GCSE OCR

Computer Science
J277

4

Secondary storage

Unit 1
Systems architecture

PG ONLINE

Objectives

- Discuss the need for secondary storage including optical, magnetic and solid state storage
- Evaluate suitable storage devices and media for a given application using the following characteristics:
  - Capacity
  - Speed
  - Portability
  - Durability
  - Reliability
  - Cost

Starter

- RAM is a type of primary storage
  - It has a fast data rate but is volatile (the data is lost if there is no power)
  - What storage devices are used that are non-volatile?

Secondary storage

- Secondary storage is not directly accessible by the CPU
  - It is non-volatile, meaning it will keep data even if there is no power
  - Secondary storage devices may be internal or external to the computer
- What is secondary storage used for?

Uses of secondary storage

Answers

- It has many different uses – for example:
  - Programs and data are stored on hard drive
  - Blu-rays may be used to distribute films
  - Memory sticks may be used to transport data from one place to another
  - Magnetic tape or external hard drives may be used for backup
  - SD cards can be used for additional storage on cameras and smartphones – this is used for music, video and photos

Storage types

- Primary storage
  - RAM and ROM
- Secondary storage
  - Hard Disk Drive (HDD)
  - Solid State Drive (SSD)
- Offline secondary storage
  - Compact Disc (CD), Digital Versatile Disc (DVD) or BluRay
  - Flash memory, SD cards
  - Removable HDD or SSD
  - Magnetic tape

Storage methods

- Magnetic: Mechanical parts move over the disks surface to read and write data magnetically, or a drive head reads a magnetic tape
- Optical: Lasers read and write data using light
- Solid State: Data is recorded onto solid memory chips without any moving parts

Worksheet 4

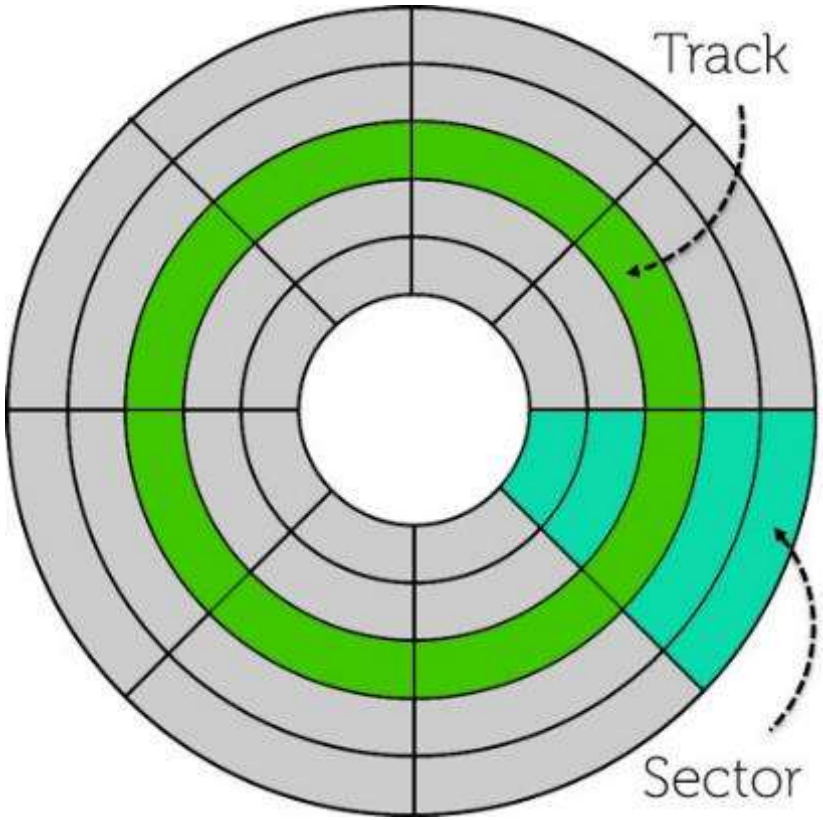
- Complete **Task 1** on **Worksheet 4**

Magnetic disks

Basic features:

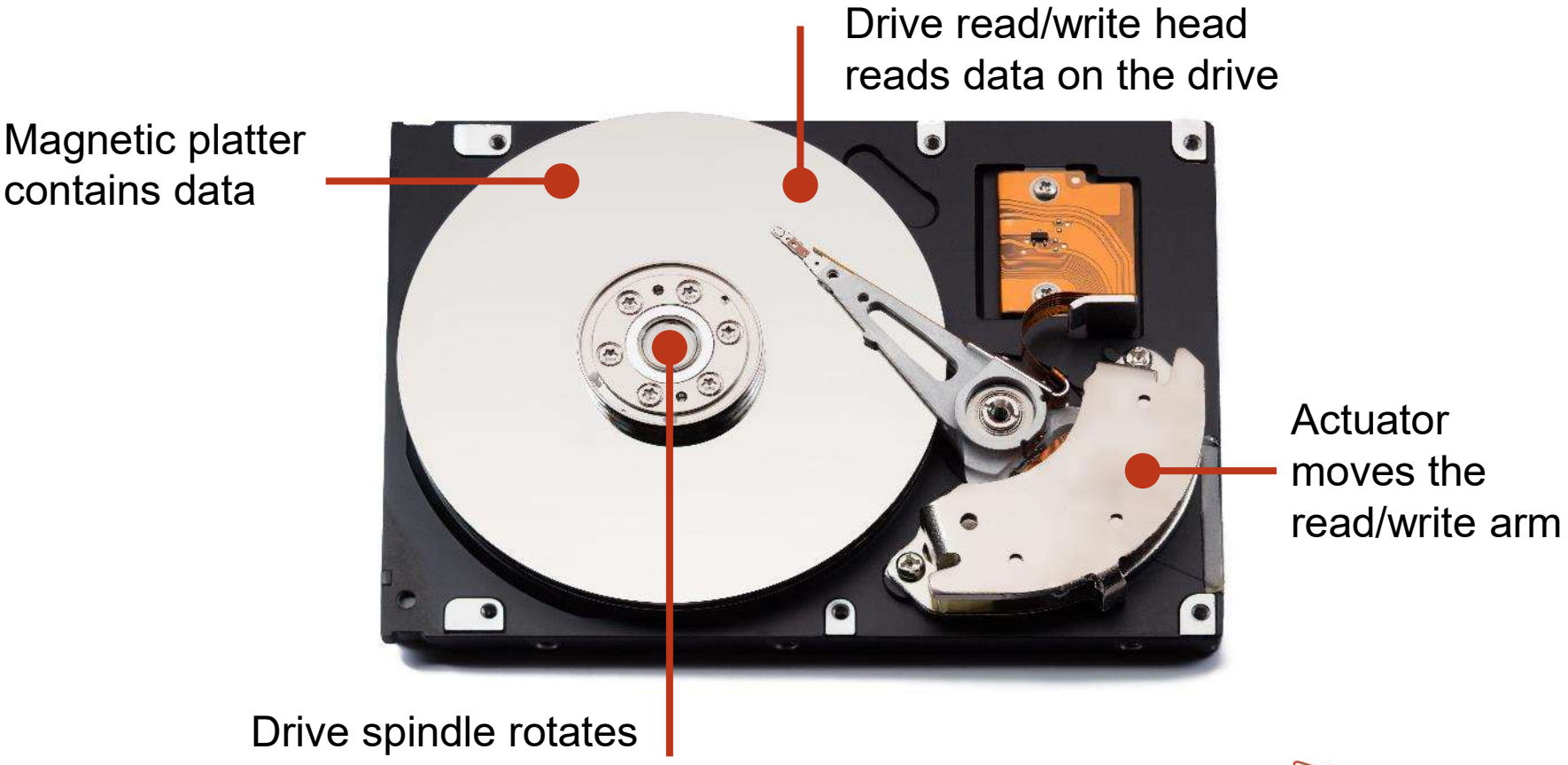
- Disk contains concentric circles called tracks
- Each track is divided into sectors
- Disk heads mounted on mechanical arms read and write the data

- A disk with a solid platter is a ‘hard’ disk
  - Soft plastic disks are known as ‘floppy’ disks



