SQA Advanced Unit Specification

General information for centres

Unit title: Computer Hardware: Desktop Computer Troubleshooting

Unit code: HT0R 48

Unit purpose: This Unit is designed to enable candidates to work effectively whilst troubleshooting and repairing desktop computers in a professional practice/consultancy or installation/technical support role within manufacturing, commercial or domestic sectors of industry. Candidates will learn about the operation of modern desktop computer components, common peripherals, common hardware and software faults as well as industrial practice and standards. Candidates will also gain experience of simplifying complex problems and an appreciation of safe working practice. The Unit is primarily intended for candidates who expect to work in a computer troubleshooting or support role, but is also relevant to all those on an IT course who require a deeper or more effective understanding of modern desktop computers.

On completion of the unit, the candidate should be able to:

1. Describe desktop computer system components and hazards.
2. Describe approaches to troubleshooting and test methods.
3. Recognise and understand common hardware problems.
4. Troubleshoot hardware using test methods.
5. Investigate and solve system software problems.

Credit points and level: 2 SQA Credits at SCQF level 8: (16 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the Centre, however it is recommended that candidates should have a good working knowledge of building or maintaining personal computers. This can be evidenced by possession of the SQA Units *Computer Hardware: Installation and Maintenance* and *Computer Hardware at* SCQF level 7*: Building a Network PC* and also provides evidence that candidates are aware of the safe working practices when working with personal computers. Candidates who do not have the Unit *Computer Hardware: Installation and Maintenance* and/or *Computer Hardware: Building a Network PC* will be required to undertake a short written assessment after a lecture on safe working practice before commencing with this unit. Candidates are then required to sign a document to acknowledge they have been made aware of the pertinent safety issues.

Candidates would also benefit from knowledge of basic electronics, basic computer architecture, computer operation, binary and hexadecimal number systems which may be demonstrated by possession of the SQA Units *Computer Architecture 1* and *Computer Operating Systems 1* at SCQF level 7.

Core skills: There may be opportunities to gather evidence towards core skills in this Unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: This Unit is included in the framework of the SQA Advanced Computing programme and is suitable for other related disciplines. It is recommended that it should be taught and assessed within the context of the particular group award to which it contributes. Candidates should have a good working knowledge of computer system components.

Assessment: All of Outcomes 1 and 2 along with Assessment Task 1 of Outcomes 3 and 5 are each a closed book assessment which test the knowledge and skills of each particular outcome and must be undertaken in closed book conditions. All of Outcome 4 with Assessment Task 2 of Outcomes 3 and 5 are practical and open book. The assessment summary for the whole of this Unit is described in the following table –

	Multiple choice assessment	Practical
Outcome 1	√	
Outcome 2	√	
Outcome 3	√	√
Outcome 4		√
Outcome 5	√	√

Any assessment activity involving practical work should be carried out in supervised conditions sufficient to ensure the confidence in the authenticity of submissions and that a candidate is working within the correct health and safety guidelines.

Candidates must be encouraged to work safely at all times, to identify workplace risks and respond appropriately by changing working practices and minimising and reporting hazards.

The candidate and the assessor should endorse a written document to certify that safe working practices have been explained and demonstrated to him/her. As a simple safety precaution, this practice is also recommended as a prerequisite for any candidate attempting practical work.

Some of the evidence requirements may be produced using e-assessment. This may take the form of e-testing (for knowledge and understanding) and/or e-portfolios (for practical abilities). There is no requirement for you to seek prior approval if you wish to use e-assessment for either of these purposes so long as the normal standards for validity and reliability are observed. Please see the following SQA publications for further information on e-assessment: (i) *SQA Guidelines on Online Assessment for Further Education* (March 2003) and (ii) *Assessment and Quality Assurance in Open and Distance Learning* (Feb. 2001).

If a centre is presenting Outcome 1 and 2 along with Assessment Task 1 of Outcomes 3 and 5 on-line the following assessment methods, where appropriate, may be selected –

- Multiple choice
- Drag and drop
- Multiple response
- Mix and match
- A combination of the above

It is expected that the questions will be of the multiple choice variety. Centres may consider the use of alternative questions types, particularly if using Computer Assisted Assessment approaches. However, care should be taken that the questions are valid and at an appropriate level. The use of simple true/false question responses is unlikely to achieve this.

