

# Computer Hardware

## Building a Computer



By the end of this unit I should be able to...

- 1) describe different methods of purchasing a computer
- 2) interpret information in various hardware specifications
- 3) make informed choices when selecting hardware components
- 4) purchase compatible components required to build a complete computer system.

### Three Ways to Buy a Desktop Computer System

There are several ways to purchase the computer of your dreams. The method you select will be determined by your knowledge, time and budget.

Before we look at different purchasing methods, let's first define what is meant by "Desktop Computer System". A basic computer system comprises the following hardware and software.

Base Unit



Monitor



Keyboard & Mouse



Operating System



Applications



#### Task 1: The changing face of computer systems

For many years consumers had a choice of two types of computer systems, desktop and laptop, when purchasing a home computer.

Search for company on the Internet that sells computer systems. Using this retailer's website, search for different categories (types) of computer system that can be purchased. Type a report that...

- names at least three new categories of computer system
- indicates a price range (cheap model to expensive model) for each category
- includes a sample image of each category of computer system.

Add your name in a footer and submit your report to your teacher.

## Method 1: Off the Shelf

The majority of home computer users and businesses will buy a computer system as a single purchase. This type of purchase will state exactly what comes as part of the package (specification). The purchaser has no opportunity to make changes to this list, with one exception.

A monitor is often selected separately.



### Desktop PC Package (specification)

- Genuine Windows 7 Home Premium (64-bit) for superior digital entertainment
- Intel® Celeron® G540T processor for outstanding performance
- 4GB memory for top system performance & running multiple applications
- 500GB hard drive for storing all of your digital files
- Intel HD Graphics
- USB Keyboard and Mouse
- DVD writer SATA DVD RAM
- 21" Widescreen Monitor

## Method 2: Off the Shelf but with Modifications

Increasingly, retailers (particularly on-line sellers) are offering customers the opportunity to adjust the specification of their purchase.

Note that the advert has a "Starting Price" of £1049. The customers can then choose upgrades to the basic system.

**Alienware Aurora Desktop**  
 ★★★★★ (65 Reviews)  
 Alienware's most powerful MicroATX desktop. Aurora™ delivers strategic component layout, maximizing internal cooling and upgradeability for high performance. Complete with 1 Year Next Day In-Home Service & Premium Phone Support as standard.  
 Starting Price £1,449  
 Instant Savings £100  
 Prices from £1,049

### Select: PROCESSOR

Help me choose

- Intel® Core™ i7-3820 (Four Core, 10MB Cache 3.60GHz) [Included in Price]
- Intel® Core™ i7-3930K (Six Core, 12MB Cache Overclocked up to 3.9Ghz) [add £450.00 or £23/month<sup>1</sup>]
- Intel® Core™ i7-3930K (Six Core, 12MB Cache Overclocked up to 4.1Ghz) [add £550.00 or £28/month<sup>1</sup>]
- Intel® Core™ i7-3960X (Six Core Extreme, 15MB Cache Overclocked up to 4.0Ghz) [add £800.00 or £40/month<sup>1</sup>]
- Intel® Core™ i7-3960X (Six Core Extreme, 15MB Cache Overclocked up to 4.2Ghz) [add £890.00 or £45/month<sup>1</sup>]

### Select: GRAPHICS CARD

Help me choose

- The video card handles all graphics processing for your computer. Increased video memory delivers more detailed graphics, sharper images and smoother video.
- Single Video Card**
    - 1GB GDDR5 NVIDIA® GeForce® GTX 555 [Included in Price]
    - 2GB GDDR5 NVIDIA® GTX 680 [add £360.00 or £18/month<sup>1</sup>]
  - Dual Video Card**
    - Dual 1GB GDDR5 NVIDIA® GeForce® GTX 555 SLI™ [add £200.00 or £10/month<sup>1</sup>]
    - Dual 2GB GDDR5 NVIDIA® GTX 680 SLI™ [add £750.00 or £38/month<sup>1</sup>]

### Select: HARD DRIVE

Help me choose

Learn More about Hard Drives

- Single Hard Drive**
  - 1TB SATA 6Gb/s (7200RPM) 32MB Cache [Included in Price]
  - 2TB SATA 6Gb/s (7200RPM) 32MB Cache [add £80.00 or £4/month<sup>1</sup>]
  - 3TB SATA 6Gb/s 7,200rpm Hard Drive [add £240.00 or £12/month<sup>1</sup>]
  - 256GB 6Gb/s Solid State Drive [add £330.00 or £17/month<sup>1</sup>]
  - 512GB 6Gb/s Solid State Drive [add £880.00 or £44/month<sup>1</sup>]

Selecting the dearest option from the three upgrades shown would increase the price of the Desktop to £3,569.

## Task 2: Class competition to design the most expensive Dell Desktop PC

Open a new web page and use a search engine to search for "Dell UK".

Navigate to the computer systems for sale. Note that retailers constantly update the look of their sites to attract customers. The Dell pages you find will probably look different from the example shown below.



This task has three parts:

- Select a computer system to start with. Ensure that you have added it to your shopping basket.
- Adjust the options to upgrade your chosen computer system. Remember that you are trying to create the most expensive computer system.
- Look for an option that will allow you to obtain a printed summary of your choices.

