COMPUTATIONAL THINKING: tackling a problem through abstraction, decomposition and algorithmic thinking.

ABSTRACTION: picking out important bits of information

DECOMPOSITION: breaking down a problem into smaller parts.

ALGORITHMIC THINKING: coming up with an algorithm to solve a problem.

ALGORITHM: a step by step set of instructions to solve a problem

BINARY SEARCH example:

1	3	5	7	9

Find 7:

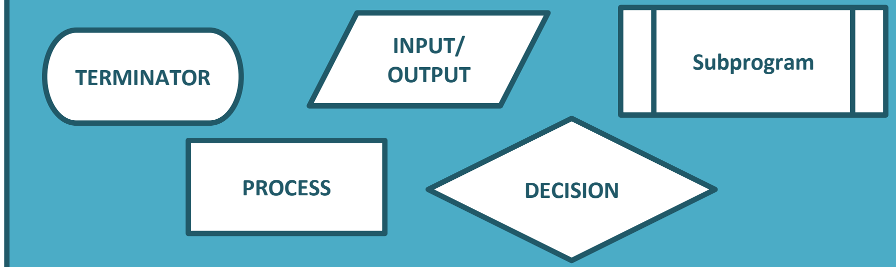
INSERTION SORT example (ascending)

13	3	50	7

MERGE SORT example (ascending)

13	3	50	7

FLOWCHART: a visual way of representing algorithms.


TERMINATOR

INPUT/ OUTPUT

Subprogram

PROCESS

DECISION

LINEAR SEARCH example

1	3	5	7	9

Find 7:

BUBBLE SORT example (ascending)

13	3	50	7

Fake Pseudocode

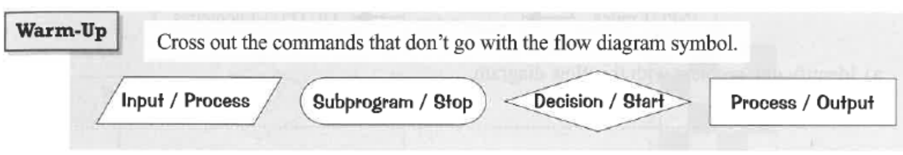
A set of instructions in the style of programming language, written in plain English.

INPUT , OUPUT, IF, THEN, ELSE

GCSE Computer Science - Topic 2.1 Algorithms

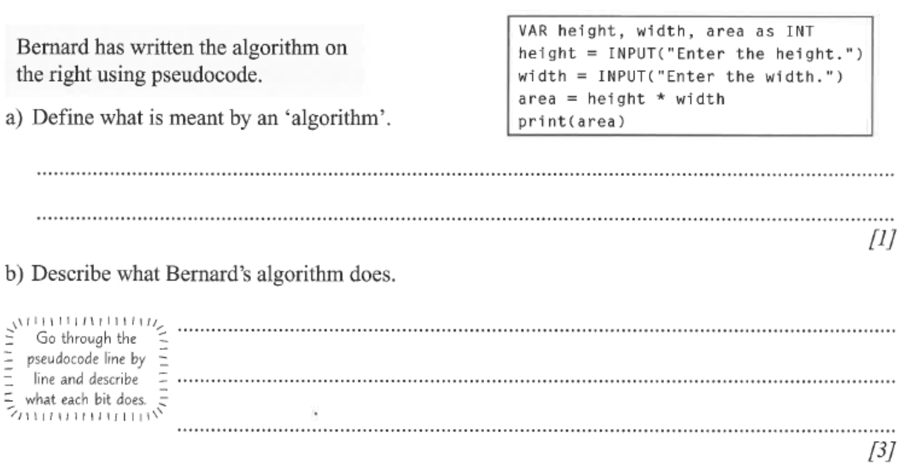
What I need to know:

Define computational thinking.
Define abstraction.
Define decomposition.
Define algorithmic thinking.
Define algorithm.
Name the two most common ways of displaying algorithms.
Define flowchart.
Define pseudocode.
Outline the steps of a binary search.
Write an ordered list of numbers or words and perform a binary search to find an item.
Outline the steps of a linear search.
Write a list of numbers or words and perform a binary search to find an item.
Outline the steps of a bubble sort.
Perform a bubble sort on a list of unordered numbers / words to put them into ascending/descending order.
Outline the steps of a insertion sort.
Perform a insertion sort on a list of unordered numbers / words to put them into ascending/descending order.
Outline the steps of a merge sort.
Perform a merge sort on a list of unordered numbers / words to put them into ascending/descending order.
Draw and label the shapes used in flowcharts.
List the keywords used in pseudocode.



Warm-Up

Cross out the commands that don't go with the flow diagram symbol.



Bernard has written the algorithm on the right using pseudocode.

```
VAR height, width, area as INT
height = INPUT("Enter the height.")
width = INPUT("Enter the width.")
area = height * width
print(area)
```

a) Define what is meant by an 'algorithm'.

....

.... *[1]*

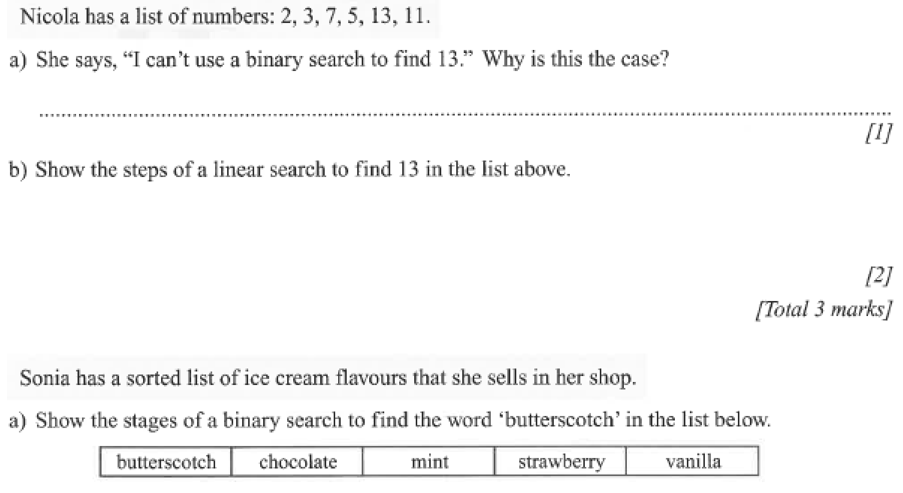
b) Describe what Bernard's algorithm does.

Go through the pseudocode line by line and describe what each bit does.

....

....

.... *[3]*



Nicola has a list of numbers: 2, 3, 7, 5, 13, 11.

a) She says, "I can't use a binary search to find 13." Why is this the case?

.... *[1]*

b) Show the steps of a linear search to find 13 in the list above.

[2]

[Total 3 marks]

Sonia has a sorted list of ice cream flavours that she sells in her shop.

a) Show the stages of a binary search to find the word 'butterscotch' in the list below.

butterscotch	chocolate	mint	strawberry	vanilla

GCSE Computer Science
Topic 2.2 Programming (1)

Variables and constants are used to store values in algorithms and programs. Variables and constants are defined as ‘ **a named memory location**’.

Variables’ values can change while a program is running.

Constants’ values must not change while a program is running.

Rules for naming variables/constants:

- Identifiers are the name of the variable or constant.
- They should ‘describe’ the data being stored.
- Short identifiers are quick/easy to write.
- Long identifiers are more descriptive.
- Identifiers cannot contain spaces must be consistent throughout the program.

CamelCaseUsesUpperAndLowerCaseLetters
Snake_case_links_all_the_words_with_an_underscore.

Operators are special characters that perform certain functions.

The **assignment operator is =**

It is used to assign values to constants or variables.

Comparison operators compare the value or expression on their left hand side to the value or expression on the right hand side and produce a Boolean value (True or False)

INPUT: Data that is put into the algorithm or program by the user.

OUTPUT:

- Data that is taken out of the program or algorithm and displayed to the user.
- This is usually done using a print statement.

SEQUENCE: Instructions are followed, one after the other in the order they are written.

SELECTION: Used in algorithms or programs to choose between two or more options.
Selection usually uses a combination of IF, ELSE and ELSE-IF statements.