Safe working practice must be observed during **all** practical exercises.

SQA Advanced Unit specification: statement of standards

Unit title: Computer Hardware: Desktop Computer Troubleshooting

Unit code: HT0R 48

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence required are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe desktop computer system components and hazards

Knowledge and/or skills

- Identify potential hazards in the working environment
- Identify safe working practices
- Identify major components contained within a standard computer system and understand their interaction
- Understand each stage of the boot process

Evidence requirements

Each candidate will be required to provide evidence of his/her knowledge and skills for the following:

- Potential hazards in the working environment
  Hazards should be correctly identified. A candidate **must** demonstrate knowledge of the hazards present during the troubleshooting of a computer system.

- Identify safe working practices
  The main attributes that contribute to safe working practices must be described, in relation to the correct use of tools, test equipment, anti-static precautions, suitable clothing and safety equipment.

- Identify major components contained within a standard computer system and understand their interaction
  A candidate must demonstrate an ability to identify the major components of a desktop system and understand how they interact.

- Understand each stage of the boot process
  A candidate must demonstrate knowledge of the boot process and each of it stages

Safe working practice should extend to the equipment as well as the candidate.

Evidence for all the knowledge and/or skills in this Outcome will be assessed using a representative sample of 20 multiple choice questions. All knowledge and skills bulleted points must be covered. The questions presented must change on **each** assessment occasion.

The assessment must be undertaken in supervised conditions and is closed book. Candidates may not bring to the assessment event any notes, textbooks, handouts or other material (calculators are not allowed). A candidate should complete this assessment within one hour.

Candidates must answer at least 60% of the questions correctly.

If a centre is presenting this assessment on-line the following assessment methods, where appropriate, may be selected –

- Multiple choice
- Drag and drop
- Multiple response
- Mix and match
- A combination of the above

Assessment guidelines

There is an opportunity for a candidate to be assessed on-line subject to meeting the prescribed assessment conditions.

Outcome 2

Describe approaches to troubleshooting and test methods

Knowledge and/or skills

- Understand approaches to troubleshooting
- Understand test methods
- Understand how to document faults
- Understanding how the use of other sources of information assist in troubleshooting

Evidence requirements

Each candidate will be required to provide evidence of his/her knowledge and skills for the following:

- Understand approaches to troubleshooting
  A candidate must understand how to prepare for troubleshooting by defining the fault accurately, using a Simple Linear or Half Split approach.

- Understand test methods
  A candidate should understand how physical testing should be carried out using safe and proper methods of common test equipment.

- Documentation of faults
  A candidate must understand the importance of documentation as a resource for finding future faults and methods of obtaining fault information from a user, who may not always be a technical user.

- Using sources of information to assist in troubleshooting
  A candidate must know where to look for further help and/or assistance in identifying a solution to a fault if the fault cannot be identified using resources such as manufacturer manuals, manufacturer's website or technical forums.

Evidence for all the knowledge and/or skills in this Outcome will be assessed using a representative sample of 20 multiple choice questions. All knowledge and skills bulleted points must be covered. The questions presented must change on **each** assessment occasion.

Assessment must be undertaken in supervised conditions and is closed book. Candidates may not bring to the assessment event any notes, textbooks, handouts or other material (calculators are not allowed). A candidate should complete this assessment within one hour.

Candidates must answer at least 60% of the questions correctly.

If a centre is presenting this assessment on-line the following assessment methods, where appropriate, may be selected –

- Multiple choice
- Drag and drop
- Multiple response
- Mix and match
- A combination of the above

Assessment guidelines

There is an opportunity for a candidate to be assessed on-line subject to meeting the prescribed assessment conditions.

Outcome 3

Recognise and understand common hardware problems

Knowledge and/or skills

- Understand BIOS functionality and reprogramming
- Understand features and implications of CMOS settings and how to change them
- Given a problem situation, interpret the symptoms and infer the most likely cause, identifying steps taken to isolate fault
- Recognise failure symptoms of CMOS battery
- Recognise common problems associated with computer system modules and their symptoms

Evidence requirements

The assessment of this Outcome requires a candidate to undertake Assessment Task 1 and Assessment Task 2.