**Print Summary**



**Aurora R4**  
 Price: £2,899.00  
 Total savings\*: £100.00  
**Total: £2,879.00**  
 Includes VAT & Shipping  
[View Finance Options](#)  
[Learn More](#)  
[Checkout Details](#)  
[Print Invoice Slip](#)  
 Date: 12/11/2012

**My Selections** | All Options

Aurora R4

Date	03/11/2012 13:48:53	Central Standard Time
Catalog Number	20211 Retail ukdhs 1	
Catalog Number / Description	Product Code	Qty SKU Id
<b>Base:</b> Alienware Aurora ALX Matte Black 875W Chassis	646398	1 [210-36734] 1
<b>Processor:</b> Intel® Core™ i7-3960X (3M Core Extreme, 19.5MB Cache Overclocked up to 4.2GHz)	650662	1 [213-14911] 146
<b>Microsoft® Operating System:</b> English Windows 8® 7. Ultimate (64-bit)	576515	1 [518-30594] [540-12903] 11
<b>Video Card:</b> Dual 2GB GDDR5 NVIDIA® GTX 680 SLI™	698298	1 [490-13778] 6
<b>Memory:</b> 8192MB (4x2GB) 1600MHz DDR3 Quad Channel	646407	1 [370-21939] 3
<b>Hard Drive:</b> 1TB SATA 6Gbps (7200RPM) 32MB Cache	646410	1 [400-40447] 8
<b>Optical Devices:</b> DVD+RW (Read/Write) 24x	528630	1 [426-15596] 16

UK 230V Power Cord			
<b>Shipping Documents:</b> English Documentation	649097	1 [340-27643]	21
<b>Gifts Bundle Reference:</b> D11AMW01	756637	1 [203-28827]	22
<b>Standard Warranty:</b> 1 year Next Business Day Hardware Support Included with your PC	323037	1 [754-56829]	29
<b>Order Information:</b> Alienware Aurora Order	651384	1 [798-17924]	111
<b>Dell System Media Kit:</b> Alienware Aurora Resource DVD	646405	1 [340-27518]	319
<b>Dell Backup &amp; Recovery:</b> Dell Backup and Recovery Not Included	741223	1 [640-12948]	200076
<b>Avatar:</b> Alienware 3D	292868	1 [644-10009]	444
<b>AlienFX Colour:</b> Astral Aqua	294378	1 [656-10004]	451
<b>Monitor:</b> Display Not Included	92239	1 [480-10999]	5
<b>Mouse:</b> Alienware Optical Mouse	292825	1 [570-10650]	12
<b>Keyboard:</b> Alienware Multimedia Keyboard - UK/Irish (QWERTY)	292823	1 [580-15618]	4
<b>Pre-Installed Software:</b> SteuerID Factory Installed and SteuerID Extra Content	334097	1 [645-10006]	689

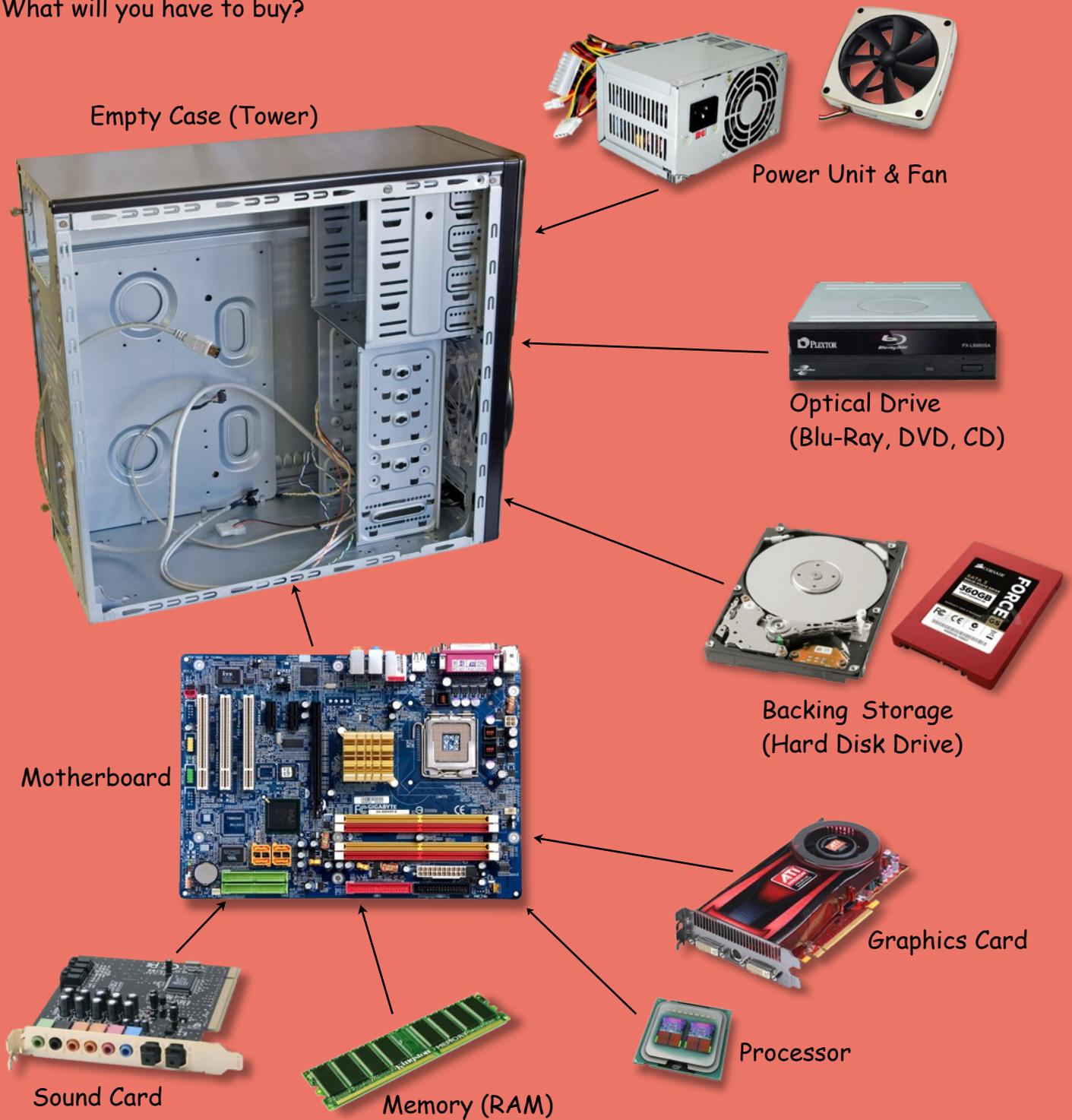


When you have finished, collect a post-it note from your teacher. Write your name, the name of the PC and your final price on the post-it. Stick your post-it up at the front of the class.