IF/ ELSE statements are used when there are only 2 options.

- IF = QUESTION, followed by what to do if the answer is true.
- ELSE, what to do if the answer is False
- If there are more than 2 options, ELSE-IF is used.

Switch-case statements can also be used in selection;

- They are used when you want to perform different actions based on the value of ONE variable’s value.

ITERATION: The process of repeating a set of instructions for a fixed number of times OR until there is a desired outcome. Iteration is carried out using a programming construct called ‘loops’.

COUNT CONTROLLED loops repeat code a fixed number of times.
The number of iterations is known before the loop is started.

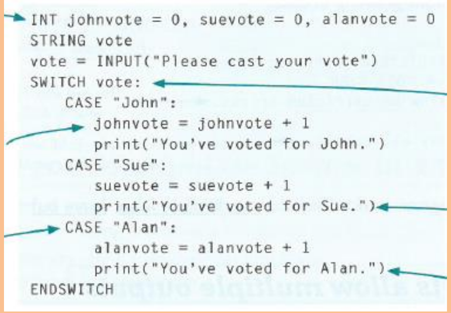
CONDITION CONTROLLED: loops are used when the number of iterations needed is not known.
The code is iterated while or until a condition is met.

DATA TYPE: A category or classification of data.
Used to make programs more robust and memory efficient.

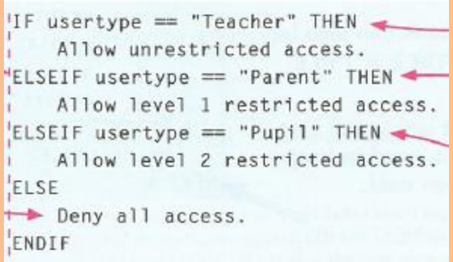
- INTEGER: A negative or positive WHOLE number.
- REAL: A negative or positive decimal number.
- CHARACTER: A SINGLE number, letter or symbol.
- STRING: A collection of characters enclosed in speech marks.
- BOOLEAN: True or False

CASTING: A function which converts an item of data into a different data type.

int()	Converts to an integer
float()	Converts into a real number
bool()	Converts into Boolean
str()	Converts to a string
ASC()	Converts into ASCII code
CHR()	Converts into ASCII character



```
INT johnvote = 0, suevote = 0, alanvote = 0
STRING vote
vote = INPUT("Please cast your vote")
SWITCH vote:
    CASE "John":
        johnvote = johnvote + 1
        print("You've voted for John.")
    CASE "Sue":
        suevote = suevote + 1
        print("You've voted for Sue.")
    CASE "Alan":
        alanvote = alanvote + 1
        print("You've voted for Alan.")
ENDSWITCH
```



```
IF usertype == "Teacher" THEN
    Allow unrestricted access.
ELSEIF usertype == "Parent" THEN
    Allow level 1 restricted access.
ELSEIF usertype == "Pupil" THEN
    Allow level 2 restricted access.
ELSE
    Deny all access.
ENDIF
```

Arithmetic operators: Characters that perform arithmetic functions.

+	Addition
-	Subtraction
*	Multiplication
/	Division (decimal answer)
**	To the power of…
// DIV	Division (integer answer)
% MOD	Divides and returns the remainder.

GCSE Computer Science - Topic 2.2 Programming (1)

What I need to know:

State how variables and constants are used in programming.

Define variable.

Define constant.

Outline the rules for naming constants/variables.

State what is meant by an operator

State what the assignment operator is used for in programming.

State the function of comparison operators.

Define the terms input / output.

Define the term sequence.

Outline what selection is used for in programming.

Define the term 'iteration'.

Describe the difference between count-controlled and condition controlled iteration.

Define the term data type.

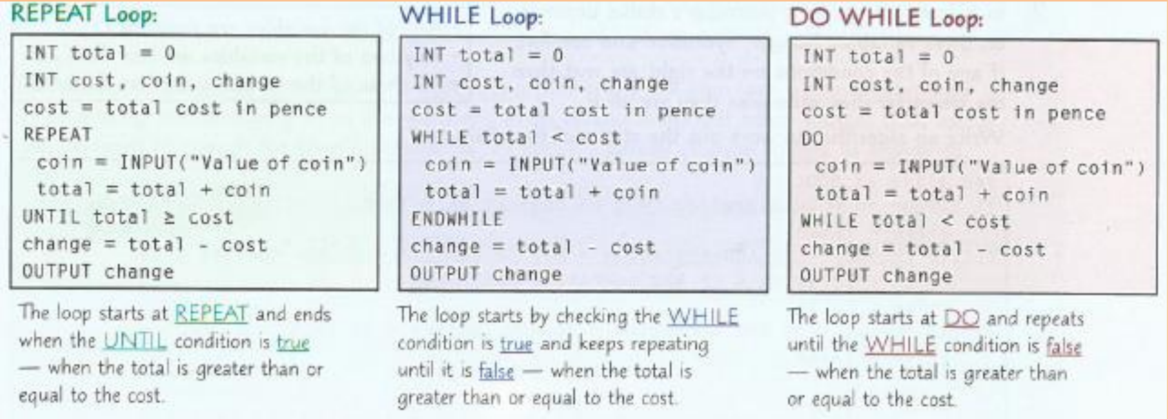
Outline the 5 main data types.

Define the term casting.

Outline the function of the 6 main casting commands.

Define the term arithmetic operator.

List the 7 main arithmetic operators and their mathematic function.



REPEAT Loop:

```
INT total = 0
INT cost, coin, change
cost = total cost in pence
REPEAT
  coin = INPUT("Value of coin")
  total = total + coin
UNTIL total ≥ cost
change = total - cost
OUTPUT change
```

The loop starts at REPEAT and ends when the UNTIL condition is true — when the total is greater than or equal to the cost.

WHILE Loop:

```
INT total = 0
INT cost, coin, change
cost = total cost in pence
WHILE total < cost
  coin = INPUT("Value of coin")
  total = total + coin
ENDWHILE
change = total - cost
OUTPUT change
```

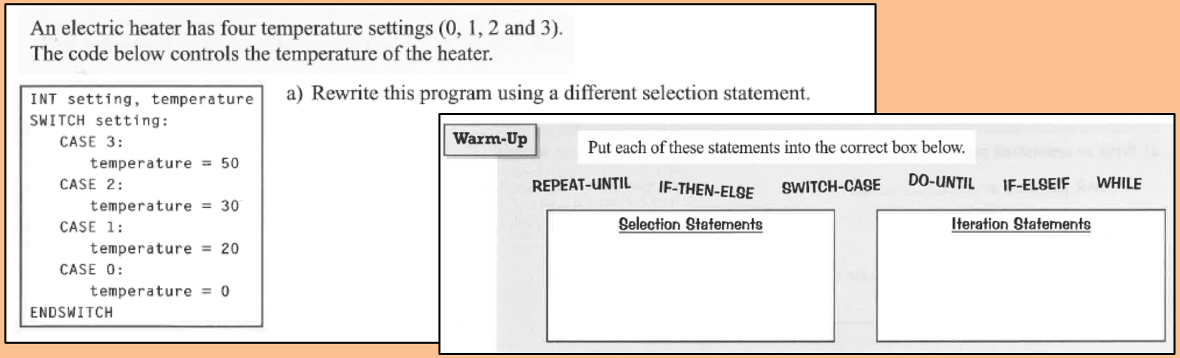
The loop starts by checking the WHILE condition is true and keeps repeating until it is false — when the total is greater than or equal to the cost.

DO WHILE Loop:

```
INT total = 0
INT cost, coin, change
cost = total cost in pence
DO
  coin = INPUT("Value of coin")
  total = total + coin
WHILE total < cost
change = total - cost
OUTPUT change
```

The loop starts at DO and repeats until the WHILE condition is false — when the total is greater than or equal to the cost.

Describe the differences between **repeat**, **while** and **do while** iteration.