<u>Assessment Task 1 – Multiple choice Assessment</u>
Evidence for the knowledge and/or skills bulleted points 1 and 2 in this Outcome will be assessed using a representative sample of 20 multiple choice questions that cover each of the following –.

- BIOS functionality and reprogramming

BIOS limitations; understand which features of a computer may not function correctly if BIOS is too out dated, such as –
- memory limitation
- hard disk limitations
- processor incompatibility

Upgrades to firmware; how to upgrade firmware of BIOS to increase functionality.

- CMOS settings –
  - How CMOS settings can affect proper use of a computer system
  - Determine appropriate settings for CMOS to ensure correct operation and how to set appropriate settings in CMOS for a given system.

Assessment must be undertaken in supervised conditions and is closed book. A candidate should complete this assessment within one hour. Candidates may not bring to the assessment event any notes, textbooks, handouts or other material (calculators are not allowed). The questions presented must change on **each** assessment occasion.

Candidates must answer at least 60% of the questions correctly.

If a centre is presenting this assessment on-line the following assessment methods, where appropriate, may be selected –

- Multiple choice
- Drag and drop
- Multiple response
- Mix and match
- A combination of the above

Assessment Task 2 – Practical Exercise

Evidence for the knowledge and/or skills bulleted points 3, 4 and 5 in this Outcome will be assessed using a practical exercise(s). The candidate will be required to identify and document two common faults given a problem situation(s), interpret the symptoms and infer the most likely cause, identifying steps taken to isolate fault and recording details by the use of a pro-forma fault report written up within a candidate logbook for each fault from the following list:

- Recognise failure symptoms of CMOS battery, recognise failure of CMOS and how this can affect the boot process and real time clock (RTC)
- Given a problem situation, interpret the symptoms and infer the most likely cause

The candidate should be able to demonstrate knowledge of logical thought process with regard to troubleshooting and how they might locate faults, based on troubleshooting methods studied in Outcome 2.

The logbook must as a minimum be properly titled with the candidate's name and date, and each entry within signed by the assessor confirming that each task is the candidate's own work.

Assessment guidelines

There is an opportunity for a candidate to be assessed on-line subject to meeting the prescribed assessment conditions for Assessment Task 1.

Outcome 4

Troubleshoot hardware using test methods

Knowledge and/or skills

- Interpret error messages
- Identify steps to isolate and troubleshoot problems
- Troubleshoot system hardware

Evidence requirements

Each candidate will be required to provide evidence of his/her knowledge and skills for the following:

- Interpret Error Messages
  Interpret POST error codes and visual error messages as they occur including failure of the CMOS battery

- Identify Steps to Isolate and Troubleshoot Problems
  A visual aid such as a detailed flowchart should be created to assist the troubleshooting method and completion of the work log. The flowchart and work log should contain the POST error code and/or the visual error message that has been received during the troubleshooting process.

- Troubleshoot System Hardware
  Candidates should demonstrate the ability to follow their previously defined method of troubleshooting a system. The prepared faults within the basic computer system should be correctly analysed. The prepared faults should be corrected using a systematic and logical method. The flowchart should be consulted to aid the troubleshooting process and work log completion.

Evidence must be generated through a practical exercise(s) undertaken in supervised conditions. The candidate must submit a details of the work that they have carried out be writing the details within their logbook detailing the methodology and solution. The logbook **must be completed within and during** the practical exercise. The assessor should ensure that all of the bulleted points in the knowledge and/or skills section are being covered by the candidate activities (and recorded in their logbook). The practical exercise must involve troubleshooting on **two separate** occasions. The assessor must endorse the use of safe working practice by signing all work logs. Safe working practice **must** be observed during the practical exercises.

The work log should include the troubleshooting of hardware faults from power-on to the completion of the boot-up process indicated by a removable media disk prompt. The log should include sufficient detail to illustrate a logical and systematic approach to troubleshooting a desktop system at boot-up.

The logbook must as a minimum be properly titled with the candidate's name and date, and each entry within signed by the assessor confirming that each task is the candidate's own work.

Outcome 5

Investigate and solve system software problems

Knowledge and/or skills

- Describe and interpret boot-up error messages
- Describe how to repair hard-disk boot-up code
- Understand core operating system components
- Understand optional operating system components and how to select them
- Understand software maintenance procedures
- Solve software problems using diagnostic software aids

Evidence requirements

The assessment of this Outcome requires a candidate to undertake Assessment Task 1 and Assessment Task 2.