Hard disks

- Parts of a hard disk



Magnetic storage: hard disks

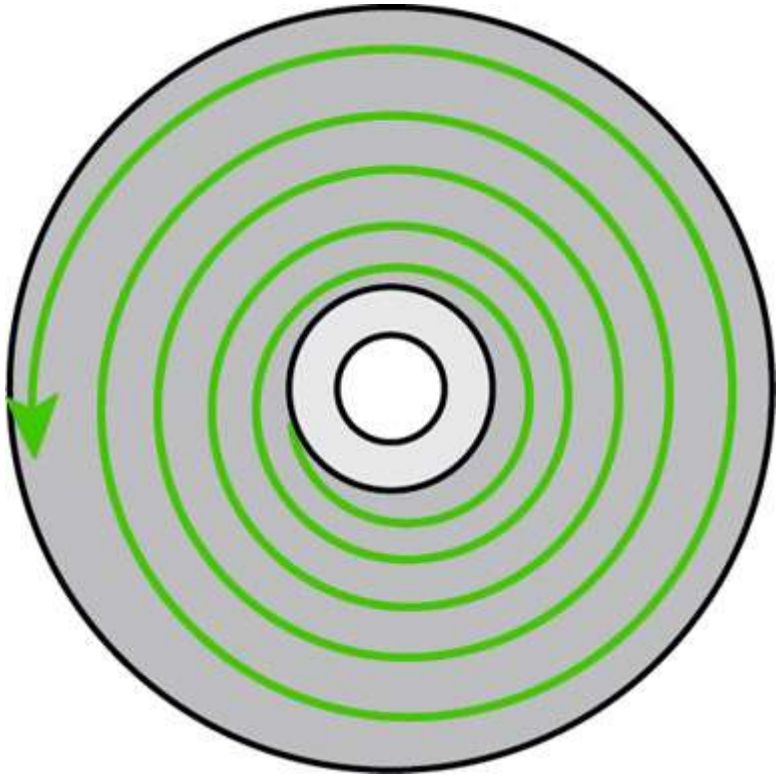
- Fixed magnetic hard disks are still used in many PCs and laptops
  - They have a very large storage capacity, up to 6TB or more
  - They are a very cheap form of storage compared to solid state drives
- Portable hard disks can be connected to a computer via a USB port
  - They are used for backing up or transporting data

Magnetic storage

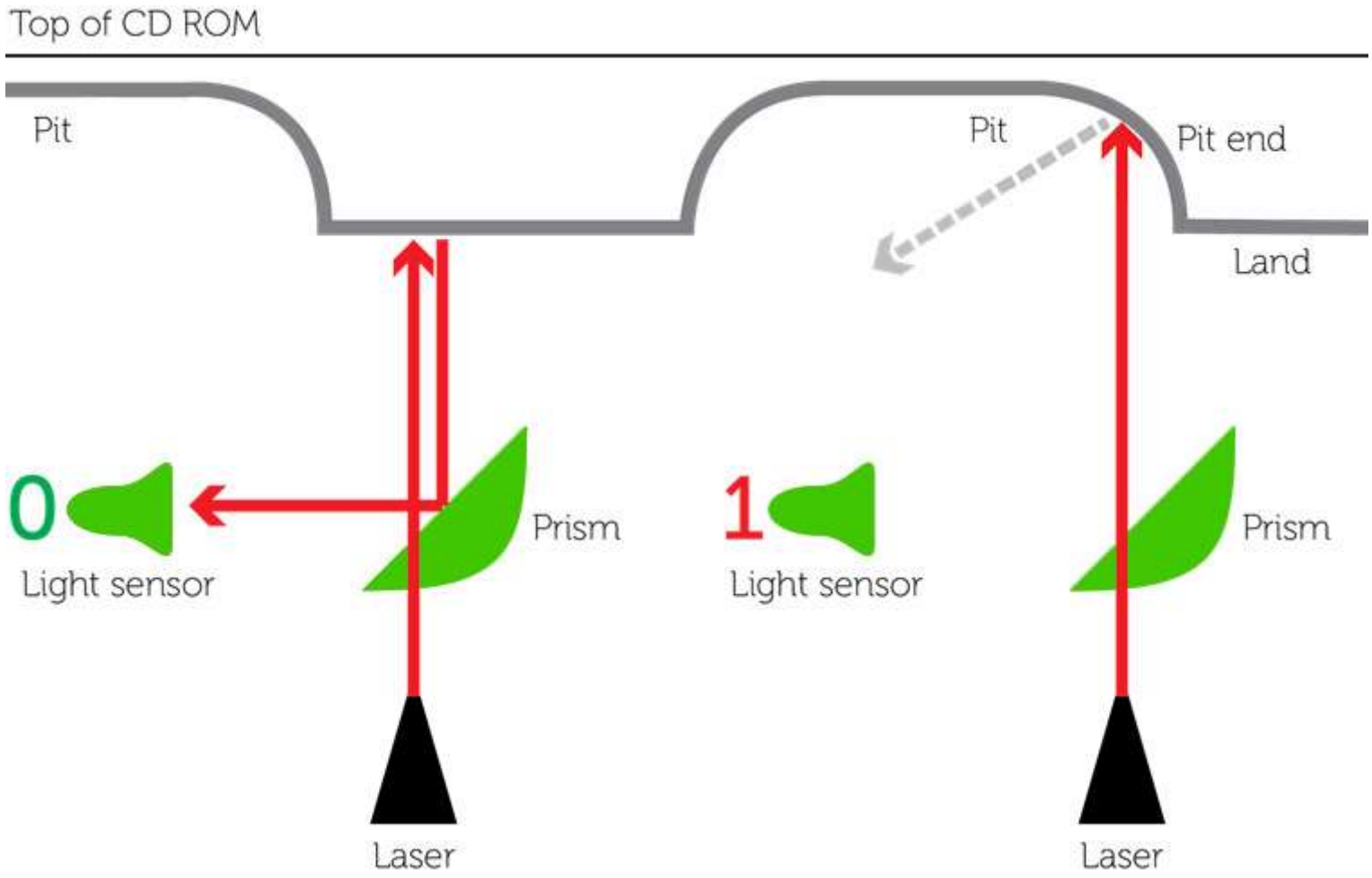
- Advantages:
  - Cheap, large storage capacities, relatively fast write speed
- Disadvantages:
  - Lots of mechanical parts, durability an issue, sealed unit due to disk head and platter precision and not very portable
- Uses:
  - Personal computers, storage of large quantities of data
- Capacity:
  - 500GB - 12TB or greater

