

Cambridge TECHNICALS LEVEL 3

Cambridge
TECHNICALS
2016

Unit 18 – Computer systems – hardware DELIVERY GUIDE

Version 2

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The activities within this teaching and learning resource must not be used for summative assessment purposes. As part of our teaching we expect support to be given to your learners; such support is not permissible for summative assessment and is likely to be considered malpractice.

INTRODUCTION

This Delivery Guide has been developed to provide practitioners with a variety of creative and practical ideas to support the delivery of this qualification. The Guide is a collection of lesson ideas with associated activities, which you may find helpful as you plan your lessons.

OCR has collaborated with current practitioners to ensure that the ideas put forward in this Delivery Guide are practical, realistic and dynamic. The Guide is structured by learning outcome so you can see how each activity helps you cover the requirements of this unit.

We appreciate that practitioners are knowledgeable in relation to what works for them and their learners. Therefore, the resources we have produced should not restrict or impact on practitioners' creativity to deliver excellent learning opportunities.

Whether you are an experienced practitioner or new to the sector, we hope you find something in this guide which will help you to deliver excellent learning opportunities.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resources.feedback@ocr.org.uk.

OPPORTUNITIES FOR ENGLISH AND MATHS SKILLS DEVELOPMENT AND WORK EXPERIENCE

We believe that being able to make good progress in English and maths is essential to learners in both of these contexts and on a range of learning programmes. To help you enable your learners to progress in these subjects, we have signposted opportunities for English and maths skills practice within this resource. We have also identified any potential work experience opportunities within the activities. These suggestions are for guidance only. They are not designed to replace your own subject knowledge and expertise in deciding what is most appropriate for your learners.



English



Maths



Work

Please note

The timings for the suggested activities in this Delivery Guide **DO NOT** relate to the Guided Learning Hours (GLHs) for each unit.

Assessment guidance can be found within the Unit document available from www.ocr.org.uk.

The latest version of this Delivery Guide can be downloaded from the OCR website.

UNIT AIM

The aim of this unit is to enable you to understand how the components of computer systems work together. You will develop the skills needed to recommend appropriate hardware systems for various purposes. Using the skills developed you will build/upgrade a full computer system with a view to testing and considering preventive maintenance procedures.

This is an optional unit within the IT Infrastructure Technician and the Emerging Digital Practitioner specialist pathways. It is important that IT technicians and network technicians have in depth knowledge, skills and understanding associated with the installation, upgrade, troubleshooting and maintenance of hardware for computer systems. Computer systems and associated hardware is an important area within emerging digital technologies.

The learning within this unit will also support the delivery of the CompTIA A+ and Cisco ITE qualification objectives.

Unit 18 Computer systems – hardware

LO1	Understand the components of a computer system
LO2	Be able to propose a computer system for identified business requirements
LO3	Be able to build or upgrade computers
LO4	Be able to test and evaluate the functionality of computer systems

To find out more about this qualification please go to: <http://www.ocr.org.uk/qualifications/cambridge-technicals-it-level-3-certificate-extended-certificate-introductory-diploma-foundation-diploma-diploma-05838-05842-2016-suite>

Cambridge
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2016

2016 Suite

- New suite for first teaching September 2016
- Externally assessed content
- Eligible for Key Stage 5 performance points from 2018
- Designed to meet the DfE technical guidance

RELATED ACTIVITIES

The Suggested Activities in this Delivery Guide listed below have also been related to other Cambridge Technicals in IT units/Learning Outcomes (LOs). This could help with delivery planning and enable learners to cover multiple parts of units.

This unit (Unit 18)	Title of suggested activity	Other units/LOs	
LO1	How a CPU works CPU chipset functions Motherboard parts and functions The motherboard BIOS The graphics processing unit Choosing a storage solution	Unit 1 Fundamentals of IT	LO1 Understand computer hardware
		Unit 3 Cyber security	LO1 Understand what is meant by cyber security
LO2	Planning a computer system	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems LO4 Understand employability and communication skills used in an IT environment LO5 Understand ethical and operational issues and threats to computer systems
		Unit 2 Global information	LO1 Understand where information is held globally and how it is transmitted LO5 Understand the process flow of information LO6 Understand the principles of information security
		Unit 3 Cyber security	LO1 Understand what is meant by cyber security
		Unit 6 Application design	LO2 Be able to investigate potential solutions for application developments
		Unit 8 Project management	LO2 Be able to initiate and plan projects
		Unit 9 Product development	LO2 Be able to design products that meet identified client requirements
	Discovering single points of failure	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems
		Unit 2 Global information	LO1 Understand where information is held globally and how it is transmitted LO5 Understand the process flow of information
	Computer clustering	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems
		Unit 2 Global information	LO1 Understand where information is held globally and how it is transmitted
	Disk drive redundancy	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems
		Unit 2 Global information	LO1 Understand where information is held globally and how it is transmitted

This unit (Unit 18)	Title of suggested activity	Other units/LOs	
LO2	NAS and SAN	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems
		Unit 2 Global information	LO1 Understand where information is held globally and how it is transmitted
		Unit 3 Cyber security	LO1 Understand what is meant by cyber security
	Load balancing	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems
		Unit 2 Global information	LO1 Understand where information is held globally and how it is transmitted
		Unit 4 Computer networks	LO1 Understand the concept of networks LO2 Be able to plan computer networks to meet client requirements
LO3	Anti-static precautions	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO5 Understand ethical and operational issues and threats to computer systems
	Computer tools	Unit 1 Fundamentals of IT	LO1 Understand computer hardware
	The BIOS BIOS configuration Disk drive partitioning	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software
		Unit 3 Cyber security	LO1 Understand what is meant by cyber security
	Preventative maintenance	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems
LO4	Disk diagnostics Memory diagnostics Using Event Viewer Command prompt diagnostics and repair Working with device drivers Computer benchmarking	Unit 1 Fundamentals of IT	LO1 Understand computer hardware LO2 Understand computer software LO3 Understand business IT systems