## Method 3: Purchase Every Component Separately and Build it Yourself

This is undoubtedly the most difficult method of purchasing a computer system but building your own computer isn't as hard as you might think and can be very rewarding. All it requires is a bit of knowledge about what to buy and where to put it.

What will you have to buy?



By purchasing all of your hardware separately you can often end up with a computer system that would have cost you substantially more off-the-shelf.

### Task 3: Additional Hardware

In addition to the standard devices on page 4 there are many other components that can be purchased for a desktop PC.

Use the website [www.dabs.com](http://www.dabs.com) to research further components.

E-mail your teacher stating which device (other than those shown on the previous page) you would choose to buy if you were building a computer system of your own. Say why you have chosen the device.

## Learning to Build Your Own Computer System

As well as being aware of what components to purchase, to build your own computer you should be aware of the following.

- As each component will vary vastly in price (a cheap graphics card is £20 and a really expensive one is £3500), it's vital to have a good understanding of the specifications of each component. As computing hardware constantly develops and improves, you should make sure your knowledge of components is up-to-date.
- To ensure the components you buy fit into your tower, or can be connected to your motherboard, you must also understand the different types of connection that exist for each component.

The following pages will describe the important information to look for when searching for each component.

Note, a good understanding of units is very important as they can be used to identify the differences between two similar devices.

In computing, **Speed** is measured using **Hertz**.

- Kilohertz - KHz (slow)
- Megahertz - MHz (medium)
- Gigahertz - GHz (fast)



**Storage** is measured using **bytes**.

- Kilobytes - Kb (small)
- Megabytes - Mb (medium)
- Gigabytes - Gb (large)
- Terabytes - Tb (very large)



## The Tower and Power Supply Unit

A typical tower specification is listed below. All specifications are very detailed so you'll need to learn to pick out the important facts. These are shown in the diagram below.

1. 11 drive bays: 3 x 5.25" tool-less drive bays / 2 x 2.5" drive bays (dedicated) / 6 x 3.5" tool-less drive bays
2. Motherboards: Standard ATX, microATX, Mini-ITX
3. Expansion slots: eight
4. Maximum graphics card size: 318 mm (12.5")
5. Maximum CPU cooler height: 170 mm (6.7")
6. Cooling System: 1 x 120 mm rear TwoCool™ fan / 1 x 140 mm top TwoCool™ fan / 2 x 120 mm front intake fans (optional) / 1 x 120 mm side intake fan (optional) / 1 x 120 mm side exhaust fan behind motherboard (optional)
7. Water cooling support: top water cooling grommets
8. Enlarged CPU cutout
9. Front I/O ports: 2 x USB 3.0 with internal motherboard connector / Audio In/Out



9. Two built in USB ports are installed at the front. The expansion slots could be used to add more at the back.

6. This tower comes with a built-in fan and the potential to install a water cooling system (7).

3. Expansion slots allow other devices to be plugged into the back of your tower (speakers, network cables etc)



1. Drive bays are where you would install DVD drives, hard disk drives etc. There are usually 2 sizes: 5.25 inch 3.5 inch



2. Three types of motherboard can be fitted to this tower (standard-ATX, micro-ATX and mini-ITX). Every other component installed in the tower is plugged into the motherboard.

A typical power unit specification is listed below. This takes power from a mains plug at 230Volts and converts it to around 12Volts. It will supply the motherboard and other devices (DVD Drive, Hard Disk Drive etc) with power.

1. Product Description: PULSE 500W PSU
2. Wattage: 500W
3. Size: ATX 12V
4. Input Range: 230Vac, 10A, 50-60Hz
5. Connectors:  
 1 x 240 +4 PIN Main,  
 1 x CPU 4-PIN 12V,  
 2 X SATA,

2. The number of Watts tells you the power limit of the supply unit.

3. This tells us that the power supply unit will power a 12Volt, ATX motherboard.

5. The types and number of connectors (plugs) are important as these list the types of devices that can be powered by the unit.

For example a SATA connector would supply power to a SATA Hard Disk Drive.

4. These numbers simply tell us that this works on a UK mains electricity supply.



## Task 4: Examining a Tower Specification

Look at the tower specification below and answer the questions. E-mail the answers to your teacher.