Assessment Task 1- Multiple choice Assessment
This assessment cover bullet points 1-5. Candidates should provide evidence to demonstrate their knowledge and understanding by answering a representative series of questions on all of the following issues:

- Boot-up error messages
  Describe and interpret the error messages that may be generated during the hard disk boot-up process. Propose solutions for the faults relating to
  - boot failure
  - invalid boot disk
  - inaccessible boot device
  - missing boot files

- Hard-disk boot-up code
  Describe how to create and/or repair the
  - master boot record
  - partition table
  - DOS boot record on the hard disk

- Optional operating system components
  Demonstrate the knowledge of selective disabling of both drivers and application software during the boot process.

- Software maintenance procedures
  Describe accepted software maintenance procedures including
  - software updates
  - backups
  - anti-virus systems
  - filing system integrity testing
  - de-fragmentation.

A description of the methods of correcting faults in applications and data must be provided/included.

Evidence for these points will be assessed using a representative sample of 20 multiple choice questions. All of these five bulleted points must be covered. The questions presented must change on **each** assessment occasion.

Assessment must be undertaken in supervised conditions and is closed book. A candidate should complete this assessment within one hour. Candidates may not bring to the assessment event any notes, textbooks, handouts or other material (calculators are not allowed).

Candidates must answer at least 60% of the questions correctly.

If a centre is presenting this assessment on-line the following assessment methods, where appropriate, may be selected –

- Multiple choice
- Drag and drop
- Multiple response
- Mix and match
- A combination of the above

Assessment Task 2 – Practical Exercise

Evidence for the last knowledge and/or skills bulleted point in this Outcome will be assessed using a practical exercise(s). The candidate should record details by the use of a report written up within their candidate logbook. A candidate will provide evidence to demonstrate their knowledge and/or skills by:

- Solve software based boot problems

  A system software problem must be solved using an efficient and systematic method. This problem will relate to the boot up error messages. An error will be placed on a system and the candidate must be able to troubleshoot the system to fix the fault. This task may be performed with the assistance of a software tool such as a Boot floppy disk and/or Boot CD and the operating system CD.

Assessment guidelines

A CD or floppy disk should be created for the bootable media.

The system software boot-up problem could involve one or any combination of the following: hard-disk boot-up code, core operating system components and optional operating system components and data recovery.

There is an opportunity for a candidate to be assessed on-line subject to meeting the prescribed assessment conditions for Assessment Task 1.

The candidate should be provided with the opportunity to gain practical experience through assisted and unassisted troubleshooting examples on specially prepared systems and as the opportunity arises throughout the course when faults naturally occur.

Safe working practice must be observed during the practical exercise. The assessor must endorse the use of safe working practice by signing all work logs.

Administrative Information

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Unit title: Computer Hardware: Desktop Computer Troubleshooting

Superclass category: CA

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SQA Advanced Unit specification: support notes

Unit title: Computer Hardware: Desktop Computer Troubleshooting

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this Unit

It is essential that candidates are made aware from the outset of the health and safety risks to themselves and others that can arise in working with electrical equipment. The risks to equipment from ESD should also be explained. Safe working practices, which balance these two problems, should then be explained and demonstrated. This is particularly important when candidates will be working in an anti-static environment or using anti-static equipment, which significantly increases health and safety risks if improperly used. It is recommended that candidates should not be permitted to work on live or exposed equipment until they have acknowledged in writing that they have received adequate safety training and have satisfied the requirements of the assessment instrument covering this topic. The importance of strict adherence to safe working practices should be stressed throughout the course.

This Unit is likely to form part of a group award that is primarily designed to provide candidates with technical or professional knowledge and skills related to a specific occupational area. It does require a significant level of prior competence from candidates, and so should be delivered towards the end of an award rather than as an initial Unit.

Wherever possible, this Unit is non-specific about the details of technologies and devices used by the computer systems being studied. This has been done to try to future-proof it in this rapidly evolving field. It is however important that candidates are exposed to a balanced range of both current and historical systems and components. Lack of specificity should not be taken as an excuse to re-deploy obsolete or ‘scrap’ equipment for these classes on the basis that it is more expendable without also providing a satisfactory range of modern components and devices to which candidates can progress once they are more proficient.