KEY TERMS

Explanations of the key terms used within this unit, in the context of this unit

Key term	Explanation
Address bus	A set of lines used to define locations of data in memory. Each line of the address bus holds a binary value '0' or '1' and the combination of binary values defines the address. A 16-bit address bus can potentially address $2^{16} = 65536$ locations of memory.
Availability	This refers to computing and database system resources being ready for use and accessible to the user. If a server goes down then its resources become unavailable to its users. Various techniques can be used to provide alternative access during down time. The quicker, and more seamlessly, the alternative resources can be brought online then the higher the availability of the system.
Basic Input Out System (BIOS)	The Basic Input Out System is an erasable ROM device that holds a program that controls and monitors all devices on the motherboard. The first instruction executed by the CPU is located in the BIOS. At start-up the BIOS configures all devices and conducts a Power On Self-Test (POST). On completion of the POST the BIOS instructions will access the hard drive to load the operating system.
Benchmarking	This is an activity that is performed on a computer by running one or more programs to apply loading to the various components of the computer (memory, CPU, disk, network). The recorded measurements under these loaded conditions provide a profile of the performance of the computer. The benchmark can then be used at a later date to compare change in performance or help to diagnose problems.
Central processing unit (CPU)	The central processing unit (CPU) is responsible for the read-execute cycle. An address is placed on the address bus, the data located at that address is passed into the CPU on the data bus from that address. The CPU decodes the data and locates a new address. This process repeats endlessly at a speed governed by the CPU clock.
Clustering	With regard to computers this term refers to two or more (sometimes hundreds) of computers connected together to share the computing load. Each computer is a cluster 'member' and a single program controls when a member is online or offline. Clusters enable high availability even when some member computers are offline.
Complementary Metal-Oxide Semiconductor (CMOS)	CMOS devices are used to manufacture a small amount of volatile memory in which to hold the BIOS variable parameters such as date, password and many other values. During shutdown this memory is kept alive by the inclusion of a battery on the motherboard.
Control bus	A set of lines that control and monitor the actions within the CPU. For example, one particular control line specifies whether the CPU is reading from memory or writing to memory.
Data bus	A set of lines used to transfer data between the CPU and memory at a specified location. The data may be an instruction to be executed or data to be processed. The wider the bus the more data that can be read in one read cycle.
Direct Attached Storage (DAS)	Direct Attached Storage refers to the internal drive connected to the motherboard interface. These drives are commonly SATA (Serial Advanced Technology Attachment) or SCSI (Small Computer System Interface).
Driver	Operating systems cannot be expected to know how to operate every piece of hardware that is connected to the computer. The manufacturer of new hardware for a computer will produce the code needed for the operating system to communicate with the device. This code is known as a 'driver'. Drivers are integrated into the operating system by means of 'installation'.
Electro Static Damage (ESD)	Static electricity is generated in all human bodies. Interaction with the environment will generate varying amounts of static and can be in the order of thousands of volts. Electro Static Damage can result from static electricity punching holes in sensitive electronic components.

Explanations of the key terms used within this unit, in the context of this unit

Key term	Explanation
Event Viewer	The operating system records information about events related to errors, security, failures and so on. The records are stored in database files and can be accessed by a utility called Event Viewer. The utility allows for sorting, filtering and displaying details of events.
Front side bus	The high speed pins of the CPU are brought out to a set of lines on the motherboard to allow connection to very high speed components such as memory or the graphics processor. Data is read or written and then a new address is placed on the bus. This process continues indefinitely.
Graphics Processing Unit (GPU)	The Graphics Processing Unit takes most of the load from the system CPU that is related to the rendering of graphical information on the monitor display. This load is very substantial, especially when it comes to high quality graphics such as those required by gaming applications. The GPU may be built-in, external or even both.
Load balancing	Load balancing is a technique for distributing the workload across two or more computers. The actual technique for distribution varies according to what is being distributed such as web pages or databases.
Memory diagnostics tool	This tool can be run in Windows if a memory problem is suspected or you can run it manually if you suspect there may be a memory problem. Even if memory passes the POST it still may be defective and require more stringent testing with this tool.
Mirroring	This is a Raid 1 arrangement of two drives. There is no increase in capacity with this combination. Every write that is made to one drive is copied (mirrored) to the other. In the event of failure the mirrored disk is brought online.
Motherboard	This is the main board of a computer and is host for most of the components: CPU, I/O and memory. There are also interfaces for network cards, graphics cards and hard drive connection. In modern motherboards almost everything is included on the board, including integrated graphics and network adapter.
Network Attached Storage (NAS)	This is a storage mechanism that is connected to a computer over a network. This is very similar to SAN (Storage Area Network). Both offer high speed access to very large capacity across the network but they differ mainly in the protocols that are used to access them.
Northbridge	The component on the motherboard that manages communication between the front side bus and the other components connected on the motherboard. The northbridge device itself connects directly to high speed devices and also to slower devices, like the hard drive, through the southbridge device.
Partition	A partition is part of the total physical disk drive capacity that is made available to the operating system. The partition appears as a complete disk to the operating system. A hard drive can be split into two or more such partitions, each of which appears as a drive to the operating system. Because the partitions are actually stored on the same physical disk then they are often referred to as logical drives rather than physical drives.
Power On Self-Test (POST)	During start-up the BIOS program executes a self-test sequence to confirm the functionality of memory and devices connected to the motherboard. No operating system is present at that time the POST is running and error information is provided in the form of beep codes. Each manufacturer has their own set of beep codes which are readily downloadable to assist with diagnostics.
Read-execute cycle	A simple sequence carried out by any CPU. An initial address (depending on the processor) is placed on the address bus at start-up.
Redundant Array of Independent Disks (RAID)	This refers to the way in which several hard drives can be connected to share their capacity and behave as a single unit of storage. A Redundant Array of Independent Disks can be used to simply extend the capacity of storage (Raid 0) or to provide an immediate backup in case one disk fails (Raid 1) or distribute data across three or more with disk parity information (Raid 5) to allow for the live removal and replacement of one drive while the remainder provides all data to users.
Single points of failure (SPOF)	Single points of failure are those points in a system that render a computer system unusable when they fail. A system hard drive failure will render a computer unusable if there is no redundant disk available.
Solid State Drive (SSD)	These drives behave, on the outside, just like any other hard drive. The interface to this type of drive is made the same way as that for SATA but the inside is very different, being composed of flash memory and not requiring any moving parts.

