3.1 Storage devices and media

- Identify storage devices, their associated media and their uses, e.g.
  - Magnetic backing storage media: fixed hard disks and drives, portable and removable hard disks, portable and removable hard drives, magnetic tape drives and magnetic tapes, memory cards
  - Optical backing storage media (CD/DVD/Blu-ray): CD ROM/DVD ROM, CD R/DVD R, CD RW/DVD RW, DVD RAM, Blu-ray discs
  - Solid state backing storage: solid state drives, flash drives (pen drive/memory stick/USB stick)

- Describe the advantages and disadvantages of the above devices
3.1 Storage devices and media

What is Storage

- **Secondary Storage** devices ensures data is stored *permanently* so that it can be used *again at a later date*.

- **Storage medium** is the name given to the device that actually *holds the data*.

- Sometimes the **storage medium** is *fixed* i.e. magnetic coated disks build into hard drive.

- Sometimes the **storage medium** is *removable* from the device i.e. CD ROM that can be taken out of the drive.

Think about what we store:
Documents, Images, Video, Music, Software, Games etc.
3.1 Storage devices and media

**Storage devices or files sizes** are measured in:
Kilobytes (KB), Megabytes (MB), Gigabytes (GB) and Terabytes (TB)

<table>
<thead>
<tr>
<th>1 KB</th>
<th>1000 Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>* 1000</td>
</tr>
<tr>
<td>1 MB</td>
<td>1000 KB</td>
</tr>
<tr>
<td></td>
<td>* 1000</td>
</tr>
<tr>
<td>1 GB</td>
<td>1000 MB</td>
</tr>
<tr>
<td></td>
<td>* 1000</td>
</tr>
<tr>
<td>1 TB</td>
<td>1000 GB</td>
</tr>
</tbody>
</table>
### 3.1 Storage devices and media

**Data Storage Capacity**

<table>
<thead>
<tr>
<th>Device</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy Disk</td>
<td>1.4MB</td>
</tr>
<tr>
<td>CD-ROM</td>
<td>700MB</td>
</tr>
<tr>
<td>DVD</td>
<td>4.7GB</td>
</tr>
<tr>
<td>Blu-Ray</td>
<td>25 GB – 128GB</td>
</tr>
<tr>
<td>Hard Drive</td>
<td>8 TB</td>
</tr>
<tr>
<td>Magnetic Tape</td>
<td>Up to 185 TB</td>
</tr>
</tbody>
</table>

Data storage devices have very different capacities. Over time the capacity has increased which has allowed for more data to be stored.

*Increase in storage capacity*
### 3.1 Storage devices and media

#### Type of Access

<table>
<thead>
<tr>
<th>Serial (sequential Access)</th>
<th>Direct (Random Access)</th>
</tr>
</thead>
</table>
| • Files are stored **one by one** in a sequence  
• Must search through the files one by one until you get to the one you want.  
• Example: VHS tape, Cassette Tape, Magnetic Tape | • Stores files so that they can **instantly** be accessed  
• No need to search through files to get to the one you want  
• Example: DVD, CD ROM, Blu-ray, external hard drive, flash drive |
### 3.1 Storage devices and media

#### Main Memory

- Sometimes known as Internal Memory or primary memory.
- Includes RAM and ROM
- Usually used to store data temporarily (in the case of RAM).
- Usually used to store data while it is being processed by the CPU.
- Is volatile – means data will be lost if computer is turned off.

#### Backing Storage

- Backing storage some known as secondary storage.
- Name for all other storage devices which are part of a computer like hard drive.
- Usually used to store data over a long time.
- Usually used to store application software, operating system software, files etc.
- Is Non-volatile - Means data will not be lost of computer is turned off.
### Magnetic Storage Devices

**Use:** Main backing storage device used by all computers to store:
- Operating Systems & System Files
- Applications
- Files (Documents, Images, videos, audio etc.)

**Access Type:** Direct (Random Access)

<table>
<thead>
<tr>
<th>Advantages:</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Less likely to break as fixed.</td>
<td>• More moving parts compared to solid state drives.</td>
</tr>
<tr>
<td>• High storage capacities compared to external drives.</td>
<td>• Incorrect shut down procedure could cause hard drive to malfunction.</td>
</tr>
<tr>
<td>• Fast data transfer rate.</td>
<td></td>
</tr>
</tbody>
</table>

- Magnetic storage media devices store data in the form of tiny magnetised dots.
- These dots are created, read and erased using magnetic fields created by very tiny electromagnets.
### Magnetic Storage Devices

**Use:**
This device connects to the computer using the USB Port. External Hard drives are used to store:
- Personal backup data.
- Transfer files between computers/devices