Resources

Candidates should be provided with access to the Internet through at least one permanently available resource computer system. This will be used to gain information and access on-line technical resources.

CDROM based technical resources should be installed kept up-to-date and made freely available. For example, Microsoft Developers Network, Microsoft Technet, Component distributor's catalogues and a range of modern diagnostic programs.

During practical exercises, each candidate should be provided with easy access to a working computer system in addition to the subject computer system. The working computer system could be shared between two candidates if space or resources are restricted. However, when assessments are to be carried out, each candidate must have sole access to a computer system.

Workbenches should be roomy and uncluttered. Anti-static work surfaces should be provided. Adequate lighting is essential.

Safety equipment should include ELCB or RCCB trips protecting all mains outlets. Anti-static earth bonding straps should be provided, tested and used.

Recommended tools (available to each candidate) should include:

- Anti-static wrist strap
- No.1 and No.0 point pozidrive screwdrivers (not Philips)
- Small and medium flat blade screwdrivers
- Flat and serrated jaw long-nosed pliers
- 5mm AF (M2.5) Nutrunner / Box spanner
- Small side cutters
- Magnifying Glass
- Tweezers
- Torch

These tools should be of high quality, typically purchased as separate items and not part of a cheap "computer tool kit". It is important to introduce the candidates to the correct tools for the job and avoid low quality, poorly fitting tools, which wear quickly and damage equipment.

Test equipment (available to each candidate) should include:

- Digital Multimeter
- Network cable tester

A range of sample removable media appropriate for the subject computers should be provided.

Spare parts and consumable items:
A selection of hardware should include screws of the two common threads, brass and nylon stand-offs, blanking plates, cable ties and electrical jumpers of appropriate sizes. Spare fuses, cables and fans. Cleaning items should include isopropyl alcohol, anti-static cleaning spray, air duster (compressed air), lint-free cloths, small brushes, and paper towels. It may seem mundane but sometimes the fault is just down to a speck of dirt.

Component spares:
A comprehensive range of spare parts will be required. These should include replacements for all the individual components within the subject computer systems. In some cases it may be difficult to provide exact replacements so suitable alternatives may be substituted. For example, a different make of video card or a different size of hard disk would be suitable.

Workbench equipment:
Each workbench should be provided with a working or spare Monitor, Keyboard, Mouse, Printer, Speakers, Power cable and a Network connection. If the subject computers include older AT equipment, then an additional AT keyboard and Serial mouse will be required. Other services are optional and may be provided if available such as ISDN, ADSL, and WLAN. In addition, a common pool of other peripherals such as USB, Firewire and SCSI devices should be available for testing those interfaces.

This is a fast moving field and not only must candidates be encouraged to keep up with recent developments but also teaching staff should be confident with current and legacy computer system components.

For candidates to be successful in this field they will have to be self-motivated to learn about new components and equipment on an on-going basis. This course provides a starting point and introduces the candidates to good practice and logical analysis. The hardware will change but the techniques and thought processes learned here should remain relevant.

Try to answer questions relating to hardware or software as they occur and encourage the questioning mind. There is no shame in being unable to answer all of the candidate's questions in this large and changing field but at least some pointers should be offered to lead the candidate to appropriate sources of up-to-date information.

Progress through the unit should not be rushed. The initial overview of the subject and of each new sub-system as it is introduced is very important to the candidate's understanding.

The candidate should be encouraged to look upon a faulty computer as a chance to gain experience and to fill in a fault report sheet. In this way, the candidate will build up a portfolio of faults throughout the year.

Introduction

The introduction to the course should include an overview of the course and your expectations of the candidates. Check that all candidates have relevant prior experience. This is at the centre's discretion, although a number of suitable units are identified at the beginning of this specification. Ensure that the assessment timetable is known and will be adhered to.

Outcome 1

Safe Working Practice
Prior to any practical work, it is necessary to cover Safe Working Practice guidelines including electrical safety, the correct use of tools and test equipment, suitable clothing and safety equipment and the appropriate use and checking of anti-static measures. This information should be imparted through lecture and practical demonstration. Each candidate should certify that safe working practices have been explained and demonstrated to him/her.

The component parts of a computer system should be identified to the candidates, along with how each interacts, inputs and outputs, this then can form the basis of troubleshooting if they are able to trace a fault through from input to output or vice versa.

