

SQA Advanced Unit specification: general information

Unit title: Computer Hardware: Hardware Installation and Maintenance

Unit code: HR91 47

Superclass: CA

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Version: 01

Unit purpose

This Unit is designed to enable candidates to install and maintain computer hardware. It will prepare them to work effectively in a computer hardware technical support role by ensuring that they possess the underpinning knowledge required to understand the operation of modern personal computer hardware at a sub-system level. Candidates will gain practical experience of installation, maintenance and main failure modes of all major personal computer sub-systems, including the installation and configuration of low-level software such as device drivers. It is primarily intended for candidates who expect to work in an IT support role, but is also relevant to all those on any programme of study who require a deeper or more practical understanding of computer hardware.

On completion of the Unit the candidate should be able to:

- 1 Identify risks and use safe working practices.
- 2 Describe the major sub-systems and operation of a modern personal computer.
- 3 Install and configure system hardware components and peripherals and perform routine maintenance, basic fault-finding and rectification at sub-system level.

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 personal computers and be capable of installing and configuring operating systems. This may be demonstrated in other relevant Units.

Credit points and level

2 SQA Credits at SCQF level 7: (16 SCQF credit points at SCQF level 7*)

**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.*

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the support notes of this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The assessment exemplar for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable Instrument of Assessment. Centres wishing to develop their own assessments should refer to the assessment exemplar to ensure a comparable standard. Assessment exemplars are available on SQA's secure website.

Unit specification: statement of standards

Unit title: Computer Hardware: Hardware Installation and Maintenance

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The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Please refer to *Knowledge and/or Skills for the Unit* and *Evidence Requirements for the Unit* after the Outcomes.

Outcome 1

Identify risks and use safe working practices.

Knowledge and/or Skills

- ◆ Electrical hazards and the effects of electric shocks
- ◆ Function of fuses and Residual Current Devices
- ◆ PAT regulations
- ◆ Effects of ESD
- ◆ Anti-static precautions and safety hazards
- ◆ LSZH sheathing cable protection and applicable British Safety Standards
- ◆ Fire Hazards and Fire extinguisher types

Outcome 2

Describe the major sub-systems and operation of a modern personal computer.

Knowledge and/or Skills

- ◆ Types and characteristics of motherboards, cases and power supplies
- ◆ Types and functions of motherboard components and interface connectors
- ◆ Operation and interfacing of input/output devices
- ◆ Operation and interfacing of peripheral equipment
- ◆ Operation and interfacing of storage devices
- ◆ Installation requirements for expansion interface cards

Outcome 3

Install and configure system hardware components and peripherals and perform routine maintenance, basic fault-finding and rectification at sub-system level.

Knowledge and/or Skills

- ◆ Connect and configure peripheral equipment identifying and rectifying input/output device or interface faults
- ◆ Install and configure motherboard, CPU and RAM identifying and rectifying installation or other faults
- ◆ Install and configure expansion interface cards identifying and rectifying video or interface faults
- ◆ Install and configure storage devices identifying and rectifying storage device faults

Evidence Requirements for the Unit

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can successfully complete the following:

Outcome 1 — Evidence of all Knowledge and/or Skills should be assessed by 15 extended response questions. The distribution of questions will be as follows:

- ◆ Electrical hazards and the effects of electric shocks (2)
- ◆ Function of fuses and Residual Current Devices (3)
- ◆ PAT regulations (2)
- ◆ Effects of ESD (2)
- ◆ Anti-static precautions and safety hazards (2)
- ◆ LSZH sheathing cable protection and applicable British Safety Standards (2)
- ◆ Fire Hazards and Fire extinguisher types (2)

Outcome 2 — Each candidate will need evidence to show that they can define the types, operation and functional characteristics of four from the six major sub-systems listed below. Evidence of all the Knowledge and/or Skills should be assessed by 20 multiple-choice/response questions. The sample of the Knowledge and/or Skills areas must change on each assessment occasion and the questions presented must also change on each assessment occasion. Each of the four bulleted points sampled for this assessment must be covered **at least** three times.

- ◆ Types and characteristics of motherboards, cases and power supplies
- ◆ Types and functions of motherboard components and interface connectors
- ◆ Operation and interfacing of input/output devices
- ◆ Operation and interfacing of peripheral equipment
- ◆ Operation and interfacing of storage devices
- ◆ Installation requirements for expansion interface cards

A single end of Unit test covering Outcomes 1 and 2 with combined extended response and multiple-choice/response questions can be undertaken under supervised closed-book conditions.