An electric heater has four temperature settings (0, 1, 2 and 3).
The code below controls the temperature of the heater.

```
INT setting, temperature
SWITCH setting:
   CASE 3:
      temperature = 50
   CASE 2:
      temperature = 30
   CASE 1:
      temperature = 20
   CASE 0:
      temperature = 0
ENDSWITCH
```

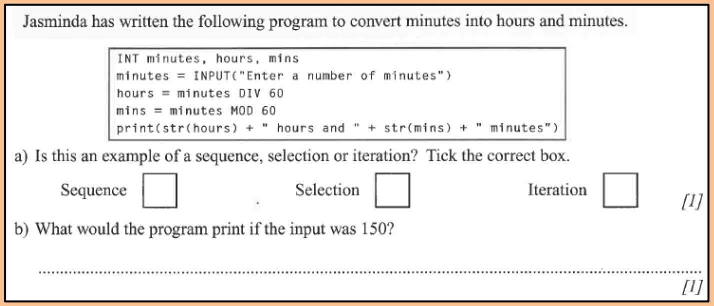
a) Rewrite this program using a different selection statement.

Warm-Up

Put each of these statements into the correct box below.

REPEAT-UNTIL IF-THEN-ELSE SWITCH-CASE DO-UNTIL IF-ELSEIF WHILE

Selection Statements	Iteration Statements



Jasminda has written the following program to convert minutes into hours and minutes.

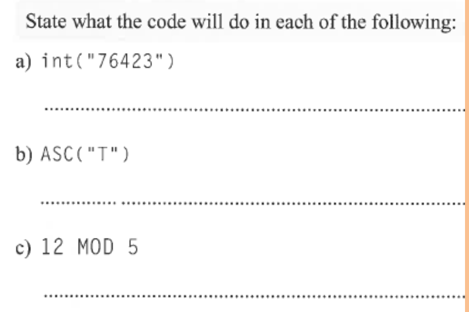
```
INT minutes, hours, mins
minutes = INPUT("Enter a number of minutes")
hours = minutes DIV 60
mins = minutes MOD 60
print(str(hours) + " hours and " + str(mins) + " minutes")
```

a) Is this an example of a sequence, selection or iteration? Tick the correct box.

Sequence □ Selection □ Iteration □ [1]

b) What would the program print if the input was 150?

.... [1]



State what the code will do in each of the following:

a) `int("76423")`

....

b) `ASC("T")`

....

c) `12 MOD 5`

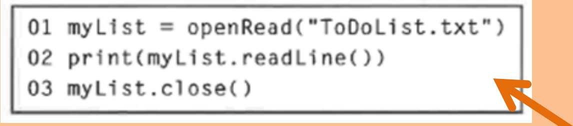
....

GCSE Computer Science
Topic 2.2 Programming (2)

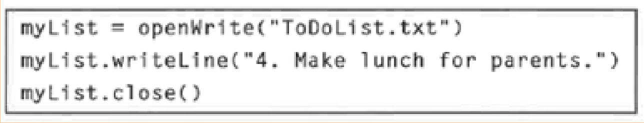
Boolean operators are used to combine **STATEMENTS** and **OPERANDS** which can all be evaluated as True or False.

They allow programs to make decisions and use selection.

AND	Using the AND operator ensures that the overall statement is TRUE only if ALL of the individual statements are True. **8 == 8 AND 4>2**
OR	Using the OR operator ensures that the overall statement is True if ANY of the individual statements are True. **7 != 2 OR 5==4**
NOT	The NOT operator REVERSES the logical state of the other operators. **NOT (3>2 AND 3!=3)** *Remember the brackets means the equations inside must be evaluated first, then REVERSED using the NOT operator.*



```
myList = openRead("ToDoList.txt")
print(myList.readLine())
myList.close()
```



```
myList = openWrite("ToDoList.txt")
myList.writeLine("4. Make lunch for parents.")
myList.close()
```

String manipulation: performing operations on string data.

.upper	Changes all characters into UPPER CASE.
.lower	Changes all characters into lower case.
Concatenation (+)	Joins two or more strings together to form a new string.
.length	Returns the number of characters in a string.
Extracting characters using index positions	Extracts single characters from a string using their index numbers. **String[i]**
Substrings	Extracts a portion of the full string the first number is the string index, the second number is the amount of characters to extract. **.substring(a, b)**
String traversal	Moving through a string one character at a time; can be used to see if a string contains certain characters.

File handling is all about how a program can access data and change data stored in an external file.

Open	Before you can do anything with a file, you have to open it. This is done using an open command, and assigning the file to a variable. There are two modes in which you can open a file: • Open to READ / Open to WRITE Once a file is opened the program will start reading or writing from the beginning. As you read from or write to a file, the program keeps its place in the file (think of it like a cursor)
OpenRead	File=openRead(“FileName.txt”) Opens the file called FileName.txt in READ MODE and allows you to ‘read’ (fetch) the data into your program.
OpenWrite	File=openWrite(“FileName.txt”) Opens the file called FileName.txt in WRITE MODE and allows you to ‘write’ (add) data from your program into the file.

- You can read lines from a file using the readLine() command.
- You can write lines of text to a file using writeLine().

** If the file already contains some text then writeLine() will **overwrite** what is currently there.*

- endOfFile()returns TRUE when the cursor is at the end of the file. Its main use is to signify when a program should stop reading a file.
- When you finish reading or writing to a file, close it using the File.close() command.

GCSE Computer Science - Topic 2.2 Programming (2)

What I need to know:

Describe what Boolean operators are used for in programming.

Explain, with examples, how the 3 main Boolean operators work.

State the purpose of string manipulation.

Outline the 7 main string manipulation commands and their function.

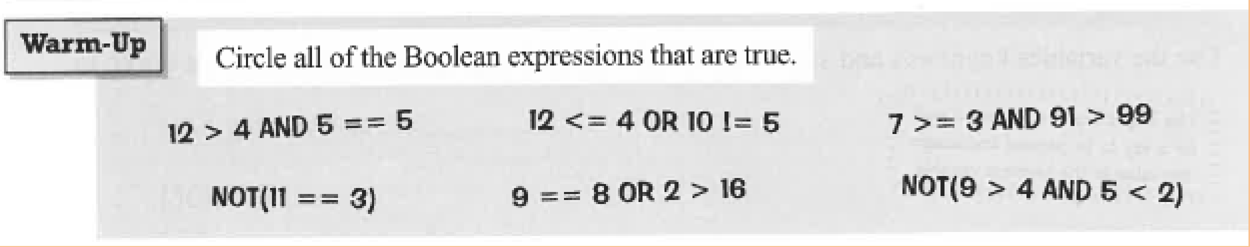
State what is meant by 'file handling'

Outline how the open command works.

Describe the difference between the openRead and openWrite file handling command.

Describe the function of readline(), writeline() and endoffile() commands.

State which command should be used when you have finished using a file.

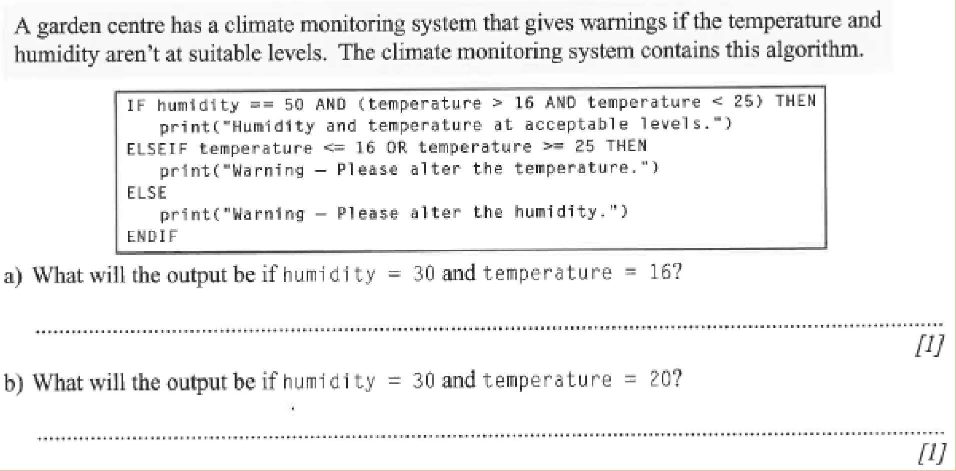


Warm-Up

Circle all of the Boolean expressions that are true.