The candidates should have a clear understanding of each stage of the boot process this will enable them to better understand where a fault may lie if there are no physical clues or the system is not powering up at all. It is helpful to show students how the POST is progressing and a POST control card may assist in this demonstration.

Outcome 2

Logical Troubleshooting Techniques
We will start with troubleshooting relatively simple linear or sequential systems.

Use a lecture to describe an example of an input or an output peripheral, the steps through which data will pass from source to destination and a method for efficiently discovering the point at which failure may have occurred. The lecturer should provide a practical demonstration of good practice. Feedback from the candidates should be encouraged and examined by group discussion.

An understanding of the systems and methods is essential to efficient troubleshooting. Demonstrations and descriptive overviews should be provided early on and supplemented with more detailed information as the course progresses.

The candidate should learn the common approaches to troubleshooting and understand that it is not a haphazard task; linear and half split approaches should be discussed

The description of data flow could be simplified by the use of a short flow chart. Flow-chart elements may represent components in the system with links to show data flow.

Each link between components represents an opportunity to apply a test method. Usually at least two methods can be applied at each stage. For example, if the data passing from one component to another is suspect, then either the first or the second component could be substituted. However a third method may include introducing a piece of test equipment into the data path.

Candidates should describe an overall approach to testing the subsystem. References should be made to the order of testing to describe an efficient and logical troubleshooting method.

The importance of documentation when troubleshooting; a lot of candidates may miss its importance so it is important that this is stressed. Documentation may range from eliciting initial fault report from customer, through completion of a fault report sheet to completing a summary of the fault and its solution. This is so that it may form part of a resource database of faults that may be tapped into.

No one technician can profess to know every fault that can occur on a computer system, it is generally accepted that manufacturers' books and resources such as forums on the internet can form part of the troubleshooting process and may save a lot of time, candidates should be made aware of this and how this is accepted in industry.

When Outcome 1 has been completed, the general ability of the candidates should be estimated and the delivery of the remainder of the course adjusted accordingly. That is, the amount of contemporary topics and examples may be increased to keep interest high in competent groups of candidates or reduced if time starts to become short.

Outcome 3

Candidates should be shown a range of common problems and how to spot them. This will aid them in troubleshooting. These should include (but not be limited to): the failure (or removal) of video card, Memory, Processor, hard disk drive, floppy disk drive. The symptoms should be clearly shown and bios beep codes explained (as video and memory rely on this).

Faults with Power Supplies can easily be identified and if required, a replacement swapped in cheaply. However candidates must be made aware that a system with a lot of power-hungry components (such as a fast processor with large fan or high spec video card and lots of extras) will need a more robust and higher powered PSU that a simple desktop setup. Candidates should be informed about the use of the power good signal and the relationship with the reset signal. It is also important that candidates are informed of the operation of the crowbar circuit inside the PSU and shown how it prevents damage during fault conditions.

Candidates should be shown the failure symptoms of the CMOS battery such as: inaccuracy of the RTC, failure to boot and loss of performance caused by fail-safe defaults

The basic functions of the BIOS should be described. Limitations of BIOS versions (such as supported hard drive capacity and processor compatibility) should be investigated. Explain the reasons for being cautious about upgrading the BIOS. If it goes wrong, will you have the ability to reboot and correct the problem? Show the sources of upgrades from manufacturers' web sites, the purposes of different versions and demonstrate the method of applying an upgrade.

Investigate the settings available within the CMOS configuration utility. Explain the purpose of each setting that relates to hardware configuration, performance and boot sequence. State the purpose of optional settings such as port configuration and memory timing.

At this point the candidates can start to do the practical exercises for troubleshooting peripherals. Assistance may be offered as necessary until they are able to complete at least two exercises unassisted.

Outcome 4

This is probably the most demanding outcome. It requires the candidate to analyse a complex hardware system full of interdependencies and define, then refine, a method for troubleshooting the system. This is not easy, so time should be taken to make sure that the system is adequately described.

For example, a faulty modem could stop a computer from booting up with exactly the same symptoms as a faulty CPU. How do you determine the cause of the fault without using inefficient guesswork? What if there are two faults? How would you protect a replacement part from the same fate?