Optical storage

- Basic features:
  - Data is stored as pits and lands burnt or pressed into a spiral track circulating outwards from the centre
  - A laser beam passes over the pits and lands the level of reflection is measured
  - From this signal, 0s and 1s can be derived



How CDs work

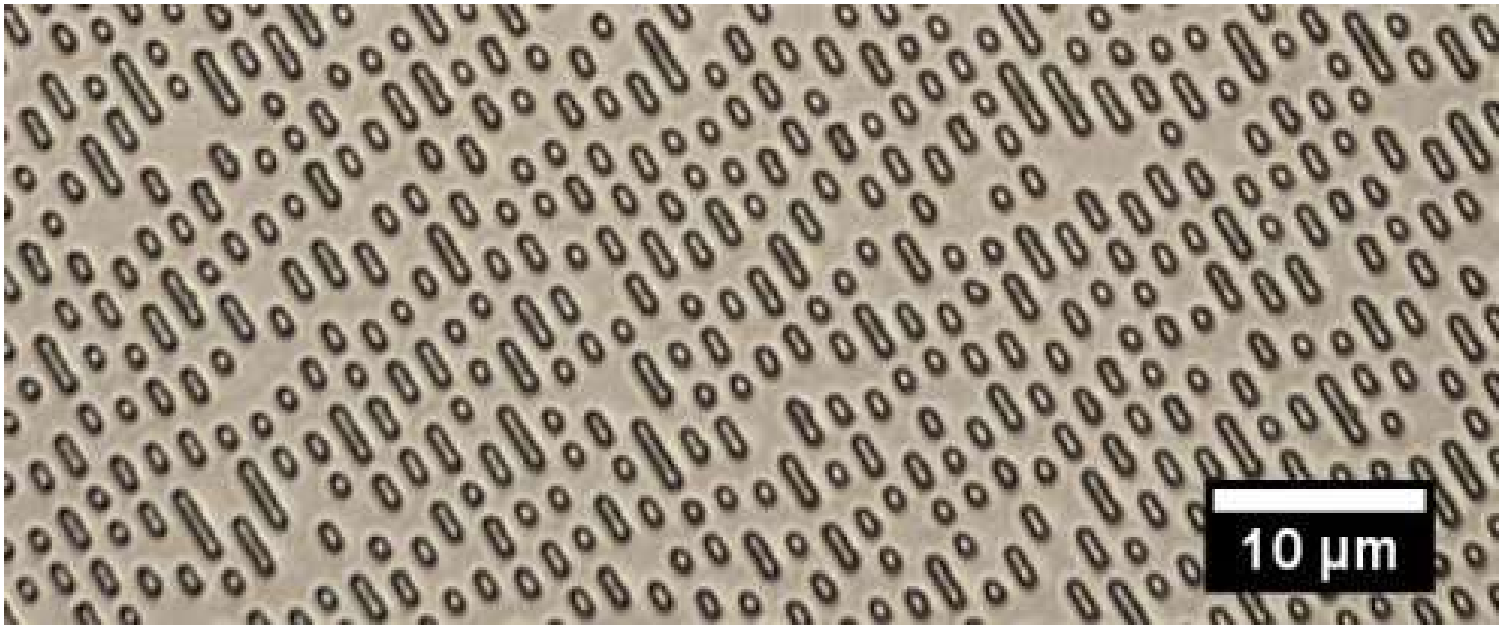

Top of CD ROM
Pit
Pit
Pit end
Land
0
Light sensor
Prism
Laser
1
Light sensor
Prism
Laser

Optical storage

- Advantages:
  - Cheap, very easily portable, takes up little space physically
- Disadvantages:
  - Less storage capacity compared to other types
  - Easily damaged / scratched, requires a CD reader
  - Slow write speeds
- Uses:
  - Songs, videos and other multi-media storage, backup and archiving of data
- Capacity:
  - CD-ROM – up to 720 MB
  - DVD – up to 8.4 GB (dual layered disk)
  - Blu-Ray – up to 50 GB (dual layered disk)

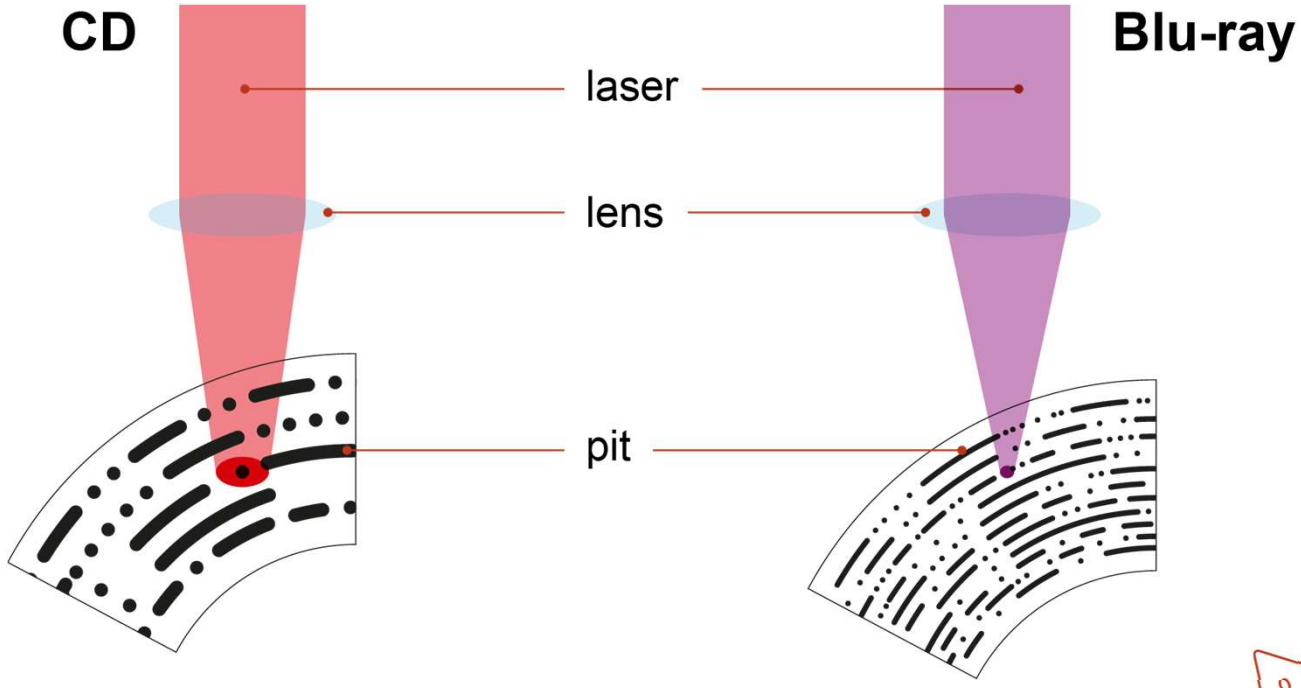
CDs, DVDs and BluRay

- Why are the capacities of these discs different given they are all the same physical size?
  - Microscopic view of the surface of a CD ROM