Explanations of the key terms used within this unit, in the context of this unit

Key term	Explanation
Southbridge	A component on the motherboard that manages the communication between all the slower speed devices, such the hard drive and USB ports, and the northbridge device.
Storage Area Network (SAN)	Like NAS (Network Attached Storage) this is a mechanism to provide large storage capacity to computers across the network. Both technologies differ in the protocols that they use for access and SAN is only available for server grade computers.
System information	A very useful tool for discovering information about computer components. The tool is located in the system tools folder of a PC operating system and displays information, for example, about the identity of the GPU or CPU.
Virtual drive	A virtual drive uses software to emulate almost any type of storage. The real storage may be on a physical disk drive on the other side of the planet. Locally the software makes this storage look like an ordinary hard drive or even a tape drive to the local computer.

MISCONCEPTIONS

Some common misconceptions and guidance on how they could be overcome

What is the misconception?	How can this be overcome?	Resources which could help
The CPU is the brain of the computer	The analogy of the CPU being the brain of the computer can be quite powerful when learning about this particular component. However, there is no notion of the CPU being able to 'think' in a way that could be attributed to a real brain. The 'thinking' has already been sequenced into the CPU by its programmer (who may be considered the 'brain').	The following video clip provides an excellent description of the function carried out by the 'brain' of the computer: https://www.youtube.com/watch?v=cNN_tTXABUA
The CPU can execute complex mathematical operations	CPUs can rarely carry out mathematical operations more complex than simple arithmetic and comparisons and even that is often only on whole numbers. The real power of the CPU derives from the fantastically high speed at which it can carry out these operations. 'Higher level' operations can then group these high speed simpler operations to enable complex maths to be carried out.	Does our brain work like a CPU? http://www.scienceforums.net/topic/38199-does-our-brain-work-like-a-cpu/
8-bit 16-bit 32-bit 64-bit	Very often 32-bit and 64-bit terms appear in descriptions of computer hardware and software. The terms relate to the width of the CPU data bus. Data is transferred during each cycle of the processor. A simple way to double the speed of a processor is to double the size of the data transferred in each cycle. 8-bit and 16-bit widths have long passed into history for most normal CPUs but 32-bit and 64-bit still remain. The term does not relate to the width of the address bus.	32-bit vs 64-bit An explanation of the terms: http://pcsupport.about.com/od/glossaryterms/g/32-bit-64-bit.htm
BIOS passwords provide security against access	The BIOS password does prevent the booting up of a computer if the correct password cannot be entered. From a security point of view it is very weak though. A disk removed from the computer is easily accessible in another computer. Also, if the CMOS battery is removed from the motherboard it will wipe the password requirement and the computer can be restarted now without it. Also, if the legal user of the computer loses the password then they, too, will also be locked out. On some computers it is not possible to reset the password if it has been forgotten!	Resetting the BIOS password: http://www.tech-faq.com/reset-bios-password.html
External GPU	There was a time when all motherboards were required to have a GPU card installed in a motherboard slot. Later manufacturer chipsets included the GPU in the chipset itself. But not all chipsets included the GPU. Even when a GPU was built-in it did not necessarily have enough features to satisfy some application requirements such as gaming. External GPU cards could be fitted to suit the application requirements. Sometimes the external and internal GPUs could be used to support dual screen monitoring.	Difference between internal and external GPU: http://www.tomshardware.co.uk/answers/id-1906530/diff-integrated-graphics-card-external-graphics-card-support.html
ESD failure	Failure of electronic components due to static electricity will not necessarily be immediate. Static electricity can degrade electronic components in such a way that they may still work (perhaps not as well) but then fail earlier in their life than expected. It is always wise to take precautions against ESD.	Electrostatic Discharge: Causes, Effects, and Solutions http://ecmweb.com/content/electrostatic-discharge-causes-effects-and-solutions

Some common misconceptions and guidance on how they could be overcome		
What is the misconception?	How can this be overcome?	Resources which could help
Command console is 'old fashioned'	Operating systems provide a wide range of commands that can be run from the command console. Whilst such commands can appear difficult to use in comparison to graphical based tools, they are included in an operating system for an important purpose. The commands themselves avoid using the graphics system and drivers which can often be unusable because of the fault being diagnosed. These commands can also be included in the scheduler of the computer to run automatically at specified times.	Command-line interface https://en.wikipedia.org/wiki/Command-line_interface
Operating system installation includes files for operating all the computer hardware	The sheer range of hardware available to work with a computer means that no operating system can possibly have code to work with all the hardware. Even motherboard hardware varies widely and so additional files will be required here also. So on completion of installing an operating system a follow-up task is to install all the drivers for the motherboard and external hardware as well as for the motherboard chipset. For common devices such as mouse and display, the operating system may include generic files so that these devices will at least be able work on first installation of the operating system, but such devices will not necessarily operate at their best and may not have all their features available until the appropriate driver is installed.	Why are chipset drivers required? http://superuser.com/questions/333526/why-should-i-install-hardware-drivers-if-my-computer-is-working-fine