Use group discussions to help the candidates define an initial method of tackling the system. Guide them to simplify the system and help to define a minimum system that is still able to respond. Introduce the concept of the minimum system and decide on the PSU, motherboard, CPU, speaker and one bank of memory. Discuss the method of troubleshooting within the minimum system and why a substitution method is required. Decide on a logical sequence and justify it. (Damage limitation). Discuss the method of troubleshooting outwith the minimum system and how you have to respond to error signals and messages. Complete the troubleshooting process up to booting to a boot disk.

Show that the minimum system method of getting to a working (even if restricted) system as quickly as possible and then building that system back up is more logical and efficient than pulling components out one-at-a-time from a full system and re-testing the system each time. This is because you are unable to test the removed components until a working system is achieved. To test the removed components, they have to be reinstalled into the working system.

A practical demonstration of troubleshooting technique and method should be given. This should draw attention to the observation of symptoms, the correct handling of equipment, the use of safe working practice (remember ATX power is never off) and the use of a logical approach.

Candidates should practice first on a working system and make notes of the sequence of events during the normal boot process. The defined minimum system should then be tried and a note made of the necessary steps to change the symptoms during re-build.

At this point, the candidates should start to develop a systematic approach that they will use during troubleshooting. Flowcharting software could be available. This approach will then provide guidance during the practical exercises that follow. Improvements may be required to the approach in the light of experience gained from the practical exercises.

A number of practical exercises for troubleshooting hardware boot problems should be carried out. Assistance at this stage should not be necessary as the candidates have now gained some confidence with the hardware but may be provided if required in the early stages.

Outcome 4

Option - Network Troubleshooting
Where circumstances allow, it may be appropriate to provide additional troubleshooting theory and practice in the area of networks. Much of the above skills can be easily transferred to this new area with a small amount of extra work. Where candidates are involved in a theoretical or administrative networking unit, benefit can be gained by linking the skills here.

Troubleshooting within a local area network involves the same logical approach as any other type of troubleshooting. Observation is the key. Some of the basics are obvious. If you have three or more systems on a network then the job of isolating the fault is much simpler. A useful troubleshooting aid then, is a laptop computer that you can join onto a small network to prove which other computers you can communicate with. Another useful piece of kit is a long patch lead and a crossover adapter to allow you to directly link two systems. Expensive network analysers can be hard to justify but simpler cable checkers can pick up the majority of faults and can be supplemented by analysis software.

Practical exercises could involve faulty and misconfigured network interface cards, IP address and subnet mask errors, logon faults, cable faults and protocol faults. All of which are common in real life.

Option - Performance Optimisation and Upgrading
As a continuation of commissioning skills, some additional time could be taken to look at performance issues. State a measurable goal such as a score obtainable in a software benchmark suite. Consider the upgrade possibilities to an example system. Measure the performance benefit and cost effectiveness of different upgrades.

Example upgrades could include the obvious choices of a faster processor, more memory, a better graphics card or a faster hard disk drive.

The real challenge here is to investigate the less obvious performance improvements such as, using multiple banks of memory and multiplexing between them, adding a pair of hard drives and creating a RAID array, changing partition sizes to gauge file system performance, measuring the effect of additional memory on a graphics card or comparing the performance of different operating systems on the same hardware. What comparisons can be made between processors manufactured by different companies? Is there a trade-off between stability and performance? Consider examples of overclocking and different types of RAID array. Does heat generation degrade longevity? Does a fast system have to be noisy?

Investigating these and other developments of computer system architecture will gain the candidate a better understanding of the hardware specifications available in the current market. Evidence may be through the instrument of a short written report.

Outcome 5
This section looks at faults that can occur at a software level, particularly problems that prevent an operating system from booting.

Candidates should be shown how errors such as wrong version of, or corrupt boot files can stop a system from booting and also the other types of boot failure that can occur such as failure or corruption of the boot code, partition table or equivalent etc and how these may be rectified.

Candidates should also be shown how to start a system with the most basic level of drivers and how selective disabling of drivers may help pinpoint a boot problem.

Candidates must also be aware of software maintenance and its importance such as anti virus software, software updates, service packs, defragmentation, in order to keep a computer system in good working order.