12 > 4 AND 5 == 5   12 <= 4 OR 10 != 5   7 >= 3 AND 91 > 99

NOT(11 == 3)   9 == 8 OR 2 > 16   NOT(9 > 4 AND 5 < 2)



A garden centre has a climate monitoring system that gives warnings if the temperature and humidity aren't at suitable levels. The climate monitoring system contains this algorithm.

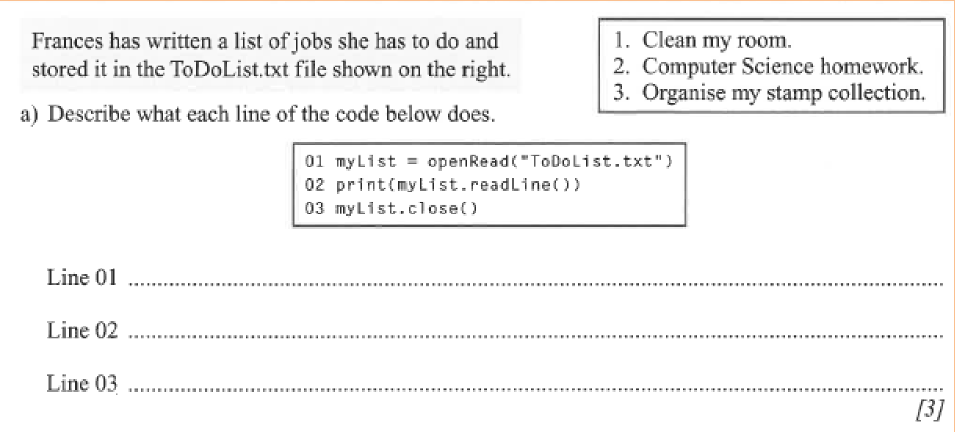
```
IF humidity == 50 AND (temperature > 16 AND temperature < 25) THEN
   print("Humidity and temperature at acceptable levels.")
ELSEIF temperature <= 16 OR temperature >= 25 THEN
   print("Warning - Please alter the temperature.")
ELSE
   print("Warning - Please alter the humidity.")
ENDIF
```

a) What will the output be if humidity = 30 and temperature = 16?

.... *[1]*

b) What will the output be if humidity = 30 and temperature = 20?

.... *[1]*



Frances has written a list of jobs she has to do and stored it in the ToDoList.txt file shown on the right.

1. Clean my room.
2. Computer Science homework.
3. Organise my stamp collection.

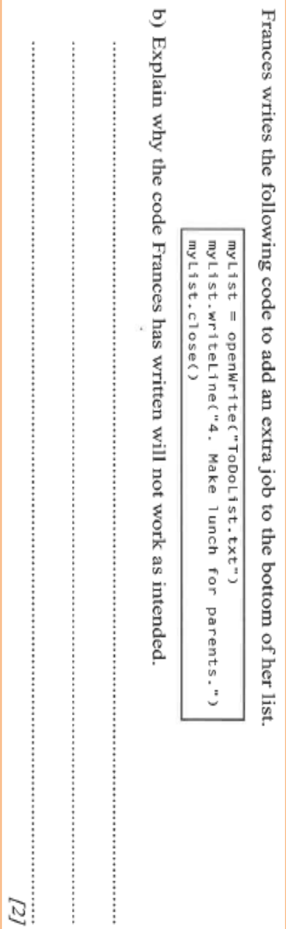
a) Describe what each line of the code below does.

```
01 myList = openRead("ToDoList.txt")
02 print(myList.readLine())
03 myList.close()
```

Line 01 ....

Line 02 ....

Line 03 .... *[3]*



Frances writes the following code to add an extra job to the bottom of her list.

```
myList = openWrite("ToDoList.txt")
myList.writeLine("4. Make lunch for parents.")
myList.close()
```

b) Explain why the code Frances has written will not work as intended.

....

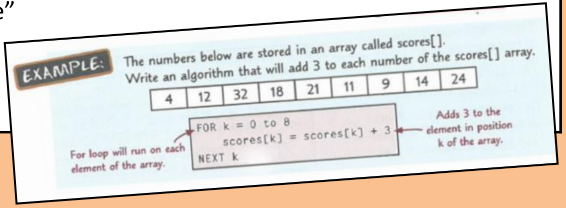
....

.... *[2]*

GCSE Computer Science
Topic 2.2 Programming (3)

Databases	A data structure where data is held in tables made up of fields (columns) and records (rows). Databases can be flat file (one table for every piece of data) or relational (different tables holding data about specific items) Relational databases have tables which are linked together by key fields.
Field	Used to store a category of data e.g. name, age, address. All data in the same field must be the SAME data type.
Record	A record stores particular data about a particular item. Data in the same record can be DIFFERENT data types.
Primary key	Each record in a database should have a primary key. A primary key is a unique piece of data per record. This makes it easier to search for and distinguish between data records.

Array	An array is a data structure that stores multiple items of data, called elements, which are all of the same data type, under one name (an identifier) *** Arrays are like lists.**
Element	Each piece of data in an array is called an element – each element can be accessed using its position (or index) in the array.
Creating & working with an array	ARRAY subjects [2] subjects [0] = “Computer Science” subjects [1] = “ Maths” print(subjects[0]) subjects [2] = “Science”



EXAMPLE: The numbers below are stored in an array called scores[]. Write an algorithm that will add 3 to each number of the scores[] array.

4	12	32	18	21	11	9	14	24

```
FOR k = 0 to 8
    scores[k] = scores[k] + 3
NEXT k
```

For loop will run on each element of the array.

Adds 3 to the element in position k of the array.

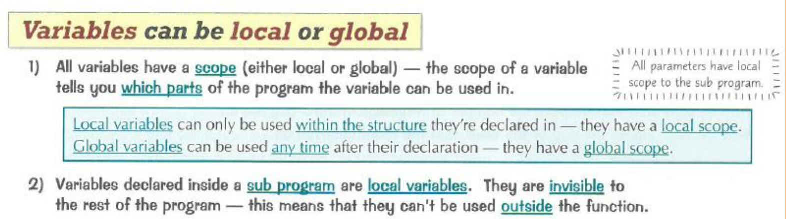
Sub program	Sub programs are a self contained sequence of code, which perform a specific task. • They used to save time and simplify code & avoid repeating code. • They make testing a program easier & give your code more structure.
Procedure	Procedures are sets of instructions stored under one name. When you want your program to do the whole set of instructions you need to ‘call’ the name of the procedure.
Function	Functions are similar to procedures, but the main difference is a FUNCTION ALWAYS RETURNS A VALUE.
Parameter	Parameters are special variables used to pass values into a subprogram.
Argument	Arguments are the actual **values**, stored in the parameters.

SQL	A set of commands that can be used to create, update and query (search) databases.

SELECT
FROM
	SELECT : Used to tell the database what information you want to retrieve.
	FROM : Tells the database which tables to look in for the data you are searching for.
	*SELECT * FROM hotels*
	SELECT hotel_name FROM hotels
	SELECT rooms, price_in_pounds FROM hotels

WHERE	Used to filter the results. The **WHERE** statement specifies conditions that must be met before data is retrieved. *SELECT * FROM hotels WHERE hotel_rating >=4.1*

AND / OR
LIKE %
	SELECT hotel_name FROM hotels WHERE bathroom = “En-suite” **AND** price_in_pounds < 45
	SELECT hotel_name, price_in_pounds WHERE hotel_name **LIKE** “%Hotel”



Variables can be local or global

1) All variables have a scope (either local or global) — the scope of a variable tells you which parts of the program the variable can be used in.

All parameters have local scope to the sub program.

Local variables can only be used within the structure they’re declared in — they have a local scope.
Global variables can be used any time after their declaration — they have a global scope.

2) Variables declared inside a sub program are local variables. They are invisible to the rest of the program — this means that they can’t be used outside the function.