Pit size and laser wavelength

- A CD has bigger pits and lands as red light has a larger wavelength
  - The smaller Blu-ray pits and lands allow it to store more data

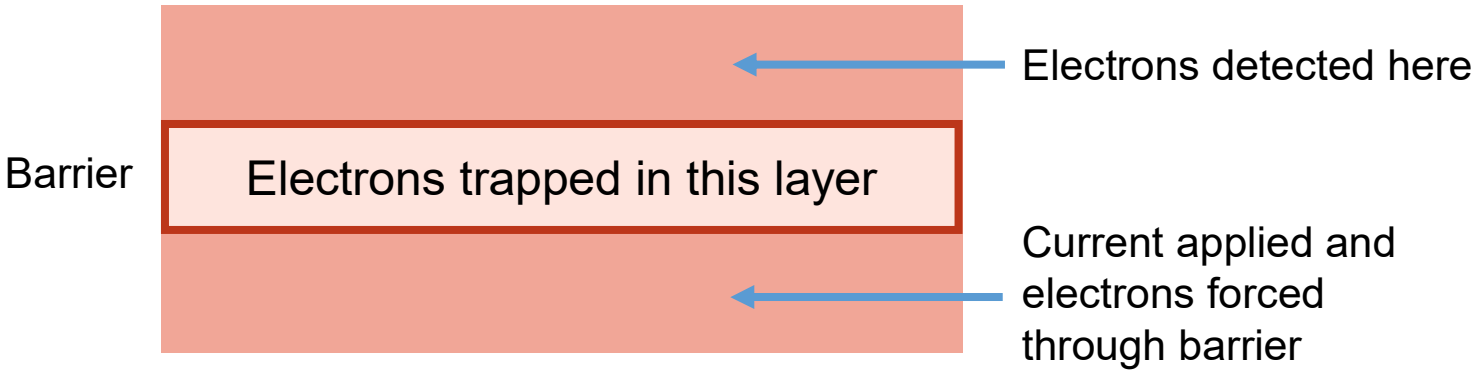


Solid State Drives (SSD)

- Basic features:
  - Solid-state disks use non-volatile flash memory to store information
  - Very fast read/write speeds as it doesn't need to wait for a disk to spin to the correct location and an arm to move
  - No mechanical or moving parts meaning these disks are very durable

How flash memory works

- Large electric current used to force electrons through a barrier and trap them on the other side



- They remain on the other side until ‘flashed’ with a new current, hence the name
  - Trapped (charged) or not trapped = 0 or 1

Advantages /disadvantages of SSDs

- Advantages:
  - Highly durable, no moving parts, very fast read/write speeds, no noisy fan or drive arm, faster start up times
- Disadvantages:
  - More expensive than magnetic hard disks, similar storage capacity as magnetic disks
- Uses:
  - Higher end computers
  - Laptops
  - Smartphones and tablets
- Capacity:
  - 100GB – 16TB