Glossary of Abbreviations

ACPI	Advanced Control and Power Interface - Power management protocols.
APM	Advanced Power Management - A legacy power management method.
AT, ATX, ATX2.03	Relating to power supplies, different form factors and specifications.
BIOS	Basic Input Output System - The motherboard's start-up program.
CD	Compact Disc - See CDROM
CDROM	Compact Disc Read Only Memory - A common type of removable media
CD-R	Compact Disc Recordable - A write-once version of a CDROM
CD-RW	Compact Disc Re-Writable - An erasable version of a CD-R
CMOS	Complementary Metal Oxide Semiconductor - Battery-powered configuration memory.
CPU	Central Processor Unit - The main calculating engine of the computer.
DOS	Disk Operating System - A simple early example of an operating system
ELCB	Earth Leakage Circuit Breaker - An electrical safety device.
FIREWIRE	See IEEE1394.
GUI	Graphical User Interface - Such as Windows
HDD	Hard Disk Drive - A mass storage device usually fixed into the system unit.
IEEE1394	Also known as Firewire or iLink - A fast serial interface for multiple independent devices.
ILINK	See IEEE1394.
MBR	Master Boot Record - The first area of information contained on the hard disk
OS	Operating System - A software program to control hardware and other software
OS/2	Operating System 2 - An obsolete operating system by IBM.
PAT	Portable Appliance Tester - Tests for electrical safety.
PC	Personal Computer.
POST	Power On Self-Test - A program contained within the BIOS chip.
PSU	Power Supply Unit - The Mains to low voltage converter inside a computer
PS/2	Personal System 2 or PS2 - A synchronous serial interface for mice and keyboards.
RCCB	Residual Current Circuit Breaker - An electrical safety device.
RS232	An asynchronous serial interface once used by mice and modems.
RTC	Real Time Clock - A battery-powered clock on the motherboard.
UPS	Uninterruptible Power Supply - A battery back-up power source.
USB	Universal Serial Bus - A fast serial interface for multiple devices.
USB2	Increases USB from 12Mb/s to 480Mb/s.
WOL	Wake on LAN - A remote start-up method used over a local area network.
WOR	Wake on Ring - A method of powering-up a system upon receiving an incoming phone call

Open learning

If this Unit is delivered by open or distance learning methods, additional planning and resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes. For further information and advice, please see *Assessment and Quality Assurance for Open and Distance Learning* (SQA, February 2001 — publication code A1030).

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Computer Hardware: Desktop Computer Troubleshooting

This Unit is designed to enable you to work effectively when troubleshooting and repairing Personal Computers in a professional practice/consultancy or installation/technical support role in manufacturing, commercial or domestic sectors of industry. You will learn about the operation of modern Personal Computer components, common peripherals, test equipment and software as well as industrial practice and standards. You will also gain experience of simplifying complex problems, analysing cost effectiveness and an appreciation of safe working practice. The Unit is primarily intended for candidates who expect to work in a computer system troubleshooting or support role, but is also relevant to all those on an IT course who require a deeper or more effective understanding of modern personal computers.

On completion of the Unit candidates should be able to:

1. Describe desktop computer system components and hazards
2. Describe approaches to troubleshooting and test methods
3. Recognise and understand common hardware problems
4. Troubleshoot hardware using test methods
5. Investigate and solve system software problems

The unit is preceded by written acknowledgement of the importance of safety issues as they relate to computer system troubleshooting.

There are five outcomes, which are assessed through practical tasks, written evidence and multiple choice assessments.

The first outcome requires that you show your knowledge of computer system components and potential hazards.

The second outcome requires that you understand the logical steps that can be taken when troubleshooting as well as your ability to use various pieces of test equipment

The third outcome requires you to recognise and understand common hardware faults that stop a system from booting. This will be carried out over several weeks and refined with feedback from practical experience gained within the classroom.

The fourth outcome requires that you learn to troubleshoot complex problems and perform your own troubleshooting on problems set for you. You will also produce a detailed system to help you find a hardware fault.

In the fifth outcome you will be expected to solve a software problem.

You will produce evidence for your success in practical tasks by generating a portfolio of work logs. You will receive more detailed guidance on the content, style and quality required for your log entries during your progress though the Unit. Your assessor will observe you carrying out the assessment tasks, and will certify on each of your reports that it is your own work, whether it is satisfactory and whether you have carried out the work properly with regard to Health and Safety requirements.