SUGGESTED ACTIVITIES

LO No:	1		
LO Title:	Understand the components of a computer system		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
How a CPU works	<p>Learners must understand that a central processing unit works on data at the most basic level. The tutor could introduce this topic by demonstrating how a CPU addresses memory to perform a read-execute cycle under the control of an electronic clock. The learners could be shown the actual CPU with a brief description of the pin functions and how to identify the make of the CPU. The instructions and data are held externally to the CPU and must be located by an address bus and transferred over a data bus.</p> <p>Learners could be divided into at least two groups. Each group could then be directed to research information on the initial read cycle of a specific make of CPU of their choice, perhaps one that they have observed on an actual motherboard. They could then report the following information back to the whole group:</p> <ul style="list-style-type: none"> • CPU make • Address bus width • Data bus width • Address of the first instruction to be executed • A typical instruction that may be located at that address • What happens after that first instruction has been executed. <p>Tutors and learners may find the following resources helpful:</p> <p>How a CPU Works. A video clip describing the internal operations of a Central Processing Unit. This resource can be found at: https://www.youtube.com/watch?v=cNN_tTXABUA</p> <p>How Computers Work – The CPU and Memory. A very descriptive web page on the functions of the CPU can be found at: http://homepage.cs.uri.edu/faculty/wolfe/book/Readings/Reading04.htm</p>	2 hours	Unit 1 LO1 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
CPU chipset functions	<p>The tutor could introduce this topic by explaining that a CPU can only operate by communicating with a range of components such as memory, graphics and hard drives. Chipsets provide a means of connecting all these devices to the CPU and are very tightly bound to the type of CPU. Learners could be shown the chipset on a motherboard and also shown how to identify the chipset.</p> <p>Learners could be split into two or more groups. Each group could identify the CPU on a motherboard. They could then research a suitable chipset for the identified CPU. The groups could then report their findings back to the whole group and include a brief description of the purpose of their particular chipset.</p> <p>Tutors and learners may find the following resources helpful:</p> <p>Motherboard Chipsets – https://www.youtube.com/watch?v=ncwhmz7hH54 A video clip providing a good description of chipset functions.</p> <p>List of Intel chipsets – https://en.wikipedia.org/wiki/List_of_Intel_chipsets A list of current chipsets with extensive details.</p>	1 hour	Unit 1 LO1 Unit 3 LO1
Motherboard parts and functions	<p>Learners must understand that a fully populated motherboard represents almost the entire computer. It hosts the CPU, associated chipset, memory, CPU heatsink and cooling fans as well as all the connectors for peripheral devices. The tutor could demonstrate the components of a specific computer motherboard.</p> <p>The tutor could then split learners into at least two groups. Each group could then be given a motherboard (different from the motherboard used for demonstration by the tutor) and compete with the other groups to identify as many components as possible.</p> <p>Each group compiles a list of motherboard components together with a brief explanation of each component. The winning group is the group with the greatest number of correct answers.</p> <p>Tutors and learners may find the following resources helpful:</p> <p>Motherboard Parts and Functions https://www.youtube.com/watch?v=yvboTSpVyfc A video that demonstrates the parts and functions of a motherboard.</p> <p>Parts of a Motherboard http://www.pantherproducts.co.uk/posts/parts-of-a-motherboard/ Details the components of a motherboard.</p>	1 hour	Unit 1 LO1 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
The motherboard BIOS	<p>The tutor could introduce this topic by explaining that the BIOS is the bridge between the operating system on the computer and all the hardware associated with the motherboard. The BIOS is a program that can control and monitor all the motherboard devices and needs to be updateable by the manufacturer to include extra functions, features as well as to correct bugs.</p> <p>Groups of learners could be tasked to identify the BIOS device on a specific motherboard. The groups could then research the purpose of the BIOS for their particular motherboard. Each group could then compile a list of BIOS details to be reported back to the whole group to include information such as:</p> <ul style="list-style-type: none"> • Purpose of the BIOS • BIOS manufacturer • Type of memory device that stores the BIOS • Reason for storing in this type of device • At what point are instructions in the BIOS executed for the first time? • The address used by the CPU to locate the first ever instruction in memory for this motherboard. <p>Tutors and learners may find the following resources helpful:</p> <p>What is BIOS in computers & how does it work? http://www.thewindowsclub.com/what-is-bios-in-computers-how-does-it-work A web page outlining the function of the BIOS and how to work with it.</p> <p>How BIOS Works http://how-bios-works.articles.r-tt.com/ A page that describes how the BIOS works and some details of functions it carries out.</p>	1 hour	Unit 1 LO1 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
The graphics processing unit	<p>The tutor could introduce this topic by explaining the need for a GPU in offloading the work required of the motherboard CPU. The location of the built-in GPU could be demonstrated on an actual motherboard.</p> <p>Learners must understand that not all motherboards will host a built-in GPU and so will need the addition of an extra card to fit on the motherboard. Even those motherboards that do have a built-in card may not have sufficient features so that they require an extra card anyway, especially to the gamer.</p> <p>Groups could be tasked with identifying the GPU on a motherboard. The built-in GPU can be identified using the Systems Information utility located in System Tools on a PC. Using this information they could then research the features of their identified GPU.</p> <p>The groups could then report back the results of their research to include:</p> <ul style="list-style-type: none"> • The name of the identified GPU • Whether built-in or additional • Top three GPU features for the gamer. <p>Tutor and learners may find the following resources useful:</p> <p>How A Graphics Card Works https://www.youtube.com/watch?v=calYxuPVCp0 A very helpful video although the narrator hasn't noticed the bird singing in the background.</p> <p>How Graphics Cards Work http://computer.howstuffworks.com/graphics-card1.htm A page that describes the function of the GPU.</p>	1 hours	Unit 1 LO1 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Choosing a storage solution	<p>Learners must understand the options available when choosing a storage unit for a new computer or when replacing the drive in a computer. Cost will usually be high on the list of priorities when making a choice, but very often cost should be lower down on the priority list.</p> <p>The tutor could introduce this topic by demonstrating a range of computer storage solutions with emphasis on the features of each device such as: type (solid state, virtual, magnetic), capacity, reliability and speed. It may be possible to arrange a visit to the school server room where an IT technician could allow the learners to observe the storage system.</p> <p>Learners must understand that choice of disk for critical applications may require some expensive features to be included.</p> <p>The tutor could split learners into two or more groups. Each group could then be tasked to research a solution for a new storage unit for the school server. The server hosts all the video and audio files for the entire school. Groups will report three possible solutions back to the whole group. The report could include for each solution:</p> <ul style="list-style-type: none"> • Manufacturer • Capacity • Access time • Type • Estimated cost • Recommended solution. <p>Tutors and learners may find the following resources useful:</p> <p>Contest: How to Choose Storage https://www.youtube.com/watch?v=eiDaxbFYDyY A video related to a contest about building a PC.</p> <p>Choosing the Best Data Storage Solution http://www.entrepreneur.com/article/172226 A page providing details about the kind of choices to be made in choosing storage for a computer.</p>	1 hour	Unit 1 LO1 Unit 3 LO1