Flash memory

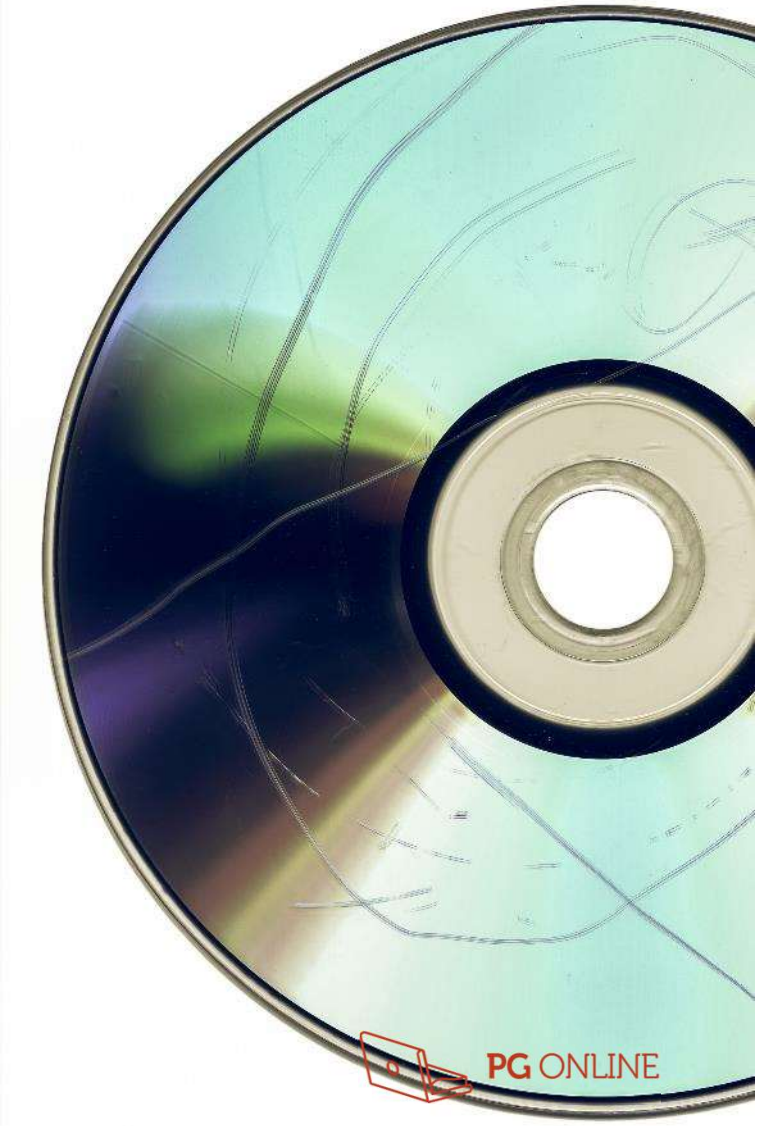
- Low cost, portable, no moving parts, durable
- This makes them ideal for a range of offline devices:
  - Cameras
  - Mobile phones
  - USB memory sticks

Worksheet 4

- Complete **Task 2** and **Task 3** on **Worksheet 4**

Other storage characteristics

- Storage devices have different characteristics that determine if they are a suitable choice
- What do each of the following characteristics mean?
  - Capacity
  - Speed
  - Portability
  - Durability
  - Reliability
  - Cost



Storage characteristics

Answers

- Characteristics of storage devices
  - **Capacity**: How much data can be stored – e.g. 700 MB, 50 GB or 2 TB
  - **Speed**: The rate (usually in MB/s) at which data can be read or written
  - **Portability**: how easy it is to carry – is the device small?
  - **Durability**: will the device break if dropped? How well does it work with extreme temperatures or magnetic fields?
  - **Reliability**: how likely is the data (or some of it) to be lost?
  - **Cost**: what is the cost of a device? How much is it to store 1 MB of data

Data capacity

- Different storage devices have a range of storage capabilities
- A higher capacity will allow greater data storage
  - How do you decide which storage device to use?
  - How do you calculate storage requirements?

Data capacity

- When you know how much data you need to store, you can decide which storage device(s) would be most appropriate
  - If you have 300GB of data to store, is optical storage appropriate?
  - If not, why not? What could you use instead?
  - Why is this particular device appropriate?

Calculating data capacity

- Knowing the capacity required will enable us to make an informed decision as to which device to use
- If we wish to store 5000 photos and each photo has a file size of 10 MB, we need a total of 50 GB
  - Which storage devices are suitable for this amount of data?
  - Which storage device would be suitable for storing this data on a smartphone?

Worksheet 4

- Complete **Task 4** on **Worksheet 4**

Plenary

- In pairs, give answers to the following:
  - 5 examples of storage devices
  - 4 other characteristics of storage devices other than cost
  - 3 technologies that storage devices use
  - 2 words that describe data that is or isn't lost when power is turned off
  - 1 word that means 1000 Gigabytes

Plenary

Answers

- Examples of storage devices:
  - Hard disk drive, floppy disk drive, tape drive, CD drive, DVD drive, Blu-ray drive, USB flash drive, SSD drive, SD card
- Characteristics of storage devices:
  - Capacity, speed, portability, durability, reliability (and cost)
- Technologies used in storage devices:
  - Magnetic, optical, solid state
- Volatile – data is lost; non-volatile – data is not lost
- 1 Terabyte (TB) = 1000 Gigabytes

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