Outcome 3 — At least one completed log for each of the four areas listed below:

- ◆ Connect and configure peripheral equipment identifying and rectifying input/output device or interface faults
- ◆ Install and configure motherboard, CPU and RAM identifying and rectifying installation or other faults
- ◆ Install and configure expansion interface cards identifying and rectifying video or interface faults
- ◆ Install and configure storage devices identifying and rectifying storage device faults

As a minimum the log (pro forma) should record the following information in order to satisfy the Outcome:

- 1 Brief outline of the problem and symptoms presented
- 2 Prioritised analysis of likely failure modes based on these symptoms
- 3 Note of problems (if any) encountered and their solutions and testing carried out
- 4 Any relevant sketch diagrams (eg component locations, connector orientations, jumper settings)

Unit specification: support notes

Unit title: Computer Hardware: Hardware Installation and Maintenance

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

The suggested time allocation for each Outcome (including assessment) is as follows:

| | |
|-----------|----------|
| Outcome 1 | 15 hours |
| Outcome 2 | 30 hours |
| Outcome 3 | 35 hours |

It is essential that candidates are made aware from the outset of the health and safety risks to themselves and others which can arise in working with electrical equipment. The risks to equipment from ESD should also be explained, and safe working practices explained and demonstrated which balance these two problems. This is particularly important if 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 covering this topic. **The importance of strict adherence to safe working practices should be stressed throughout the programme of study.**

It is appreciated that there will not be time during the delivery of this Unit to present a comprehensive fault-finding methodology, or to give candidates extensive experience of the rich variety of complex faults found in the real world. If this is required, it is suggested that an alternative or additional Fault-Finding Unit be delivered. However, centres should identify the importance of effective fault analysis and resolution in commercial and professional practice, and base delivery of this Unit around basic fault-finding principles and strategies to reinforce this.

It is suggested that the teaching of fault-finding should focus on a logical analysis of presenting symptoms to identify as quickly as possible the faulty sub-system. It is important that centres should discuss failure modes and known common problems as an integral part of the presentation of information on each major sub-system rather than as a separate topic. Candidates should then be encouraged to develop a logical strategy for resolving faults using a combination of simplification and a prioritised procedure based on “most likely, least invasive” down to “least likely, most invasive” possibilities.

Guidance on the delivery of this Unit

This Unit is likely to form part of a Group Award which 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 a Group 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 and future-proof the Unit, and avoids obsolescence 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. It is also important that candidates are exposed to a range of modern computing hardware — both teaching and assessment should (if available) for example include work on modern Apple Mac systems (if available) as well as Intel/AMD or like PCs.

While not essential, candidates would benefit greatly from exposure to more sophisticated diagnostic tools such as low-level diagnostic software and POST code display cards:

Outcome 1

The assessment of Outcome 1 should be introduced early in the delivery of the Unit and before any practical work is carried out. The candidate must certify (by signature) that they fully understand the implications of health and safety within the context of delivery.

Health and safety risks and requirements relating to electrical and cabling work must be described and good working practices explained and demonstrated by the assessor. This must include risks to self and others from electric shock, Portable Appliance Testing regulations, Electro Static Damage and bond resistance testing. Issues surrounding cabling fire risks and the use of LSZH sheathing LSZH sheathing cable protection and the following British Safety Standards BS EN 50200, BS 8434-1 Standard performance cable — integrity in case of fire, BS 8434-2 Enhanced performance cable — integrity in case of fire , BS 6425 Low smoke — low acidity must be explained. Fire Extinguishers, Class A Flammable solids, Class B Flammable liquids, Class C Flammable gasses, Class D Flammable metals, Class E Electrical and Class F cooking oils must be explained. 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 must demonstrate awareness of risks to health and safety and of ESD damage to equipment, and the ability to minimise risk to self, others and equipment at all times. Awareness will be evidenced by the candidate answering **all** extended response questions. Candidates need not be re-assessed on knowledge/skills area(s) they have previously completed successfully. Each candidate should 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.

Outcome 2

The assessment of Outcome 2 will be by one Instrument of Assessment which should be midway through or near the end of the delivery period for the Unit. Each candidate must show that they can define the types, operation and functional characteristics of **four** from the six major sub-systems detailed below.

- ◆ Types and characteristics of motherboards, cases and power supplies

Defines the main characteristics and differences between main types of motherboards as defined by socket type, chipset, cases and power supplies (eg AT, ATX). These must include board and case layout, mounting methods, interface connections exposed or cabled to the back panel, front panel connections, power connectors and PSU capabilities, (eg hard/soft-switched, suspend and awaken capabilities with ACPI and APM, power good indication).