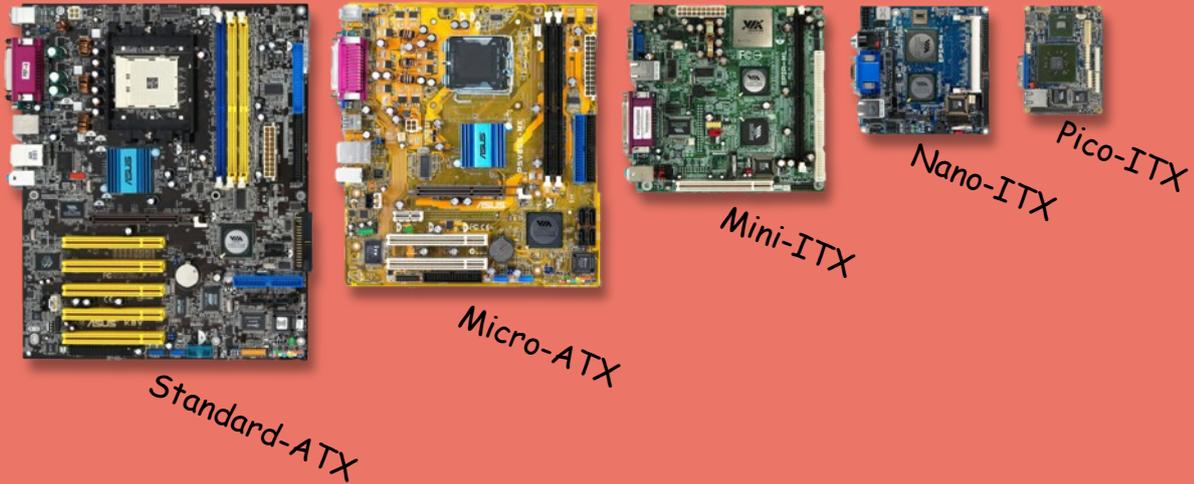
- Dimensions ( W x H x D ): 185 x 420 x 445 mm
- Material: ABS / Mesh/ 0.6 mm SGCC
- Colour: Black
- Side panel(s): TAC 2.0
- Drive bays: 5.25" x 1 , 3.5" x 1 +6(internal)
- Expansion slots: 7
- ATX / Micro ATX
- I/O ports: 2 x USB 2.0 / 1 x HD Audio / 2 x USB 3.0
- Fans Front: 2 x 120mm silent fan
- Weight: 5.78kg

1. How many 5¼ inch bays does this tower have?
2. State the types of motherboard that can be installed in this tower.
3. How many slots are available if the customer wishes to expand the hardware installed in the tower?
4. How many USB ports come with this tower?
5. If you purchased this tower would you need to buy an additional fan?

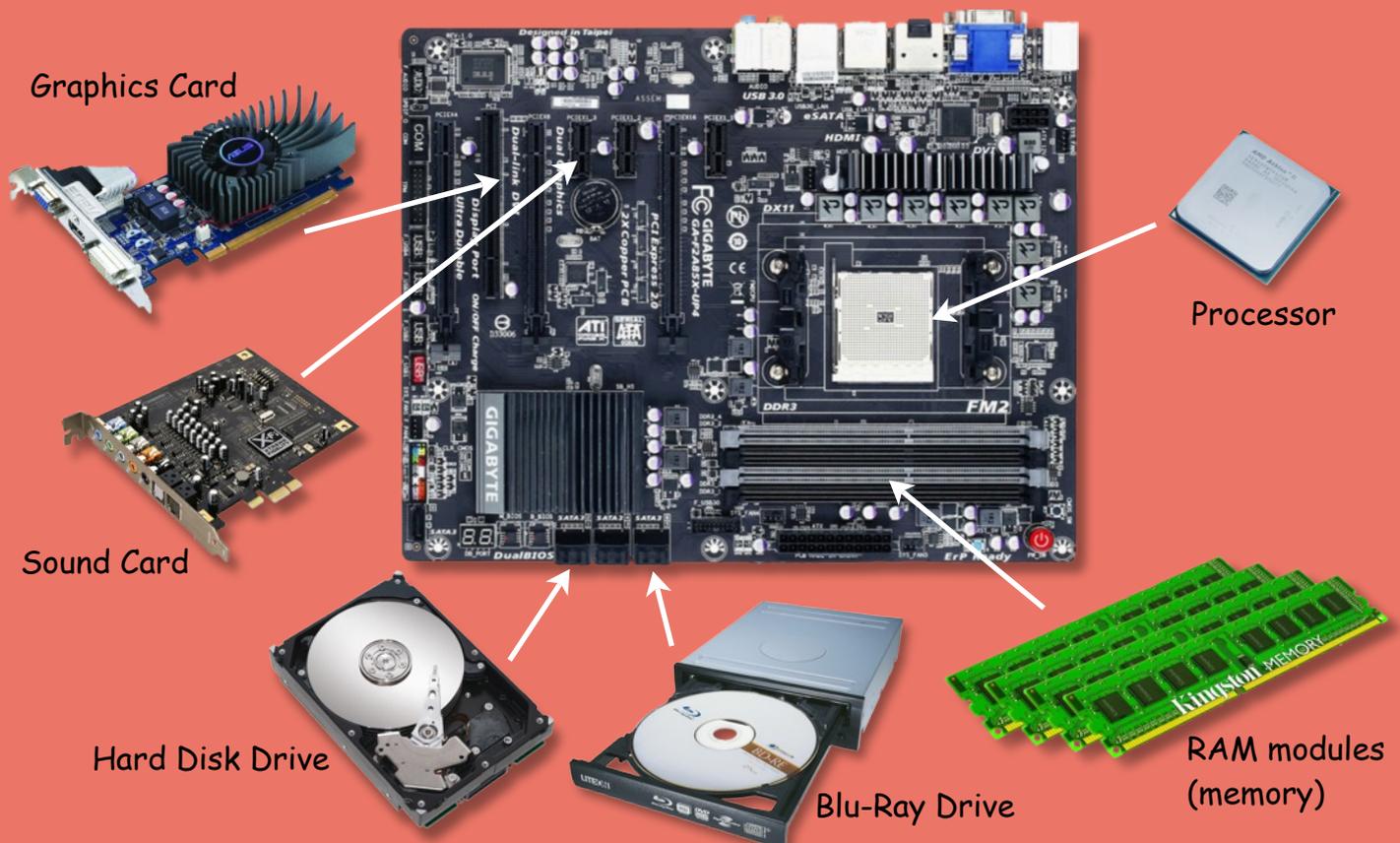
## Motherboard

The motherboard is the heart of any computer system. Everything plugs into the computer's motherboard. This is necessary as its role is to allow all the different parts of the computer system to communicate with each other.

Motherboards come in a variety of sizes. Some standard sizes are shown below.