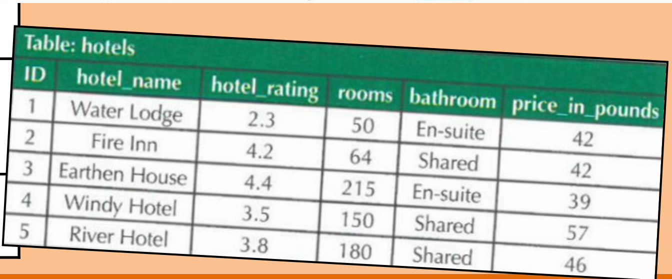


Table: hotels

ID	hotel_name	hotel_rating	rooms	bathroom	price_in_pounds
1	Water Lodge	2.3	50	En-suite	42
2	Fire Inn	4.2	64	Shared	42
3	Earthen House	4.4	215	En-suite	39
4	Windy Hotel	3.5	150	Shared	57
5	River Hotel	3.8	180	Shared	46

GCSE Computer Science - Topic 2.2 Programming (3)

What I need to know:

Describe what is meant by a 'database'.

Define the term 'field'.

Define the term 'record'

State what is meant by a primary key.

Describe what SQL is used for.

State the function of the SELECT command.

State the function of the FROM command

Outline the function of the command 'SELECT *'

Describe what the WHERE command is used for

State the function of the % wildcard .

Define the term 'array'.

Define the term 'element'

Write the code required to create an array, add 3 elements and then print out the first element.

Describe what is meant by a sub program.

Outline the benefits of using sub-programs.

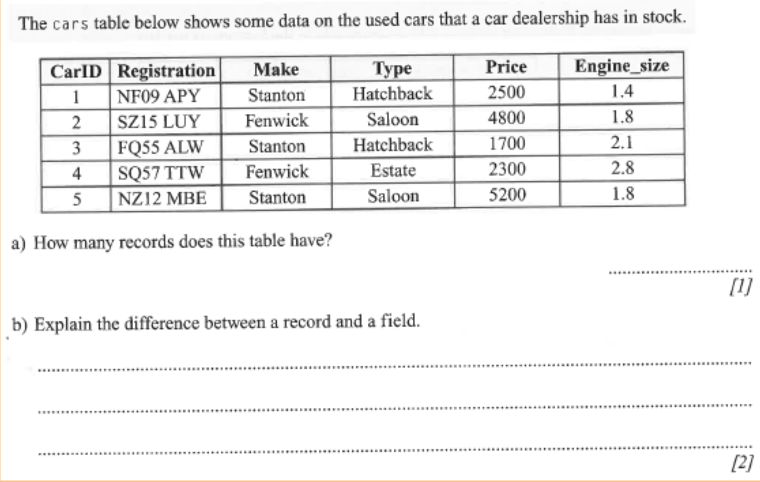
Define the terms 'function' and 'procedure' and state the main difference between the two.

Define the term 'parameter'.

Define the term 'argument'

Describe what is meant by the scope of a variable.

State the difference between a local and global variable.



The cars table below shows some data on the used cars that a car dealership has in stock.

CarID	Registration	Make	Type	Price	Engine_size
1	NF09 APY	Stanton	Hatchback	2500	1.4
2	SZ15 LUY	Fenwick	Saloon	4800	1.8
3	FQ55 ALW	Stanton	Hatchback	1700	2.1
4	SQ57 TTW	Fenwick	Estate	2300	2.8
5	NZ12 MBE	Stanton	Saloon	5200	1.8

a) How many records does this table have?

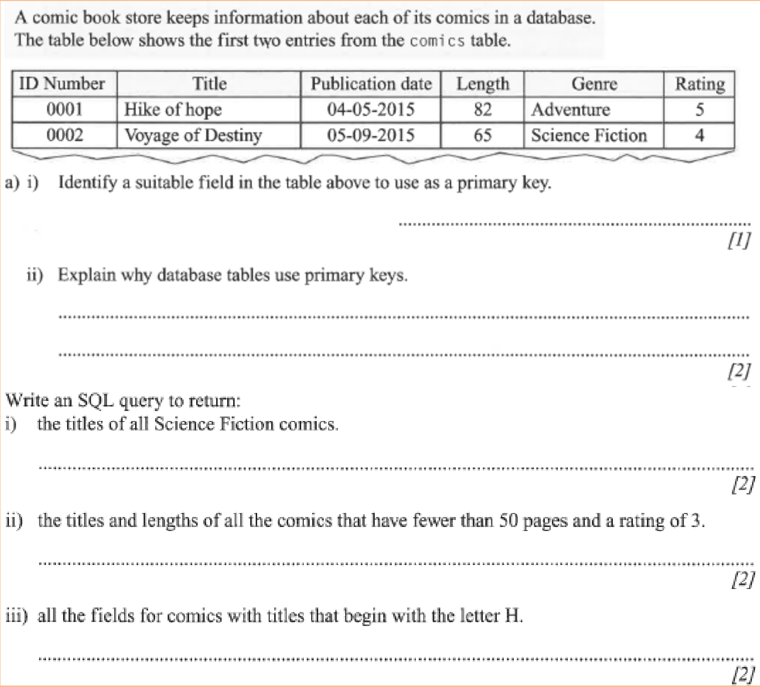
.... [1]

b) Explain the difference between a record and a field.

....

....

.... [2]



A comic book store keeps information about each of its comics in a database.
The table below shows the first two entries from the comics table.

ID Number	Title	Publication date	Length	Genre	Rating
0001	Hike of hope	04-05-2015	82	Adventure	5
0002	Voyage of Destiny	05-09-2015	65	Science Fiction	4

a) i) Identify a suitable field in the table above to use as a primary key.

.... [1]

ii) Explain why database tables use primary keys.

....

.... [2]

Write an SQL query to return:

i) the titles of all Science Fiction comics.

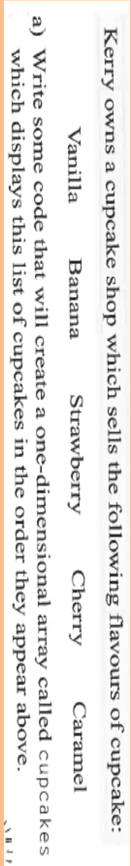
.... [2]

ii) the titles and lengths of all the comics that have fewer than 50 pages and a rating of 3.

.... [2]

iii) all the fields for comics with titles that begin with the letter H.

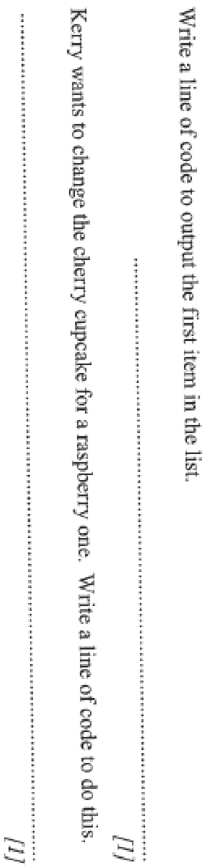
.... [2]



Kerry owns a cupcake shop which sells the following flavours of cupcake:

Vanilla Banana Strawberry Cherry Caramel

a) Write some code that will create a one-dimensional array called cupcakes which displays this list of cupcakes in the order they appear above.



Write a line of code to output the first item in the list.

.... [1]

Kerry wants to change the cherry cupcake for a raspberry one. Write a line of code to do this.

.... [1]

GCSE Computer Science
Topic 2.3 Robust Programs

Why defensive design?
Helps to ensure programs function properly.
- ✓ Not breaking
- ✓ Not producing errors

3 elements of Defensive design:
- Anticipate how users might '**misuse**' their program to prevent it from happening.
- Ensure their code is **well maintained**.
- Reduce the numbers of errors in the code through **testing**.

Planning for contingencies / anticipating misuse
- Computer programs should be designed to COPE with unexpected or erroneous input from users.
- Coders should PLAN for all contingencies that might occur. (accidental and deliberate inputs)

Input validation: Validation checks that data input is sensible, reasonable and appropriate to be processed by the program.

Presence check: Checks that data has actually been entered and the field has not been left blank..

Length check: Checks that a specified number of characters has been entered.

Range check : Checks that the input falls within a certain range. e.g. 1-100

Type check : This checks that the data inputted is a certain data-type e.g. number or letters.

Format check :
Checks that the input is in the correct format e.g.
National insurance number XX999999X

Input sanitisation : Removes any unwanted characters BEFORE passing the data to the program.

