NOTES

Storage devices are designed to hold your data on a permanent or semi-permanent basis. They are non-volatile, which means that even when the computer is switched off, the data will still be safe.

Storage devices are sometimes referred to as **secondary storage**.

MAGNETIC TAPES

- Thin ribbon of plastic;
- Tape is coated on one side with a material that can be magnetised to record the bit patterns that represent data

Tape reels - these are fairly large and are usually used to back up data from mainframe computers.
Cassettes or cartridges - these are fairly small in size but able to hold enough data to back up the data held on a personal computer or a small network.

A magnetic tape cartridge	A magnetic tape reel
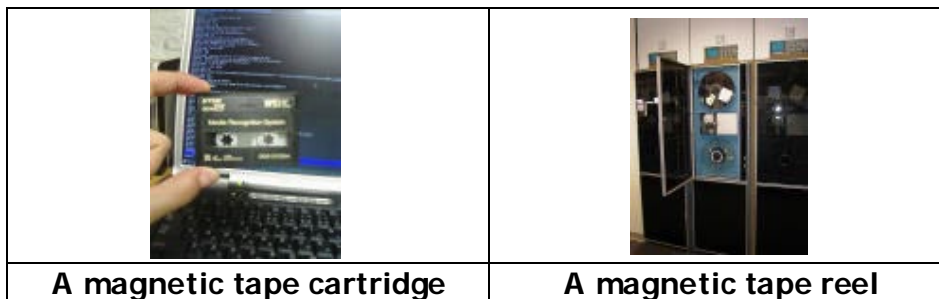
Because it takes a long time to back up onto magnetic tape, it is usually done at night or over a weekend when the computer network is not in heavy use.

Main advantages
- Relatively cheap
- Can hold in excess of 20GB of data (it is possible to get devices that will back up over 800 GB of data)
- Backup capacity is easily expanded by simply using more tape.

Main disadvantages
- **Serial access** - this means that in order to get to something on the tape, you have to go through everything that comes before it. Think of it like a video tape. The program that you want to watch might have been recorded half way through the tape, but you have to wind forward right from the start to get to it.
- **Slow** - Because of serial access, it is relatively slow to find the data that you need (however in an exam question, don't just say 'slow', compare it to a storage device with faster access.
- **Specialist hardware** is needed to read the tapes. Most standard PCs do not come with the hardware required to use them.
- **Not suitable for heavy use** - As you may realise from video tapes at home - they are a bit fragile with a tendency to stretch and tangle! Tape is best suited for back-up purposes.
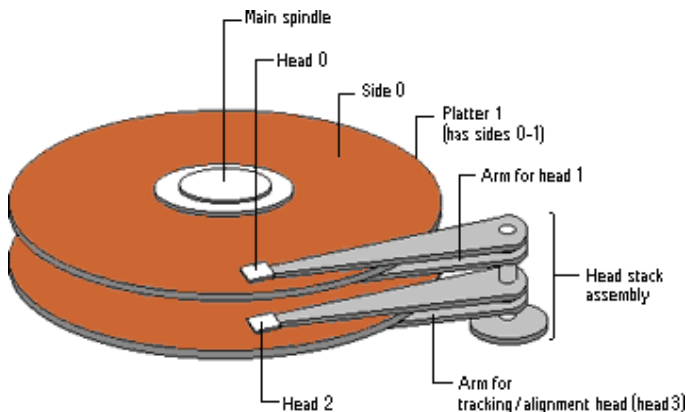
HARD DISK

The hard disk is the main storage device within a computer. It is where all the applications software and data is kept.

A hard disk spins around thousands of times per minute inside its metal casing, which is why it makes that whirring noise. Far less than a hairs breadth above the disk, a magnetic head creates the 1 and 0s on to the circular tracks beneath.

Most hard drives are installed out of the way inside the computer, however you can also purchase external drives that plug into the machine.

Modern hard drives are measured in gigabytes (GB). The most expensive computers will have the largest hard drives. Standard systems come with hard drives between 80Gb and 250Gb

It is also possible to add more than one hard disk inside a computer. In fact this is an excellent idea if you wish to back up your data whilst you work - the main disk holds your data whilst the second disk 'mirrors' it in the background. In that way when one of the disks fails the other is keeping your data safe.

There are two types of hard disks (standards):

IDE (Integrated Device Electronics)

- Standard interface in PC's
- More common than SCSI
- Cheaper and slower than SCSI

IDE is by far the most common standard, because it is 'good enough' for most purposes. However, if you wish for high speed and a more robust / reliable system then SCSI offers an alternative.

SCSI (Small Computer Systems Interface)

- Faster - high speed of transfer than IDE
- More reliable than IDE
- Specialist card required
- More expensive than IDE.

CD-ROM stands for **c**ompact **d**isk **r**ead **o**nly **m**emory.

These disks have been pre-recorded with data, cannot be over written.
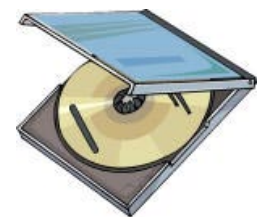
A CD is a fairly simple piece of plastic, about four one-hundredths (4/100) of an inch (1.2 mm) thick. Most of a CD consists of an **injection-molded piece of clear polycarbonate plastic**. During manufacturing, this plastic is impressed with microscopic bumps arranged as a single, continuous, extremely long spiral track of data.