SUGGESTED ACTIVITIES

LO No:	2		
LO Title:	Be able to propose a computer system for identified business requirements		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Planning a computer system	<p>The tutor could introduce this topic by explaining that all computer systems are built with a particular purpose in mind. The computer to be built might be a general purpose desktop like those in the classroom where the components are required to support the whole range computing activities carried out by learners. However, when it comes to computers that will perform the role of servers, for example, then the choice of components may be much more extensive and their specifications much more exacting. It may be possible to organise a visit to the school server room where an IT technician could demonstrate the differences between servers and desktop computers.</p> <p>Learners must understand that cost is a major consideration when planning a new computer. The cost must be balanced against what the computer is required to do for the end user.</p> <p>Scenario: The centre requires a new file server because the existing server does not have the capacity to host the vast range of audio and video files that have been purchased by the multimedia department. A plan is required for the new server.</p> <p>The tutor could split learners into two groups. Each group could then research the requirements for a new computer. Each group will then compile a prioritised list of the top five questions they would ask the user, together with a brief reason, regarding the requirements of the new system. The groups could then report their findings back to the whole group.</p> <p>Tutors and learners may find the following resource helpful: Key Questions When Planning a Computer System http://managementhelp.org/computers/planning.htm</p>	2 hours	Unit 1 LO1, LO2, LO3, LO4, LO5 Unit 2 LO1, LO5, LO6 Unit 3 LO1 Unit 6 LO2 Unit 8 LO2 Unit 9 LO2

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Discovering single points of failure	<p>The tutor could introduce this topic by explaining that the failure of a single component on a desktop computer will often mean that the computer will be unusable until it is repaired.</p> <p>Learners must understand that the inconvenience to many users as a result of server outage due to failure of a single component requires planning for such 'single points of failure'</p> <p>Scenario: The centre has introduced a facility whereby the learners can access all their work from home and participate in centre work online. The user requirements require the centre web server to be available 24/7.</p> <p>The tutor could split learners into at least two groups to research 'single points of failure'. The groups could then compile a list of three key areas where single points of failure could occur and include brief reasons.</p> <p>Tutors and learners may find the following helpful: Single point of failure (SPOF) http://searchdatacenter.techtarget.com/definition/Single-point-of-failure-SPOF</p>	1 hour	Unit 1 LO1, LO2, LO3 Unit 2 LO1, LO5
Computer clustering	<p>Learners must understand that the highest level of hardware redundancy is the computer itself. If a standby server is available, containing all the applications of a failed server, this can be started and somehow the users could then be connected to the new server and continue to work. This would not be a highly available solution though since users will have difficulty in continuing the work just prior to the failure.</p> <p>The tutor could demonstrate this problem by having two group members play the role of an active server and standby server respectively. Initially the group will be connected to the active server; each member of the group will take note of what they are currently doing on the server: writing a report, reading a web page etc. The tutor will then deem the active server failed and, after a few minutes, deem the standby server active. The group could then discuss any loss of data or functionality that has occurred on the switchover and the reasons.</p> <p>Learners could now be split into two groups. Each group could research the topic of 'computer clustering'. The groups could then compile a brief list of why clustering would solve the issues arising from the group exercise. The groups could then report back to the whole group.</p> <p>Learners and tutors may find the following helpful:</p> <p>Windows Server 2008 R2 Failover Clustering Introduction https://www.youtube.com/watch?v=wcByPD_PuQE Clustering is a very complex topic. The first 10 minutes of this video demonstrates the terminology and components involved in ensuring the online resource is available even if one of the computers fails. It is unnecessary to view the remainder of the video.</p>	1.5 hours	Unit 1 LO1, LO2, LO3 Unit 2 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Disk drive redundancy	<p>The tutor could introduce this topic by considering a file server, say, with a single hard drive. Such a hard drive would have to support the computer operating system as well as the installed applications; it is also quite likely to be electro-mechanical and so it is vulnerable to mechanical failure. Such a failure would mean complete disruption for all users of the server and possibly loss of data.</p> <p>Learners must understand that if servers are to be highly available to users then the disk hardware must continue to work, without interruption, in the face of complete disk failure of a single disk. Disk mirroring and RAID are common solutions in applying redundancy to a computer hard drive system.</p> <p>Learners could be split into groups that could research the use of Disk Mirroring and RAID within computer hardware. They could then devise an outline procedure to install a basic version of RAID and Mirroring, using multiple hard drives, on a server. The groups could then report their procedures back to the whole group.</p> <p>Tutors and learners may find the following helpful:</p> <p>How to Set up a Mirrored Array in Windows 8.1 https://www.youtube.com/watch?v=LZeMVg0242M A video outlining how RAID and Mirroring is set up using an operating system.</p> <p>How to Mirror a Hard Drive http://www.wikihow.com/Mirror-a-Hard-Drive</p> <p>RAID http://searchstorage.techtarget.com/definition/RAID</p>	1.5 hours	Unit 1 LO1, LO2, LO3 Unit 2 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
NAS and SAN	<p>The tutor could introduce Storage Area Networks (SAN) and Network Attached Storage (NAS) by explaining the need, in some situations, to have storage independent from the hardware of the computer that uses it.</p> <p>Learners must understand that Direct Attached Storage (DAS) can represent a weakness with regard to capacity and reliability when used within critical systems such as file servers.</p> <p>The learners could be split into groups to research the competing SAN and NAS technologies for computer storage.</p> <p>Scenario: The centre would like to use a network technology to store data for all the IT servers, but is unable to afford any external help for this venture and will have to rely entirely on the centre IT staff for design, installation and maintenance. The servers currently have a combined capacity of 40TB.</p> <p>Each group will recommend either SAN or NAS with brief reasons. Groups will then report their findings back to the whole group.</p> <p>Tutors and learners may find the following helpful:</p> <p>What is network storage? https://www.youtube.com/watch?v=2T99tW1KEMc A video clip introducing storage technology; DAS, NAS and SAN.</p> <p>Still confused about NAS? NAS explained in 3 minutes https://www.youtube.com/watch?v=k13sQxybqiA A video clip explains.</p>	1.5 hours	Unit 1 LO1, LO2, LO3 Unit 2 LO1 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Load balancing	<p>The tutor could introduce this topic by explaining how web pages are requested from a web server. If two web servers held the exact same set of pages then users could request pages from either so long as there was a way in which each request could be directed to a different web server. In this way the available capacity can be increased simply by adding another web server to the network.</p> <p>Learners must understand that components like web servers have to serve pages to many users, perhaps millions. Think of Amazon; the web server will only have finite resources (CPU, memory etc) to serve pages to its users and then no further page access is possible. If users can be directed to different web servers with the exact same content then the users will be able to split the load between servers. Very often we hear in the press that ‘the website crashed because of high demand’; this is an example of web servers being expected to operate when resources are exhausted.</p> <p>The learners could be split into groups to consider load balancing on the school website.</p> <p>Scenario: Because of high demand the IT technician has built an exact copy of the current web server but they are not sure how they might use these together.</p> <p>Groups could research load balancing and provide some information to the technicians to help them configure the system.</p> <p>Each group could provide a brief description of load balancing a web server and report this back to the whole group.</p> <p>Tutors and learners may find the following resources helpful:</p> <p>Networking 101 - Load Balancers https://www.youtube.com/watch?v=zHn2G71hok A YouTube clip on load balancing.</p> <p>Network Load Balancing Overview https://www.youtube.com/watch?v=nrgS5q3ifWg This video clip gives a good overview of what load balancing is and the terminology associated with it. However, it is part of a Microsoft Certification course and so it refers to some other parts of that course. The clip also explains that there are limitations to the type of application that can be balanced.</p> <p>Load balancing (computing) https://en.wikipedia.org/wiki/Load_balancing_(computing) Wiki definition of load balancing.</p>	2 hours	Unit 1 LO1, LO2, LO3 Unit 2 LO1 Unit 4 LO1, LO2