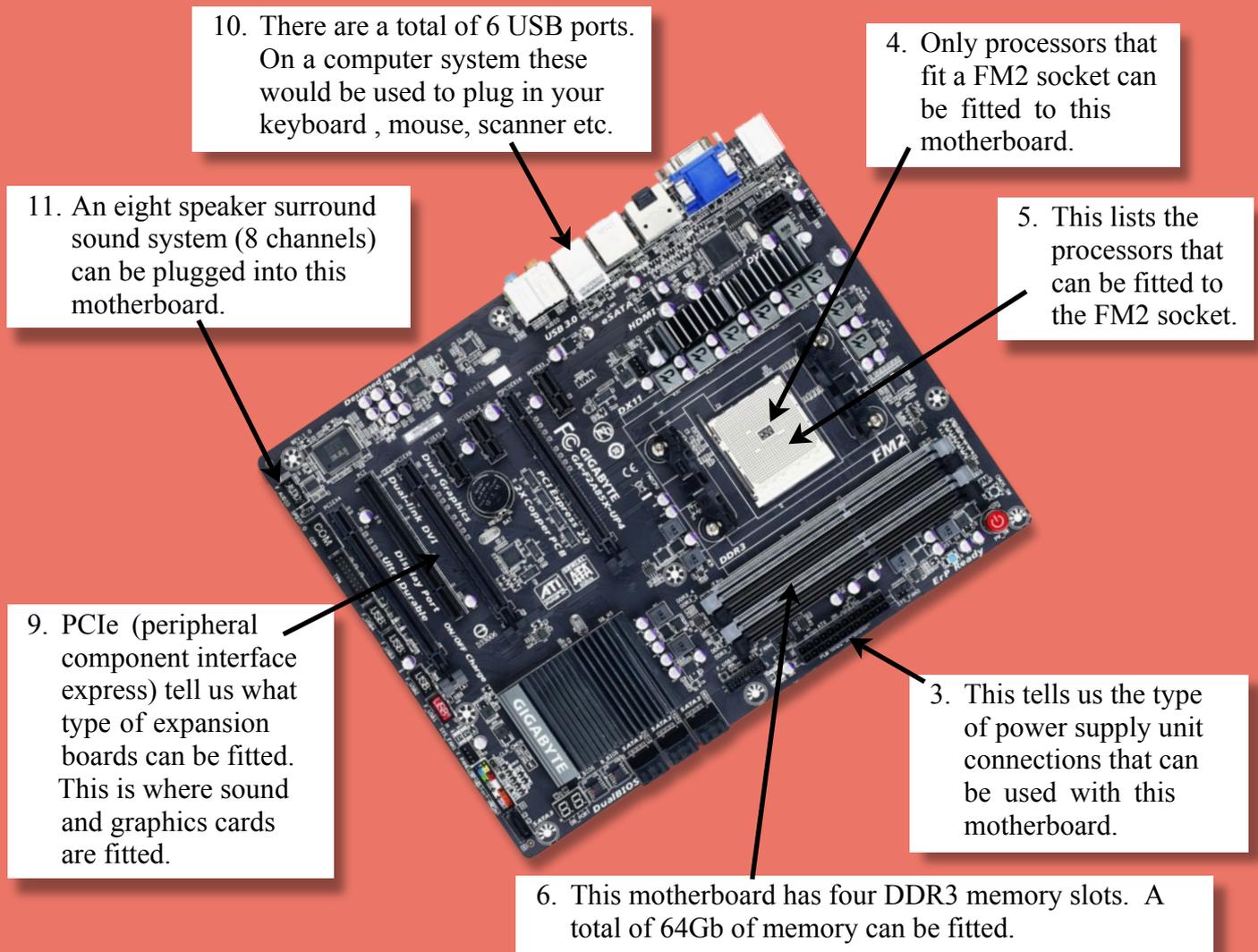


A few of the devices, found inside a computer system, that could be plugged into a motherboard are shown below.



Look at the motherboard specification below. The important information is again explained in the diagram below the specification.

1. Product Description: Gigabyte GA-F2A85X-UP4
2. Product Type: Motherboard - ATX
3. Power Connectors: 24-pin main power connector, 8-pin ATX12V connector
4. Processor Socket: 1 x Socket FM2
5. Compatible Processors: Athlon II X4, A8 series, A6 series, A4 series, A10 series
6. Max RAM: 64 GB (4 DIMM slots - DDR3)
7. Ram Bus Clock: 1600 MHz, 1333 MHz, 1066 MHz, 1866 MHz
8. Storage Ports: 7 x SATA-600 (RAID), 1 x eSATA-600 (RAID)
9. Expansion Slot(s): 3 x PCIe
10. USB: 4 x USB 3.0, 2 x USB 2.0
11. Audio: HD Audio (8-channel)
12. LAN: Gigabit Ethernet



## Task 5: Interpreting a Motherboard Specification

Open a new word processing document.

Using [www.dabs.com](http://www.dabs.com) find a motherboard costing roughly £150 to £250.

On page 1 of your blank word processing document enter the following:

- A Heading
- Your name in a Footer
- An image of the motherboard you selected
- A detailed specification of the motherboard. This may be copied and pasted from [www.dabs.com](http://www.dabs.com).

On a new page in your document start a bullet point list.

Using the information on page 9 to help you, explain as much of the specification as possible. Use one bullet for each piece of information.

For example, if the specification states:

Product Type: Motherboard - micro ATX

You would type:

- This as a micro ATX motherboard

When finished print your document and hand it in to be marked. You get 1 mark for every fact you explain in your own words (and 0 if you simply copy the specification).

## Processors

In its simplest terms a computer is nothing more than an intricate box of electronics that calculates numbers very quickly. The component of the computer that carries out all these calculation is the processor.

The processor is one of the most expensive components to purchase.



## Task 6: Identifying the Age of Processors

Using the world wide web, find out which of the processors above is the oldest and which is the newest. Research one other difference between the two.