**Access Type: Direct (Random Access)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| • Portable – transfer files between computers.  
  • High Storage capacity compared to optical disks. | • More prone to errors than fixed hard drive.  
  • Could be damaged if incorrectly ejected from computer. |

- Magnetic storage media devices store data in the form of tiny magnetised dots.
- These dots are created, read and erased using magnetic fields created by very tiny electromagnets.
3.1 Storage devices and media

### Magnetic Storage Devices

**Use:**
- Large organisations make daily backups of their networks on to Magnetic Tapes
- Long-term archiving of data.

<table>
<thead>
<tr>
<th>Access Type: Serial</th>
<th>Advantages:</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Huge storage capacity compared to fixed and portable hard drives.</td>
<td>• Slower Access Tape reader has to start at the beginning of the tape and continue <strong>fast forwarding</strong> until it gets to the piece of data that needed.</td>
</tr>
<tr>
<td></td>
<td>• Stored away in a fire proof safe.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Robust – last for long time</td>
<td></td>
</tr>
</tbody>
</table>

- Magnetic storage media devices store data in the form of **tiny magnetised dots**.
- These dots are created, read and erased using magnetic fields created by very tiny electromagnets.
Optical Media

**Use:** CD-ROM disks are read-only. CD-ROMs are normally used to store:
- Audio CDs
- Software Applications
- Device Drivers

**Access Type:** Direct

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hold more data than floppy disks.</td>
<td>• Data transfer rate is slower compared to other storage medium.</td>
</tr>
<tr>
<td>• Cheaper than hard drives and USBs.</td>
<td>• Not Robust - easily be damaged or scratched.</td>
</tr>
<tr>
<td>• Compatible with audio systems.</td>
<td></td>
</tr>
</tbody>
</table>

- Optical storage devices save data as patterns or dots.
- Data is read by bouncing the laser beam off the surface off the medium.
3.1 Storage devices and media

Optical Media

**Use:** DVD-ROMs disks are read-only. DVD-ROMs are normally used to store:
- DVD Movies
- Software Applications
- Computer Games

**Access Type: Direct**

<table>
<thead>
<tr>
<th>Advantages:</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold more data than CD-ROMS.</td>
<td></td>
</tr>
<tr>
<td>Can store larger applications.</td>
<td></td>
</tr>
<tr>
<td>Videos is higher resolutions.</td>
<td></td>
</tr>
</tbody>
</table>

- Data transfer rate is slower compared to other storage medium.
- Have to buy a separate DVD player.

- Optical storage devices save data as patterns or dots.
- Data is read by bouncing the laser beam off the surface off the medium.
3.1 Storage devices and media

Optical Media

**Use:** Blu-Ray disks uses a blue laser instead of red laser used with CD/DVD ROMs. Blu-Ray disks are normally used to stored:
- HD Movies
- Large Software/Game Applications
- In camcorders in cartridge form.

**Access Type: Direct**

<table>
<thead>
<tr>
<th>Advantages:</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Large storage capacity used to store HD video content.</td>
<td>• More expensive compared to other optical media.</td>
</tr>
<tr>
<td>• Access Speeds are greater than other optical medium.</td>
<td>• Separate player required – more expensive.</td>
</tr>
<tr>
<td>• Secure Encryption System to minimise chance of copyright.</td>
<td>• Not all movie titles available on Blu-Ray.</td>
</tr>
</tbody>
</table>

- Optical storage devices save data as patterns or dots.
- Data is read by bouncing the laser beam off the surface off the medium.
### 3.1 Storage devices and media

#### Optical Media

<table>
<thead>
<tr>
<th>CD-R and DVD-R</th>
<th>CD-RW and DVD-RW</th>
<th>DVD RAM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| CD-R and DVD-R are only **recordable once**. Once the process has been **finalised** then the disks become **Read Only**.  
- Backup of data  
- Audio CDS | CD-RW and DVD-RW allows for data to be written, erased and rewritten **many times**.  
- Used in CCTV  
- Record television programs | **DVD RAMS are used when data constantly needs to be re-written.** DVD RAMS can hold up to 10GB of data and commonly used in recording equipment. |
| **Advantages** | **Can be reused many times.** | **Long life, large capacity, and can be rewritten many times.** |
| **Disadvantages** | **Can be expensive.**  
- Data could be overwritten. | **Not compatible with all playback formats. Can be expensive.** |

**R** – Write once only  
**RW** – Can be written to or read many times.
Describe the differences between DVD-R, DVD-RW, DVD RAM and DVD ROM?

Key Words: Read only, Recordable once, Re-writable, Constantly re-written, capacity, recording equipment.