SUGGESTED ACTIVITIES

LO No:	3		
LO Title:	Be able to build or upgrade computers		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Anti-static precautions	<p>The tutor could introduce this topic by explaining that many computers are built or upgraded where no precautions have been observed with regard to electro-static discharge (ESD) and where no resulting damage has occurred to the computer.</p> <p>Learners must understand that ESD can cause immediate catastrophic damage to some components, but the most likely damage is a degradation of components. Early failure of affected components is usually no longer linked to ESD.</p> <p>Learners could be split into two groups, each group being directed to research the effect of ESD on computer components. The groups could report back to the whole group on two of the most common precautions against ESD during computer build or upgrade.</p> <p>The report should also include:</p> <ul style="list-style-type: none"> • How the measure works • Possible health and safety dangers in using the measures. <p>Tutor and learners may find the following helpful: Safety Precautions in Handling Computers http://www.sbca.warduz.com/index.php?option=com_content&view=article&id=94:safetyprec&catid=36:fundit</p> <p>Electrostatic Discharge: Causes, Effects, and Solutions http://ecmweb.com/content/electrostatic-discharge-causes-effects-and-solutions</p> <p>Anti-Static and Safety Precautions http://www.kitchentablecomputers.com/static.php</p>	1 hour	Unit 1 LO1, LO5