Test Plan	A test plan will outline exactly what you're going to test and how you are going to test it. It should cover all the possible paths through a program.
Normal data	Data that the user is LIKELY to input into the program. Data that the program should be able to process.
Extreme / Boundary data	Values at the limit of what the program should be able to handle. This data should still be able to be processed by the program.
Erroneous data	Data that the program should not accept; usually the wrong data type.

Authentication is determining the identity of the user before they can access the program or parts of the program.
This is usually based upon a username and associated password.
TOO MUCH AUTHENTICATION CAN:
- *Affect the functionality of the system.*
- *Can put people off using it.*

Maintainability:
Keeping the code well maintained aids defensive design as it means when editing, improving or testing the code – it is clear and easy to understand what the code should be doing.

Commenting:
#Usually written with **//** or **#**
#Comments are useful for explaining what key features of a program do.
#Well written/clear comments are essential in allowing other programmers to understand your program.

Indentation :
This is used to separate different statements in a program. This allows other programmers to see the flow of a program more clearly and pick out the different features.
Indentation is usually used to show which statements are part of a previous line of code.
E.g. with ***selection*** and ***iteration***.

Naming Variables:
Variables should be named so that they reflect their purpose.
This helps other programmers keep track and recognise what the variables are when reading /using the program.

- **Testing** ensures that the software produces the expected results and meets the needs of the user.
- Testing makes sure the program is robust.
- Testing should be destructive and should try to find errors rather than just proving the program works.

ITERATIVE TESTING: Tests carried out whilst the program is being developed. The test results are then used to guide further improvements.

FINAL TESTING: This is carried out once the software has been developed.
Alpha testing is done by the developers.
Beta testing is carried out by the potential users of the software.

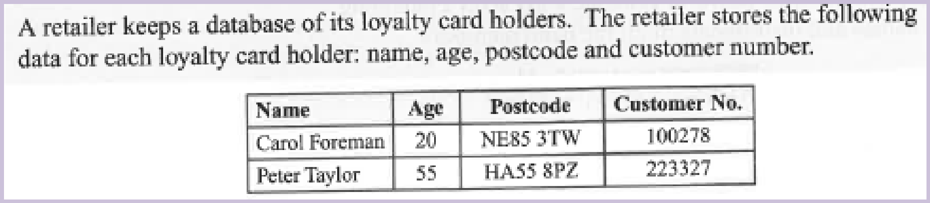
A **syntax error** occurs when the compiler or interpreter doesn't understand something the user has typed because it doesn't follow the rules or grammar of the programming language.
Syntax errors produce a error message which details what is wrong and which line of code contains the error.

Logical errors: The interpreter / compiler will be table to run the code, but the program will do something unexpected.
E.g. using the wrong Boolean operator.
Logical errors are difficult to diagnose / track down.
Logical errors can only be found through testing, using a test plan.

GCSE Computer Science - Topic 2.3 Robust Programs

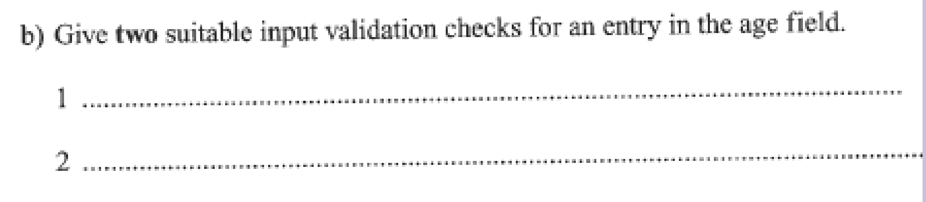
What I need to know:

Explain the programmers defensively design programs.
State the 3 elements of defensive design.
Explain what planning for contingencies involves.
Describe input validation.
State the function of a presence check.
State the function of a length check.
State the function of a range check.
State the function of a type check.
State the function of a format check.
Describe input sanitisation.
Define authentication.
Explain what is meant by maintainability.
Describe how commenting helps improve maintainability.
Describe how indentation helps improve maintainability.
Describe how variable names help improve maintainability.
Explain why programs are tested.
Describe iterative testing.
Describe final testing.
State what is meant by a syntax error. Give an example.
State what is meant by a logical error. Give an example.
Describe what is meant by a test plan.
What are the three types of data a program should be tested with?
Define normal, extreme and erroneous data.



A retailer keeps a database of its loyalty card holders. The retailer stores the following data for each loyalty card holder: name, age, postcode and customer number.

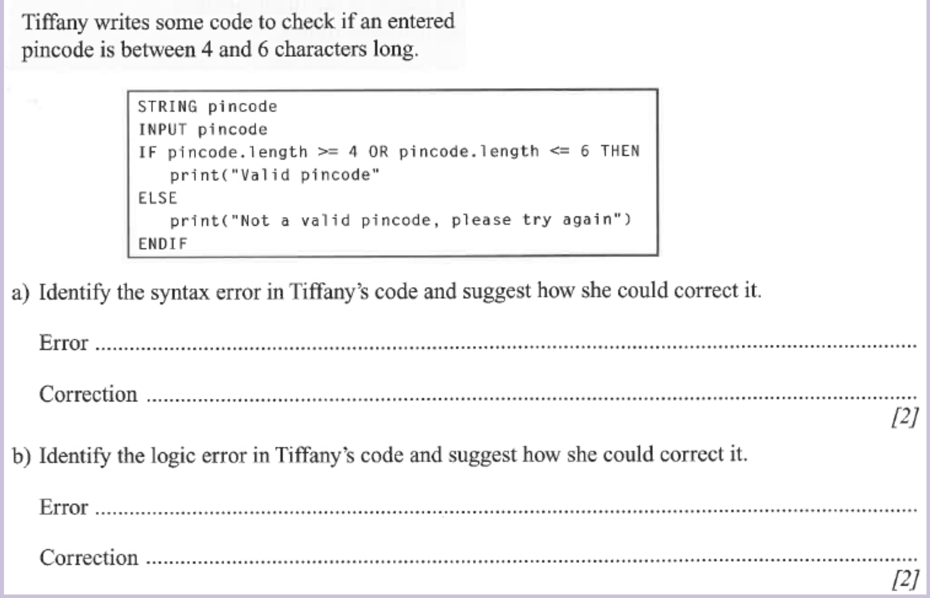
Name	Age	Postcode	Customer No.
Carol Foreman	20	NE85 3TW	100278
Peter Taylor	55	HA55 8PZ	223327



b) Give **two** suitable input validation checks for an entry in the age field.

1 ....

2 ....



Tiffany writes some code to check if an entered pincode is between 4 and 6 characters long.

```
STRING pincode
INPUT pincode
IF pincode.length >= 4 OR pincode.length <= 6 THEN
   print("Valid pincode"
ELSE
   print("Not a valid pincode, please try again")
ENDIF
```

a) Identify the syntax error in Tiffany's code and suggest how she could correct it.

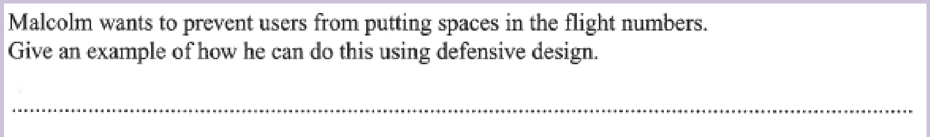
Error ....

Correction .... *[2]*

b) Identify the logic error in Tiffany's code and suggest how she could correct it.

Error ....

Correction .... *[2]*



Malcolm wants to prevent users from putting spaces in the flight numbers.
Give an example of how he can do this using defensive design.

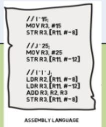
....