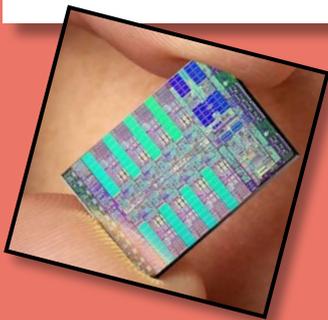
E-mail your answers to your teacher.

When examining a processor specification you should be looking for the following:

1. Product Description: Intel Core i7 3770K
2. Product Type: Processor
3. Number of Cores: Quad-Core / 8 threads
4. Cache: 8 MB
5. 64-bit Computing: Yes
6. Integrated Graphics: Intel HD Graphics 4000
7. Compatible Processor: LGA1155 Socket
8. Clock Speed: 3.5 GHz
9. Max Turbo Speed: 3.9 GHz

8. The clock controls how fast the processor carries out instructions. The higher the number the faster the processor.
9. Processors can be “over-clocked” by increasing the clock speed on the motherboard.

3. A core is another term for a processor. A quad-core processor therefore has four separate processors and can process four instructions simultaneously



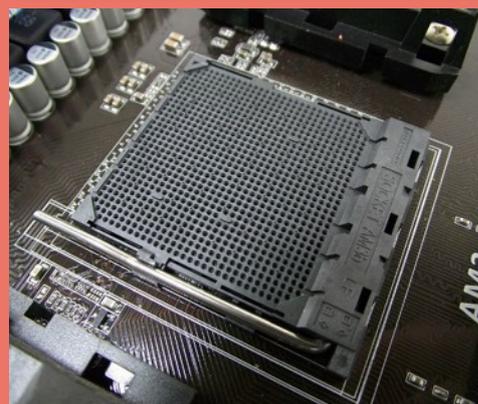
A Cell Processor from the Sony PS3 with 8 cores.

4. The Cache allows the processor to temporarily store data while it's working. A larger cache makes the processor more efficient so it can process instructions faster.

7. Processors plug into a socket on the motherboard. You must ensure that the processor you buy fits the socket on your motherboard.



An LGA1155 socket.



An FM2 socket.

Socket
LGA1155 Socket (46)
Socket AM3+ (11)
Socket FM1 (9)
[N/A] (8)
LGA771 Socket (7)
Socket AM3 (7)
LGA1366 Socket (6)
LGA2011 Socket (5)
Socket FM2 (3)
LGA775 Socket (1)
More...

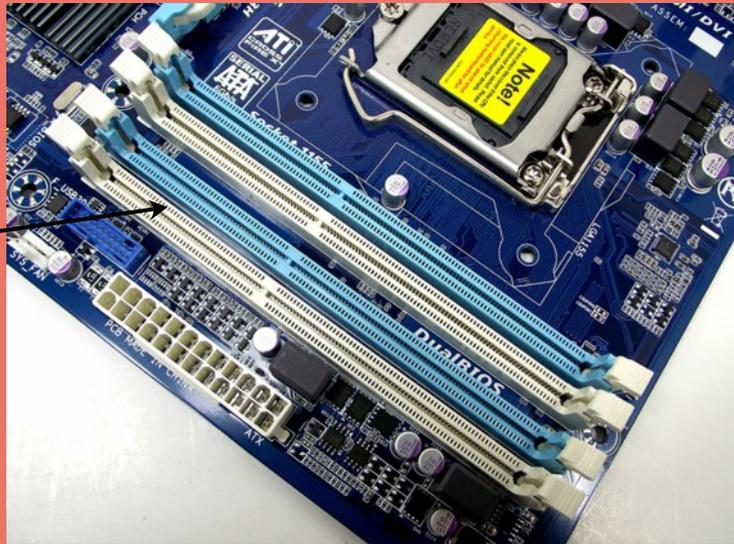
A list of available sockets types taken from the dabs website.

## Memory (RAM)

Computers use memory to store programs and data. The memory is built onto modules which plug into DIMM slots on the motherboard.



Memory Module



When building a computer, you must check how many slots there are on the motherboard and what is the maximum amount of memory that can be installed.

The example above can take a maximum of 16Mb of RAM. As there are 4 DIMM slots, this means that 4 x 4Mb RAM modules can be installed.



Motherboards may also have memory requirements such as:

- Speed (Mhz)
- ECC/non-ECC
- Buffered/registered

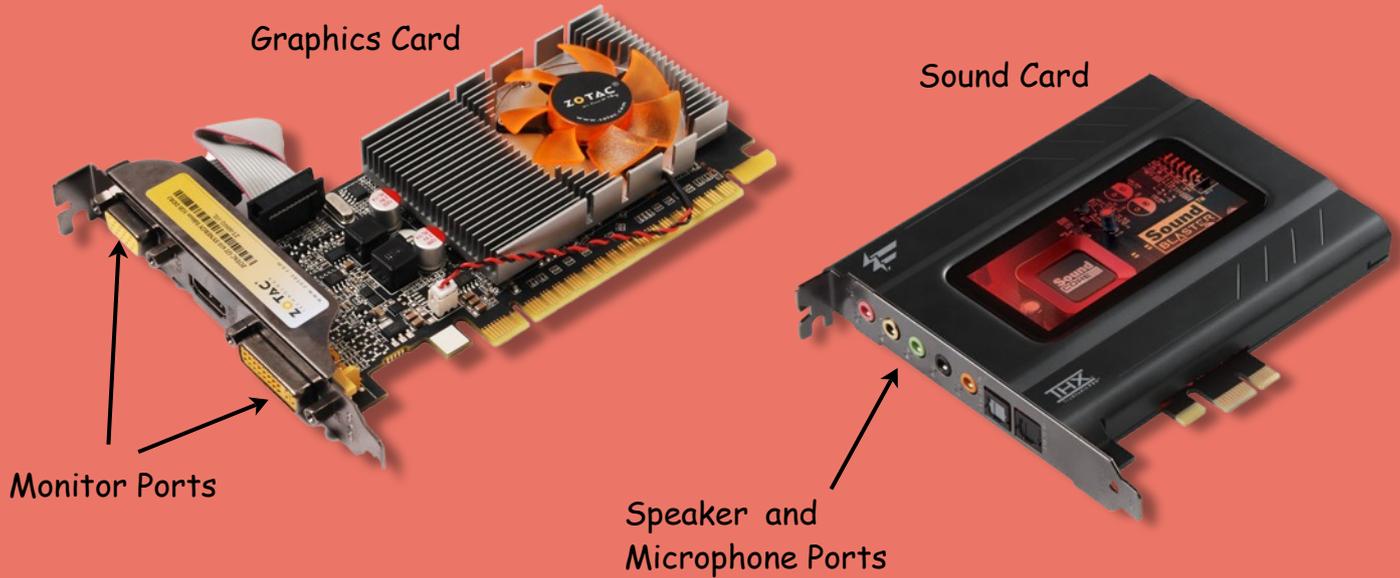
### Task 7: Matching Components

Collect the 16 coloured cards you will need for this task from your teacher. Your task is to create 4 computers systems each consisting of a case, motherboard, processor and memory. **Every component should be compatible.**

Your teacher will check each completed computer.

## Input and Output (Graphics and Sound Cards)

Many motherboards have graphics and sound capability built into them. These may be quite basic however, so installing separate graphics and sound cards can improve your system.



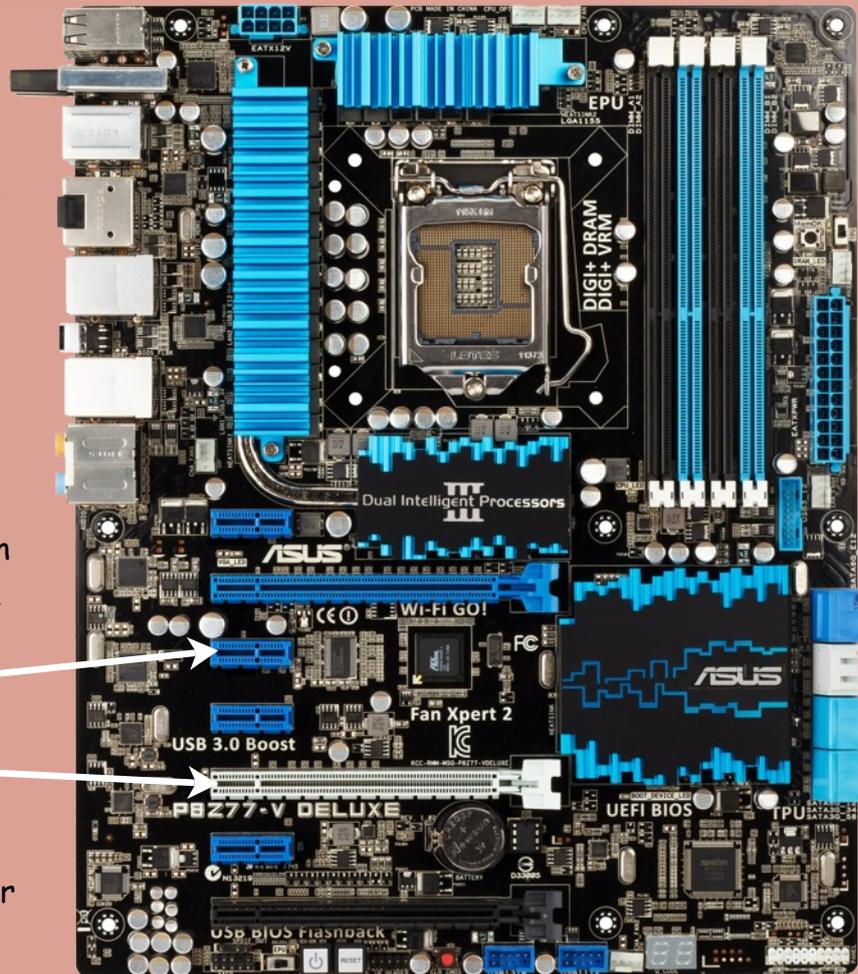
### Task 8: Components Interfaces

When you purchase a graphics or sound card you must ensure that your motherboard has a matching component interface slot. Your task this time is to research the names of the two different types of component interface shown on the motherboard below.

Interface A

Interface B

E-mail your answers to your teacher.



The specifications of graphics and sound cards focus on their functions.

## Graphics Card



A graphics card processes and send images to a monitor. Look for information relating to the quality of the pictures it produces and how fast it can process them.

**Device Type:** Graphics card - low profile

**Bus Type:** PCI Express 2.0 x16

**Graphics Engine:** NVIDIA GeForce GT 610

**Core Clock:** 810 MHz

**RAM:** 1Gb (1200 Mhz)

**Memory Interface:** 64bit

**Max Resolution:** 2560 x 1600

**Interfaces:** VGA, DVI-I (dual link), HDMI

**API Supported:** DirectX 11

**Features:** ASUS 0-dB thermal solution, Nvidia CUDA technology, Nvidia PhysX-Ready, Super Alloy Power technology, Dust-proof fan , HDCP

## Sound Card



A sound card processes and sends sound to speakers. Look for information relating to the quality of the sound it produces and the number of speakers it can send sound to.