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Computer tools	<p>The tutor could introduce this topic by explaining that it is possible to build an entire computer with tools that comprise only a pair of pliers and a screwdriver.</p> <p>Learners must understand that the professional build or upgrade of a computer will require the use of a wide range of readily available tools. Such tools ensure that the computer is built effectively while also observing health and safety precautions.</p> <p>Learners could be split into at least two groups with one group directed to research tools for a computer build. The other group could research health and safety measures to be considered during a computer build. Each group could then compile a prioritised list of tools/measures they would consider for a build and give brief reasons for the choice as well as priority.</p> <p>Tutors and learners may find the following resource helpful:</p> <p>Essential tools for building, repairing, and upgrading PCs (and other electronic devices) http://www.pcworld.com/article/2017370/essential-tools-for-building-repairing-and-upgrading-pcs-and-other-electronic-devices.html</p>	1 hour	Unit 1 LO1
The BIOS	<p>The tutor could introduce this topic by demonstrating to learners the BIOS device on a motherboard and explaining its function and how to identify the manufacturer of the device.</p> <p>Learners must understand that the BIOS holds the first instructions that a CPU will execute when the computer starts up. The instructions in this device are responsible for testing and communicating with all motherboard devices before the operating system is installed. If there are bugs in the BIOS program then this could result in failure of some of the features of the operating system when it is installed. Manufacturers issue updates to their BIOS programs to overcome bug problems.</p> <p>The tutor could split learners into two groups. The groups could then discover the BIOS details of a classroom computer using the 'System Summary' in the System Information utility. The groups could then research their identified BIOS storage and report their findings back to the whole group. The report could include:</p> <ul style="list-style-type: none"> • Manufacturer and version on the computer • Latest version available from the manufacturer • Type of device used to store the BIOS program • Give a reason for the choice of device type • Any precautions to observe on BIOS update. 	1 hour	Unit 1 LO1, LO2 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
BIOS configuration	<p>The tutor could introduce this topic by demonstrating how the BIOS can be configured by a user so that the computer hardware can be set up (time, date, disks, fans, USB, password etc) according to the user's needs.</p> <p>Learners must understand that configuration settings must be saved for when the computer is shut down and then restarted later. These settings are saved in CMOS memory.</p> <p>The tutor could split learners into at least two groups, each group being directed to research the configuration details on the BIOS of a classroom computer. The manufacturer can be discovered using the System Information utility. Groups could report back to the whole group with the following information:</p> <ul style="list-style-type: none"> • BIOS manufacturer • Method of entering the BIOS • Process for setting a BIOS password • Consequences of setting a BIOS password and then forgetting the password • Process for saving BIOS changes to the CMOS memory. <p>Tutors and learners may find the following resources helpful:</p> <p>BIOS http://pcsupport.about.com/od/termsb/p/bios.htm</p> <p>What is the difference between BIOS and CMOS? http://www.computerhope.com/issues/ch001360.htm</p>	1 hour	Unit 1 LO1, LO2 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Disk drive partitioning	<p>The tutor could introduce this topic by explaining what it means to partition a disk drive. This could then be followed by demonstrating partitioning on an actual computer.</p> <p>Learners must understand that the partitioning process is a destructive procedure and is commonly carried out during the commissioning of a new computer. However, partitioning may be required after a computer has been in operation for some time.</p> <p>Learners can be split into two groups, with each group provided with the following scenario.</p> <p>Scenario: Your group built a PC for a customer 12 months ago. The PC houses only a single physical 2TB drive. The customer calls to say that they wish the data on the disk to be stored in a different partition from that of the operating system.</p> <p>Each group could research this issue and report back to the whole group. The report should include:</p> <ul style="list-style-type: none"> • Outline the steps to partition the disk • Precautions to be taken when carrying out the procedure. <p>Tutors and learners may find the following resources useful:</p> <p>Hard Disk repartitioning using Disk management tool https://www.youtube.com/watch?v=YYjvRVIRQvs</p> <p>How to partition a hard drive http://www.pcworld.com/article/2066191/how-to-partition-a-hard-drive.html</p>	1.5 hours	Unit 1 LO1, LO2 Unit 3 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Preventative maintenance	<p>The tutor could introduce this topic by explaining that the school IT infrastructure will require ongoing monitoring to ensure that services are highly available to the learners and staff. Computer hardware can get hot and dirty and components fail. Staff and learner data will require safeguarding.</p> <p>The tutor could then demonstrate some tools that can be used as part of IT preventative maintenance.</p> <p>Learners could be divided into at least two groups. Each group is tasked with carrying out research on IT preventative maintenance. The groups are required to compile a list of items to include in the school IT Maintenance Plan. Some of these items may appear in more than one category: for example, incremental and full backups. The report from each group is fed back to the whole group and could include:</p> <ul style="list-style-type: none"> • Interval: <ul style="list-style-type: none"> – Daily (2 items) – Weekly (2 items) – Monthly (2 items) • A suggestion as to how some of the tasks can be automated. <p>Tutors and learners may find the following resources helpful:</p> <p>Preventive Maintenance Best Practices https://www.youtube.com/watch?v=DSf1a6Jxzo4</p> <p>Hardware Tips: Complete PC Preventive Maintenance Guide http://www.pcworld.com/article/116583/article.html</p>	1.5 hours	Unit 1 LO1, LO2, LO3