GCSE Computer Science
Topic 2.4 Translators and facilities of languages

Low Level		High Level
Machine Language	Assembly Language	Python, C, C++, Java, SQL, HTML etc.
Binary Programs are written as millions of 1s and 0s.	Each command word represents one binary instruction in machine code. ADD e.g. is used to replace the binary command 1011 0000	Resemble human language. Keywords used e.g. print, if, input. Deal with logic not how the CPU / Memory works.

```
1100 1010 1011 0011
1100 1010 1011 0011
1100 1010 1011 0011
1100 1010 1011 0011
1100 1010 1011 0011
1100 1010 1011 0011
```

MACHINE CODE



```
// i = 15;
MOV R3, #15
STR R3, [R11, #-8]

// j = 25;
MOV R3, #25
STR R3, [R11, #-12]

// i = i + j;
LDR R2, [R11, #-8]
LDR R3, [R11, #-12]
ADD R3, R2, R3
STR R3, [R11, #-8]
```

ASSEMBLY LANGUAGE

Translators of High Level Code		
Assembler	Compiler	Interpreter
Assemblers are used to turn assembly language into machine code. They just have to assemble the mnemonics then turn them into machine code instructions. *Remember – 1 assembly instruction per machine language command.*	Compiler translates high level code in one go. It compiles the program first then executes it so it can be processed quicker. It creates an executable file of 'compiled code' which protects the source code from being viewed by others. Errors reported at the end.	An interpreter translates line by line and is required each time the program is run. When an error is encountered , the translation process is halted and the error is reported to the programmer. Easier to debug but slower as needs to be translated each time it is run. Easy to edit as source code is always available.

The 5 main features of IDEs

Editors: This is where the code is written.
Line numbering, colour coding, auto-indentation.
Some IDEs have auto-correct and auto-complete

Run-time environment
Allows the code to be RUN within the IDE.

ASSEMBLY LANGUAGE	HIGH Level
Used by embedded systems as it is used to control system hardware. Used in real-time systems where speed is essential. Specific code per CPU – Programs written in for one type and cannot be used on others.	Most software is developed. Programs are portable from one machine to another. Can be used on different models of CPU.

LOW level	HIGH Level
1 instruction in assembly = 1 in machine code. Written for 1 type of machine. The programmer needs to know about the specifics of the CPU. Code is difficult to read, understand and modify. Commands in machine code can be executed directly without the need for a translator. Machine code controls exactly what the CPU does/ how it uses memory so programs will be memory efficient and faster.	1 instruction in high level = many instructions of machine code. Same code will work on many different machines/processors. The programmer doesn't need to know about the CPU. Code is easy to read, understand and modify. Must be translated into machine code before a computer can understand it. You don't have control over the CPU does, so programs will be less memory efficient and slower

IDEs: A piece of software that provides a **combination** of tools to help the programmer develop their program.

Error diagnostics / debugging tools help the programmer identify syntax errors.

They provide the location and type of error encountered.

Translators: **Compiler** / **interpreter** or both.

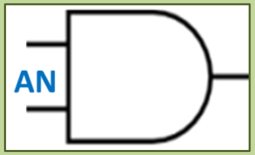
Which translates the program code into machine code within the IDE.

GCSE Computer Science
Topic 2.5 Computational Logic

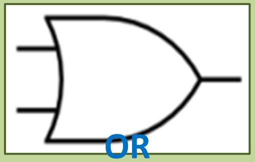
Computers are DIGITAL .
Digital signals can only be ON or OFF.
Computers use binary to represent this:
1 = ON, 0 = OFF

Logic gates are special switches built into computer chips that use transistors

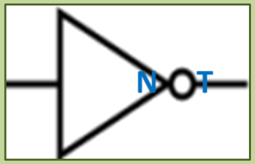
They receive binary data 1s and 0s.
Apply a Boolean operation: AND, OR, NOT.
Then output a binary result: either 1 or 0



1 AND 1 = 1
Any other inputs = 0
∧

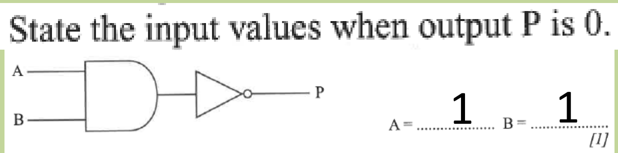


1 OR more 1s
INPUTTED = 1 OUTPUT.
∨



If 1 is INPUT,
it is NOT 1 on OUTPUT.
¬

Multiple logic gates can be added to the same circuit to carry out different operations.
You can work out the truth tables by working through each gate, in order.



State the input values when output P is 0.

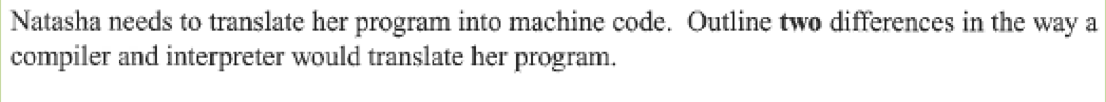
A = 1 B = 1

[1]

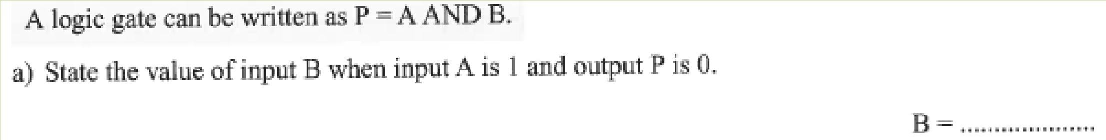
GCSE Computer Science
Topic 2.4 Computational Logic & 2.5 Translators and facilities of languages

What I need to know:

State the two levels of programming language.
Describe the key features between machine, assembly and high level language.
Describe the uses of assembly language and high level language.
Describe the differences between high level and low level languages.
Outline the function of an assembler.
Outline the function of a compiler.
Outline the function of an interpreter.
State what IDE stands for.
Explain what an IDE is used for.
Describe the 5 main features of an IDE.
Explain why computers use binary.
Describe what a logic gate is.
Draw and label the 3 main logic gate symbols.
Draw a truth table to show the inputs and outputs for each logic gate.
Draw a logic diagram with multiple gates and explain how to work out the input/output combinations.



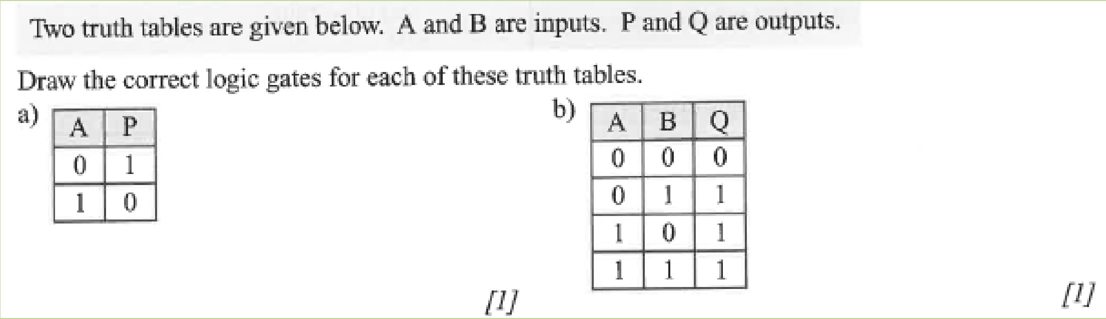
Natasha needs to translate her program into machine code. Outline **two** differences in the way a compiler and interpreter would translate her program.



A logic gate can be written as P = A AND B.

a) State the value of input B when input A is 1 and output P is 0.

B = ...



Two truth tables are given below. A and B are inputs. P and Q are outputs.

Draw the correct logic gates for each of these truth tables.

a)

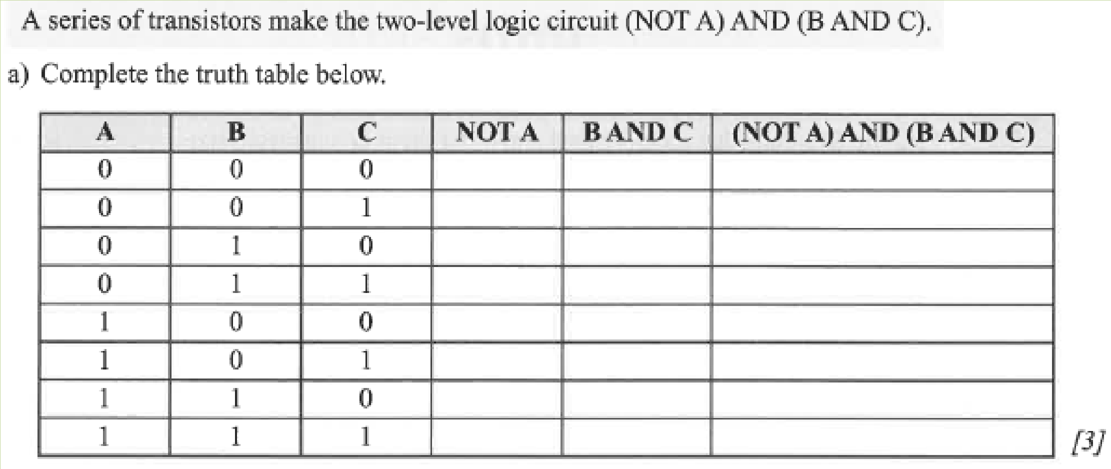
A	P
0	1
1	0

[1]

b)

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

[1]



A series of transistors make the two-level logic circuit (NOT A) AND (B AND C).

a) Complete the truth table below.