Exam Question

DVD-R are only recordable once. Once the process has been finalised then the disks become Read Only. DVD-RW allows for data to be written, erased and rewritten many times. DVD-ROM are Read Only and typically contain software, movies and games. DVD RAMs are used when data constantly needs to be re-written. DVD RAMS can hold up to 10GB of data (higher capacity) and commonly used in recording equipment. DVD RAM will typically last longer than the DVD-R, DVD-RW and the DVD-ROM as it is more durable. However it will be more expensive.
Compare and contrast the use of optical discs and the use of fixed magnetic disks to store data.

Exam Question

Optical discs such as CDs, DVDs, and Blu-ray discs are read from and written to using a laser beam. Magnetic disks are read from and written to using read/write heads. Both have direct access, however, more time would be taken to write to an optical disc compared to a magnetic disc due to slower access and transfer rates. Optical discs are more portable and cheaper to buy. However, they are more prone to damage as they can easily be scratched or broken. Magnetic disks, however, have a higher capacity to store more information. Optical discs are used to store videos, music, software, in contrasts magnetic disks store installed applications, system and user files.
### 3.1 Storage devices and media

#### Solid ‘state’

- **Solid-state storage devices** are based on electronic circuits with **no moving parts**.
- **Solid-state storage devices** store data using a special **type of memory called flash memory**.
- **USB/Memory Cards use Direct Access**

#### Examples

<table>
<thead>
<tr>
<th>Uses:</th>
<th>USB Memory Stick</th>
<th>Memory Card</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Used to transfer files/backup (work) between computers.</td>
<td>Used to store files on digital cameras, mobile phones and mp3 players.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advantages</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Portable &amp; Small</td>
<td>• Very small and can be removed and placed in other devices.</td>
</tr>
<tr>
<td></td>
<td>• Robust</td>
<td>• Robust</td>
</tr>
<tr>
<td></td>
<td>• large capacities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No need for additional drivers/software</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disadvantages</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Easy to loose</td>
<td>• Smaller storage capacities.</td>
</tr>
<tr>
<td></td>
<td>• USB could be damaged if not ejected correctly.</td>
<td>• Quite expensive.</td>
</tr>
</tbody>
</table>
A fixed hard drive is the primary storage device found in a computer system. Application and system software will be installed on to the fixed hard disk. It is less prone to damage because it is fixed into the computer whereas the portable hard drive and the USB drive could be damaged when ejecting. In addition the fixed hard drive will have a higher capacity compared to the portable and USB storage. Files can be easily transferred between computers when using a portable hard drive and a USB drive. However the USB drive will be more portable than the portable hard drive. Both the portable and the USB drive is use to back up files however the portable hard drive will be used to typically back up larger files.
Discuss why you use a USB to backup data compared to optical disks?
Key Words: larger capacity, more portable, more robust, accessibility to USB ports

A USB drive is more suitable to backup data compared an optical disk because it tends to have a **higher storage capacity**. In addition it is **much quicker to copy files** to a USB Drive rather than burning files onto an optical disk. Furthermore the USB drive is **more portable** and **robust**. Finally not all computers would have an optical disk drive however many have **accessibility** to USB ports.

Discuss the advantages and disadvantages of solid state storage devices?
**Key Words:** portable, smaller, expensive, robust, capacity, lost, damage

Solid state devices do not having any moving parts and can be referred to as flash memory. A **USB drive or memory cards** are examples of solid state storage devices. They are **typically smaller** and very **portable**. They are quite **expensive** to buy and can be easily lost or damaged if not correctly ejected from the computer. The devices are available in different **capacity** and are **more robust** compared to optical disks.
Backup means making one or more copies of your data in a different storage medium.

Why?

• You could delete a file by accident
• Your computer could break down
• Your computer could get infected by a virus which could edit data
• Your laptop is stolen or becomes damaged.
• Data could be corrupted by hackers.

• Most businesses use computers to store very important data (customer records, financial information, designs for products, etc.)

• If this data is lost, then this would cause disruption to the business. Backing-up business data is essential.
3.1 Storage devices and media

How are Backups created

Personal Backups:
• Burning files to a CD-R
• Copying files to an external hard-drive
• Copying files to a USB
• Copying the files to another computer on a network

Business Backups:
• Making copies of data very regularly (daily).
• Using large-capacity media such as magnetic tape
• Keeping old copies of backups, just in case.
• Automating the system so that nobody forgets to do it!
• Keeping backup media off-site (in case of fire or theft)
3.1 Storage devices and media

Describe what is meant by backup?
Key Words: File, Copy, Storage medium

Backup means making one or more copies of your data/file in a different storage medium.

Discuss why you would have to make a backup?
Key Words: File, Delete, Corrupted, edited, stolen, encrypted, breakdown

The reason for making a backup is that you could delete a file by accident. Also the computer may breakdown which would mean you would lose all of your files. In addition if your computer is infected by a virus then the data could be edited, corrupted or encrypted. Furthermore your laptop could also be stolen or damaged which would result in losing your original files.