SUGGESTED ACTIVITIES

LO No:	4		
LO Title:	Be able to test and evaluate the functionality of computer systems		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Disk diagnostics	<p>Tutors could introduce this topic by discussing the various ways that disk drives can fail; either during normal operation or under stress. Fragmentation of files is a fact of life on disk drives, but it does cause problems and sometimes file corruption.</p> <p>Learners should understand that all disks, being mechanical, are destined to fail in the long run. Failure may also occur through increasing areas of the disk no longer being able to hold data.</p> <p>Scenario: The centre's 100 computers have recently been upgraded with a larger single-disk 2TB drives. Over the last week the IT help desk records show that 25 of the upgraded machines have experienced random 'blue screen' crashes. In all cases the computers can be started again but some of the learners' work is being corrupted.</p> <p>The tutor could divide the learners into two or more groups. Each group could create a formal test plan with three tests using different tools to investigate the potential disk problem</p> <p>Groups could report back to the whole group with:</p> <ul style="list-style-type: none"> • Test plan • Tools used. <p>Tutors and learners may find the following resources helpful:</p> <p>14 Free Hard Drive Testing Programs http://pcsupport.about.com/od/toolsofthetrade/tp/tophddiag.htm</p> <p>How To Test The Health Of Your HDD Drive http://www.digitalcitizen.life/how-test-health-your-hdd-drive</p>	1 hour	Unit 1 LO1, LO2, LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Memory diagnostics	<p>The tutor could introduce this topic by explaining the ways that memory can fail in a computer. This could be followed by demonstrating how to use a memory diagnostic tool. Most operating systems have a built-in memory diagnostic utility but others are available for download.</p> <p>Learners need to understand that memory can fail partially. Such a partial failure may give rise to sudden crashes and other faults that may look like hardware problems. Simply writing data to memory and reading it may not be enough to expose a memory device as failing.</p> <p>The tutor could split learners into two or more groups. Each group could then research the symptoms of memory failure on a computer. The groups would then write down a memory test procedure that can be used by the IT support technician. The groups could report back to the whole group the following:</p> <ul style="list-style-type: none"> • The procedure to test memory on a computer • Explain why some tests take so long to complete • The name of a built-in memory test • The name of an external memory test. <p>Tutors and learners may find the following resources helpful:</p> <p>Windows 8 Memory diagnostics tool for ram problems https://www.youtube.com/watch?v=PCDc0cQAK5E</p> <p>5 Symptoms of a RAM Problem and How to Fix It http://hubpages.com/technology/5-Symptoms-of-a-RAM-Problem-and-How-to-Fix-It</p> <p>Diagnosing memory problems on your computer http://windows.microsoft.com/en-gb/windows7/diagnosing-memory-problems-on-your-computer</p>	1.5 hours	Unit 1 LO1, LO2, LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Using Event Viewer	<p>The tutor could introduce this topic by explaining that when an operating system loads and runs, it will record numerous details about the computer system during the time it is running. These recordings are called 'events' and instead of showing these on the display for the user to see, they are instead quietly logged in a file which can be examined at any time. Some of these events will be simply informational, but others may signal serious problems.</p> <p>The tutor could then demonstrate how the built-in Event Viewer utility can be started and how it can be used to show the various categories of events.</p> <p>Learners should understand Event Viewer offers the possibility of discovering problems on a computer system and being provided with details that can help to diagnose the cause of these problems.</p> <p>The learners could be split into at least two groups. The groups can then be tasked with finding one critical event, one Error event and one Warning event in the system log. They could then use the associated error ID for each event to 'Google' the likely causes of these events. The groups could then report their findings back to the whole group.</p> <p>Tutors and learners may find the following resources helpful:</p> <p>Diagnose Windows Problems Using the Event Viewer https://www.youtube.com/watch?v=3FAfM469WSQ</p>	1.5 hours	Unit 1 LO1, LO2, LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
<p>Command prompt diagnostics and repair</p>	<p>The tutor could introduce this topic by explaining that operating systems will usually include a range of tools to aid a technician in diagnosing system problems and even repairing them. Many of these tools are used from the command console because they avoid having to use the computer graphics system and also because they can be run automatically by including the commands in the computer scheduler.</p> <p>The tutor could then demonstrate how to enter the command console and execute a command. Note that commands that can potentially modify the system will need to be 'Run as Administrator'! The command used could be, for example, the System File Checker. This command will verify the integrity of all the system files. Missing or corrupt files are replaced. Enter the command as Administrator:</p> <ul style="list-style-type: none"> • sfc /? (to get help) • sfc /scannow (to test and repair). <p>Learners should understand that IT technicians must not only be aware of the tools available to assist with solving problems, but also how these tools are used. Tools that are run at the command console will usually have multiple options that can be applied when they are executed. Such commands will also usually have a means of asking for help; sometimes simply by typing 'help' with the command, sometimes by appending '/?' to the command.</p> <p>The tutor could split the learners into at least two groups. Each group could then be tasked with researching two command console tasks other than the System File Checker that can assist in diagnostics and repair of the computer system. They could report back to the whole group by:</p> <ul style="list-style-type: none"> • Naming the command • Specifying the command purpose • Giving two options for running the command. <p>Tutors and learners may find the following resources helpful:</p> <p>Windows Command Line Troubleshooting - CompTIA A+ https://www.youtube.com/watch?v=PZYtR_VfCTY</p> <p>This video clip is part of a CompTIA A+ course and it is quite long at 30 minutes duration. However, although all of the clip is of interest for diagnostics, it is the first 10 minutes that are particularly helpful in demonstrating using the command line.</p> <p>10 Windows 7 commands every administrator should know http://www.techrepublic.com/blog/10-things/10-windows-7-commands-every-administrator-should-know/</p> <p>The Best Tools Hidden in Windows' Command Line http://lifelhacker.com/the-best-tools-hidden-in-windows-command-line-1553193077</p>	2 hours	Unit 1 LO1, LO2, LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Working with device drivers	<p>The tutor could introduce this topic by explaining that any hardware added to a computer, for example a Bar Code Reader, will need to add code to the operating system if the computer is to be able to interact with it. This code is called a 'device driver'. The driver code is the responsibility of the hardware manufacturer and is usually supplied with the device.</p> <p>Learners should understand that operating systems must make provision for 'plugging in' this code into the computer in order to work with these devices. The addition, removal, updating and maintenance of device drivers is accomplished by tools supplied by the operating system.</p> <p>The tutor could split the learners into two groups and they are directed to research tools to assist with driver troubleshooting. They could be given the scenario that a Bluetooth driver for the classroom PCs was recently updated and now the computers crash.</p> <p>The groups will report back to the whole group on one tool that they could use to help to rectify the issue with the driver and include the following:</p> <ul style="list-style-type: none"> • Specify the tool • Demonstrate how to run the tool • Explain the tool's purpose. <p>Tutors and learners may find the following resources helpful:</p> <p>Troubleshooting Devices Drivers https://www.youtube.com/watch?v=2mTboQd3XsY</p> <p>What is a Hardware Driver? http://www.wisegeek.com/what-is-a-hardware-driver.htm</p> <p>Troubleshoot & fix Device Driver Problems in Windows 10-8-7 http://www.thewindowsclub.com/tips-to-fix-common-driver-problems-in-windows-7</p>	1.5 hours	Unit 1 LO1, LO2, LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Computer benchmarking	<p>The tutor could introduce this topic by explaining what benchmarking is and why you would want to conduct benchmarks on a computer. It doesn't necessarily take much expertise to purchase the individual components of a computer and assemble them into a working product. However, the way in which the components of memory, storage, CPU and network work together can mean that the new computer may not be operating at its best. Similarly, an existing high performing system may deteriorate when problems occur with the components of the system. Benchmarking records enable comparisons of performance and provide a tool to help diagnose faults. The tutor could then demonstrate the use of one benchmarking product.</p> <p>Learners need to understand that putting a computer together and getting it to work is not the same as getting a computer that will work at its best. Each component is a potential bottleneck on performance. Adding more memory may reduce the need to use disk for virtual memory, but because the application can now work faster, this may mean a bottleneck on the network traffic on the computer.</p> <p>The learners could be split into at least two groups to research one benchmarking software product to be used on a new classroom computer build for the school network. The groups will report their findings back to the whole group to include:</p> <ul style="list-style-type: none"> • The benchmarking product • Reasons for choice of product • Main features of the product • How the product might be used to diagnose problems. <p>Tutors and learners may find the following resources helpful:</p> <p>How to Benchmark Your PC https://www.youtube.com/watch?v=X7NgcYfywNc This video clip demonstrates what benchmarking actually is and includes a reference to free software that can be downloaded to do benchmarking. The clip is 20 minutes long, but the first 5 minutes provides the essential information.</p> <p>How to Benchmark Your PC for Free http://www.pcworld.com/article/258473/how_to_benchmark_your_pc_for_free.html</p> <p>You built a computer. Now what? https://www.reddit.com/comments/fw0gw/you_built_a_computer_now_what</p>	1.5 hours	Unit 1 LO1, LO2, LO3



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