Once the clear piece of polycarbonate is formed, a thin, reflective aluminum layer is sputtered onto the disc, covering the bumps. Then a thin acrylic layer is sprayed over the aluminum to protect it. The label is then printed onto the acrylic. A cross section of a complete CD (not to scale) looks like this:
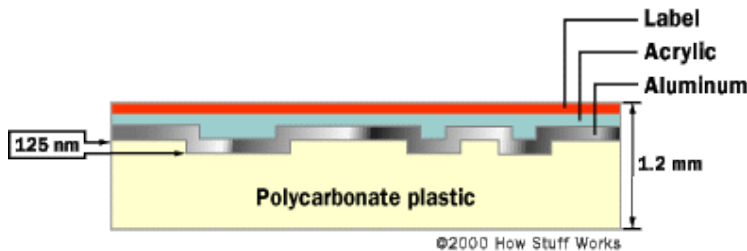
The data is written on the disk using disc-mastering machinery that impresses pits into a continuous spiral track:
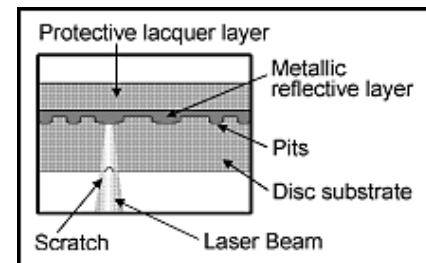
CD-R

These disks are blank but have been designed to be written onto **once only.** The **'cd-writer'** drive uses a laser to burn tiny pits onto the spinning surface of the CD-R media. Each pit represents a '1' data bit. Once the pit is burnt it cannot be erased.

Sometimes your CD Burning software may allow you to burn a 'multi-session' disk. All this is doing is treating the CD-R as a number of smaller areas or 'sessions'. Each time you start a new session, the drive simply moves to another blank part of the disk.

CD-RW

This technology allows the same area of the disk to be over-written many times (about a 1000 times).

-   To write data the player uses the magnet and the laser; the **laser** heats a precise spot on the disk to a temperature of 200°C. The magnet is then used to set the state of the data bit at this spot.
-   To read data the player uses only the laser.

This is why they are known as **optical storage devices**. A laser beam also reads the information from the disk. The same technique is used for CD music disks, which is why many computers with CD-ROM drives can play audio CDs.

DVD-ROM. Digital Versatile Disk can store between 5-17 gigabytes of data.

This is because the length of every pit is less than half compared to a CD and the data track spiral spacing is only 0.74µm vs 1.6µm.

To read the smaller pits DVD drives use a laser with a shorter wavelength.

DVD-R

Similar format to the CD-R, except that the data layer of read-only polycarbonate is replaced with an organic dye.

The DVD-R drives record data by burning spots in the dye to alter the amount of reflected laser light. This new technology is only just becoming affordable to the general public.

DVD-RW

Commonly used for backing up data. It is increasingly common to have a DVD re-writer drive in a new personal computer. There are also stand-alone DVD-RW units that allow you record television programs directly onto disk.

The recording layer is a special phase-change metal alloy. By adjusting the power of the laser beam, the alloy can be switched back and forth between a crystalline phase and an amorphous phase.

Flash memory

Sometimes it is called a 'memory stick', USB memory, Key Memory and others.

What it does is to combine a well tried memory technology called 'Flash' with the convenience of the USB connector.

Flash is a **'solid state'** memory i.e it has no moving parts unlike magnetic storage devices, nor does it make use of lasers - unlike optical drives.

Instead, it works in a similar way to RAM. The key difference is that data is retained in Flash memory even when the power is switched off.

A flash drive consists of a small printed circuit board typically in a plastic or metal casing. Most use a typical USB connection allowing them to connect directly to a port on a PC.

Typical sizes range from 32Mbytes up to 512Mbyte and beyond.

Storage medium	Capacity	Transfer speed	Access time (ms)
Magnetic hard disk	40GB to 1.4TB	5-110 MB/s	Under 10
Magnetic floppy disk	Up to 1.44 MB	250-500 Kbit/s	94

Magnetic tape cartridge or cassette	10-800 GB	200 KB/s to 20 MB/s	Long
CD-ROM, CD-R, CD-RW	600-700 MB	Up to 7Mb/s	~100
DVD-ROM, DVD-R, DVD±RW, DVD-RAM	2.8 – 17.1 GB	Up to 22Mb/s	~100
Blu-ray	25-50 GB	Up to 288Mb/s	110
HD DVD	15-51 GB	36 Mb/s	500
USB flash drive	Up to 5GB	Up to 60MB/s	0.8-10

Storage medium	Application
Magnetic hard disk	Online storage of programs and data files
Magnetic floppy disk	Backup and transfer small files; boot disk for an operating system.
Magnetic tape	Backup and archive large volumes of data
CD-ROM	Distributing software
CD-R	Transfer files, distribute software, store photographs, backup / archive data
CD-RW	Backup data, transfer files
DVD-ROM	Distribute software or videos
DVD-R	Transfer files, distribute software/videos, store photographs, backup / archive data
DVD±RW	Backup data, transfer files
DVD-RAM	Backup data
Blu-ray	Distribute videos
HD DVD	Recording high-density videos
USB flash drive	Transfer files, running applications.