A	B	C	NOT A	B AND C	(NOT A) AND (B AND C)
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

[3]

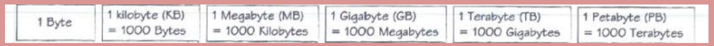
GCSE Computer Science
Topic 2.6 Data Representation

Each 1 or 0 is a bit. Short for **bi**nary digi**t.**

1. Bit
2. Nibble
3. Byte
4. Kilobyte
5. Megabyte
6. Gigabyte
7. Terabyte
8. Petabyte

There are **8** bits in a **byte**
Then **1000** of each smaller unit in each bigger unit.

128	64	32	16	8	4	2	1



1 Byte	1 kilobyte (KB) = 1000 Bytes	1 Megabyte (MB) = 1000 Kilobytes	1 Gigabyte (GB) = 1000 Megabytes	1 Terabyte (TB) = 1000 Gigabytes	1 Petabyte (PB) = 1000 Terabytes

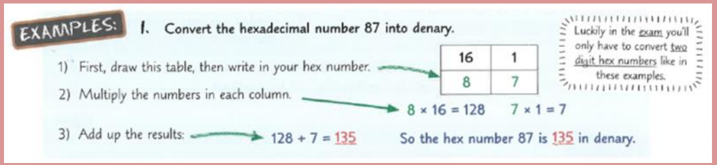
Check digits are a way of checking that data has been **entered** and **read** correctly.
They are digits added to the **end** of numbers.
If the check digit is correct when the data is read, it is **likely** the data has been entered/read correctly.
For binary data, the check digit is called a **parity** bit.

- You can have **odd** and **even** parity bits.
- An **even** parity bit is added to make the binary string have an **even number of 1s**.
- An **odd** parity bit is added to make a binary string have an **odd number of 1s**.

Number 1	0	0	0	1	1	1	0	1
Number 2	1	0	0	1	1	0	1	1
Answer	1	0	1	1	1	0	0	0
Carry	0	0	1	1	1	1	1	

1 + 1 = 0 *CARRY* 1

1 + 1 + 1 = 1 *CARRY* 1



EXAMPLES: 1. Convert the hexadecimal number 87 into denary.

1) First, draw this table, then write in your hex number.

16	1
8	7

2) Multiply the numbers in each column. → 8 × 16 = 128 7 × 1 = 7

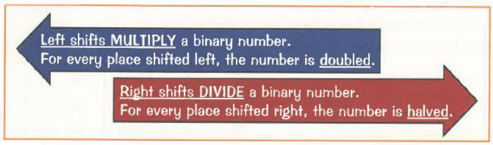
3) Add up the results: → 128 + 7 = 135 So the hex number 87 is 135 in denary.

Luckily in the exam you'll only have to convert two digit hex numbers like in these examples.

DEN	BINARY	HEX
0	0	0
1	1	1
2	10	2
3	11	3
4	100	4
5	101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Sometimes when doing binary **addition** you get a result that requires **more bits** than the CPU is expecting. This is called an **overflow error**

Overflow errors result in **loss of data** and the results are **inaccurate**



Left shifts MULTIPLY a binary number.
For every place shifted left, the number is doubled.

Right shifts DIVIDE a binary number.
For every place shifted right, the number is halved.

A binary shift (or logical shift) moves every bit in a binary number either left or right a certain number of places.
Gaps at the beginning or end of a number, after a shift are filled with 0s.
Left shifts can cause overflow errors and right shifts can cause digits to ‘drop off’ the end.
Bits dropping off or overflowing can cause loss of accuracy or loss of data.

- ✓ Its easier to remember large numbers in HEX.
- ✓ Because HEX is shorter there are less chance of typing errors.
- ✓ Its easier to convert between binary&hex than binary and denary.

Analogue signals are converted to digital signals so that they can be processed by a computer.
This process is called sampling.

Sample intervals	Sample frequency	Sample size/depth	Bit rate
The time gap between taking a sample. e.g. sound may be sampled every 5 milliseconds Sample interval 5ms.	**How many samples are taken in a second.** e.g. 44.1khz means 44,100 samples are taken per second.	**How many bits are available to store each sample.**	**Number of bits used per second of audio.** **Bit rate = sampling frequency * sample size.**

Increasing any of the above means better quality but larger file size.

Character set: A collection of characters that a computer recognises from their binary representation.

ASCII - Uses 7 bits – this means it can represent 128 characters. (2^7 = 128)
EXT ASCII: Uses 8 bits – allowing 256 characters to be represented (2^8 = 256).
Unicode uses 16-32 bits -2^16 bit (65, 536) 2^32 bit (4,294, 967,296) ***Unicode covers ALL major languages.***

Bitmap images are made up of tiny little dots called pixels.
The colour of each pixel is represented by a binary code.
More colours = more bits (longer binary code)
Colour depth: the number of bits used for each pixel.
MORE COLOURS = BETTER QUALITY BUT LARGER FILE.
Resolution - how many pixels are in an area of the image – measured in dpi (dots per inch)
MORE DOTS, MORE BINARY = LARGER FILE.
Metadata is the data stored in an image file which helps the computer recreate the image on screen. *File format, height, width, colour-depth and resolution, time/date/location image was taken.*
WITHOUT METADATA, DEVICES WOULD NOT BE ABLE TO DISPLAY IMAGES.

GCSE Computer Science - Topic 2.6 Data representation

What I need to know:

Define the term bit.
How many bits are in a byte?
Order the binary units from smallest to largest.
Explain, with an example how to convert a number from denary into binary.
Explain, with an example, how to convert a number from binary to denary.
Define the terms check digit / parity bit.
Explain with examples how odd and even parity bits are used.
Demonstrate how to perform binary addition.
Explain with examples, how to convert binary into hexadecimal.
Explain with examples how to convert hexadecimal into binary then to denary.
Define the term overflow error.
Explain with examples, how to perform binary shifts.
What are the benefits of using the hexadecimal number system.
Explain the process of sampling.
Explain the factors that affect the size and quality of a digital sound file.
Define the term character set.
Explain the key differences between ASCII, extended ASCII and Unicode.
Explain how images are represented on a computer system using the terms colour depth and resolution.
Define the term metadata.

a) Convert the 8-bit binary number 10010011 into a denary number.

b) Convert the denary number 252 into an 8-bit binary number.

Add the binary numbers 00111001 and 01010110.

Complete a 3 place left shift on the binary number 00011010.

State an appropriate binary shift to divide a binary number by 4 and use it on 11010100.

Convert the hexadecimal number 37 into denary.

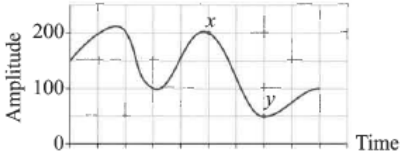
Convert the denary number 45 into hexadecimal.

1	1	0	0	1	0	1	1
1	0	0	1	0	1	1	1

(i) Identify the problem that this addition has created.

....

A three hour radio broadcast transmits an analogue signal. A digital recording of the broadcast is made by sampling different points of the analogue wave.



a) Complete the table below for point *x*.

	x	*y*
Denary Value		50
Binary Value		00110010
Hex Value		32

[3]

b) Explain how decreasing the sampling interval can affect the quality of the sound file.

....

....

[2]