**Device Type:** Sound card

**Enclosure Type:** Internal

**Interface Type:** PCI Express x1

**Sound Output Mode:** 5.1 channel surround

**DAC Resolution:** 24-bit

**Sample Rate:** 8 kHz (min) - 96 kHz (max)

**Interfaces:** 1 x audio line-in, microphone mini-phone 3.5mm, 1 x audio line-out, headphones - mini-phone 3.5mm, 3 x speakers mini-phone 3.5mm , 1 x SPDIF input, 1 x SPDIF output

**System Requirements:** Microsoft Windows 7 (32/64 bits)

### Task 9: Graphics Card & Sound Card Specification Questions

Answer **one** of the following challenging questions and e-mail your answer to your teacher. You will probably have to research your answer.

- Q1 On the above graphics card specification, what do the letters **VGA**, **DVI-I** and **HDMI** refer to?
- Q2 Describe the speaker arrangement in a **5.1 surround sound** system.
- Q3 What part of the graphics card does the **Core Clock** speed of **800Mhz** refer to?
- Q4 **Sample Rate** is a term associated with recording sound. What does the term describe?

## Storage (Hard Disk and Optical)

The final internal components are required to store and retrieve data.

The hard disk drive (HDD) stores the computers operating system, applications and saved files. The most important information on any hard disk specification is the amount of data it can store and whether or not it can be fitted to your computer (capacity and interface).

1. Device Type: Hard drive (internal)
2. Capacity: 2 TB
3. Form Factor: 3.5" x 1/3H
4. Interface: Serial ATA-600
5. Buffer Size: 64 MB
6. Drive Transfer Rate: 600 Mbps (external)
7. Spindle Speed: 7200 rpm



Since 2010 a new type of hard disk drive has become increasingly popular. Solid State drives are smaller and have no moving parts. They store data on memory in a similar way to a USB Flash Drive.



### Task 10: Hard Disk Drive Prices

Using a website of your choice, find one standard HDD and one solid state HDD that have the same capacity. Take a note of the price of the two drives.

E-mail the two prices to your teacher.

Almost all computer systems will also contain an optical drive (CD, DVD or BLU-RAY).

A typical specification is shown below.

1. Product Description: DVD±RW (±R DL) / DVD-RAM / BD-ROM drive
2. Interface: Serial ATA
3. Dimensions: (WxDxH) 14.6 cm x 17 cm x 4.1 cm
4. Drive Bay: 5.25" x 1/2H
5. Read Speed: 48x (CD) / 16x (DVD) / 12x (BD)
6. Write Speed: 48x (CD) / 16x (DVD±R) / 8x (DVD±R DL)
7. CD / DVD Rewrite Speed: 24x (CD) / 6x (DVD-RW) / 8x (DVD+RW) / 12x (DVD-RAM)



Optical drives are either:

**ROM** drives (these only read disks)

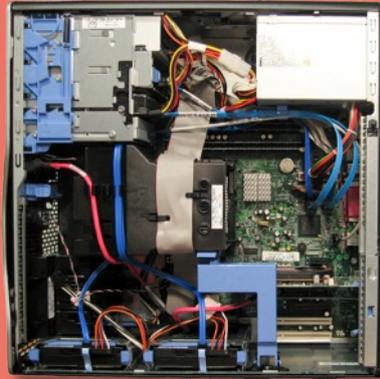
**Writers** (these can burn data to blank disks)

**Combo** drive (they can read from some disks and write to others)

The above example is a Combo Blu-Ray ROM/DVD Writer

## Peripheral Devices

Until now, all the components we have looked at are installed inside the case.



To build a fully functioning computer we also require the following peripheral devices. A "peripheral" device is any device that plugs into the case.



Almost all keyboards and mice now plug into USB ports. This ensures they are compatible with nearly every system.

When purchasing monitors, spending more will usually result in a larger screen with a higher resolution. Compatibility of monitors is usually determined by the type of connector they have.



DVI connector



VGA connector



HDMI connector

Check the connector matches the connection on the motherboard or graphics card.

## Operating System

Without software, a computer is a useless box of electronics. The operating system on a computer is responsible for controlling all the components, running your applications, communicating with peripheral devices and saving/loading your files.

In 2012, when this unit was written, there were two main operating systems available for your self built computer.

Microsoft Windows 8 - costs approximately £45



Linux - free to download



Before you buy or download an operating system, you should ensure that all your devices are compatible with the software. Most hardware specifications will list the operating systems the device can be used with. An example of a sound card is shown below.

Product Description	Creative Sound Blaster Recon3D sound card
Device Type	Sound card
Interface Type	PCI Express x1
Sound Output Mode	5.1 channel surround
DAC Resolution	24-bit
System Requirements	Microsoft Windows Vista (32/64 bits) SP2, Apple MacOS X 10.5 or later, Microsoft Windows 7 (32/64 bits)

## The Project Tasks

This unit is called "Building a Computer". Now is your chance to put everything you have learned together and simulate buying a complete computer system.

There are three projects to attempt:

- Basic (40 marks)
- Intermediate (50 marks)
- Advanced (60 marks)

At the end of the project you will be given a mark out of 60. You may choose whichever project you wish but if you choose to attempt the Basic project the highest mark you can achieve is 40 out of 60.

Your chosen project should be typed up in a word processor. Marks for each project will be awarded as follows.

**Basic:** **12 marks** for finding and listing all the components names, pictures and prices required to build a complete computer system. (-1 mark for every component you miss.)

**12 marks** for giving a brief description of why each component is required (-1 for each missing description.)

**2 marks** for including an overall cost of your computer system and ensuring it is inside the budget you are given.

**12 marks** for quality of your report. Layout, accuracy of terminology, spelling and grammar.

**2 marks** for meeting the deadline set by your teacher.

40 marks

**Intermediate:** All of the above plus.

**10 marks** for the including the compatibility of each device. E.g. showing that the processor fits the socket on the motherboard.

50 marks

**Advanced:** All of the above (basic & intermediate) plus.

**10 marks** for explaining in your report why you selected each particular component.

60 marks

Throughout the projects you can refer back to this unit as often as you wish.

Now collect your chosen project from your teacher.