- ◆ Types and functions of motherboard components and interface connectors

Defines all the main functional elements and components commonly found on a motherboard, including CPU, memory, (eg ROM, DRAM, cache), battery, crystals, at least three common expansion bus connectors, (eg PCI, PCIe 1, 1.1, 2, 2.1, 3 and AGP), main chipsets, at least three common integrated interface and peripheral chipsets, circuitry and connectors, (eg Serial and parallel ports, IDE, FDC, SATA, sound (onboard), video (VGA and HDMI), keyboard controller). For each element, its function and the type of physical components used to implement it must be covered.

- ◆ Operation and interfacing of input/output devices

Defines the function and physical implementation of standard PC I/O devices, (eg AT and PS/2 keyboard, serial and PS/2 mouse, VGA, USB 2 and 3), Sound. This should include device and interface functions as well as types of physical connectors and cabling required. Networking devices such as Network Interface Cards, Wireless Network Interface Cards, ADSL/Cable Modems and Routers should also be mentioned and/or used.

- ◆ Operation and interfacing of peripheral equipment

Defines the function and physical implementation of a range of more complex external peripheral devices, (eg printer, modem, scanner). This should include device and interface functions as well as the types of physical connectors and cabling used. At least two different types of printer, (eg laser, inkjet, dot matrix) should be covered along with at least one other common peripheral.

- ◆ Operation and interfacing of storage devices

Defines the function and interfacing of typical storage devices. The function of at least two different common types of storage device should be covered, (eg hard disk, CD-ROM, CD-RW, DVD, Solid State Hard drives, SD, SDHC and xD (or relevant current standard) Memory cards, USB pen drive storage devices). At least two common interfaces should be covered, (eg SATA, EIDE, SCSI, USB) including device identification and cabling.

- ◆ Installation requirements for expansion interface cards

Defines the basic installation requirements for expansion interfaces (I/O address, IRQ and Memory Range) and consequences of misconfiguration. At least one difference in configuration requirements for different expansion bus types should also be covered, (eg Plug and Play operation with PCI and USB and Firewire).

Outcome 3

The practical component of this Outcome is evidenced by successful completion of a log. Logs must be based on a pro forma given to candidates, and must, as a minimum, be properly titled with the candidate's name and date and signed by the assessor confirming that each task is the candidate's own work. Each log should record the following information:

- ◆ A brief outline of the problem and symptoms presented
- ◆ A prioritised analysis of likely failure modes based on these symptoms
- ◆ Outline note of all work carried out
- ◆ Note of problems (if any) encountered and their solutions and testing carried out
- ◆ Any relevant sketch diagrams, (eg component locations, connector orientations, jumper settings)

A candidate's response can be judged to be satisfactory where the log evidence provided is sufficient to meet the requirements for each item as follows:

- ◆ Identify and rectify video faults

Demonstrates ability to identify and replace efficiently a faulty video interface or monitor. Satisfactory evidence must be provided for at least one interface or connector fault and at least one monitor fault. Candidates must **NEVER** open or work inside a monitor at any stage.

- ◆ Identify and rectify storage device faults

Demonstrates ability to identify and replace efficiently a faulty storage device. Satisfactory evidence must be provided for at least one interface or cabling fault and at least one storage device misconfiguration or fault.

- ◆ Identify and rectify input/output device or interface faults

Demonstrates ability to identify and replace efficiently a faulty simple input/output interface or device. Satisfactory evidence must be provided for at least one interface or cable fault and at least one device misconfiguration or fault for a common input/output device (eg keyboard, mouse).

- ◆ Identify and rectify peripheral device or interface faults

Demonstrates ability to identify and replace efficiently a faulty peripheral interface or device. Satisfactory evidence must be provided for at least one interface or cable fault and at least one device misconfiguration or fault for a common peripheral device (eg printer, scanner, network card, router and switch).

Guidance on the assessment of this Unit

Testing for the knowledge component can be done in either a machine-based or paper-based format and must be invigilated by a tutor or appropriate person. There must be no communication between candidates and communication with the invigilator must be restricted to matters relating to the administration of the test. Centres are recommended to create a coverage grid to highlight which questions cover which knowledge bullet points to assist in the assessment process.

Outcome 1

The assessment must be undertaken in a supervised closed-book environment where candidates have no access to the Internet, books, handouts, notes or other learning material. Testing can be done in either a machine-based or paper-based format and must be invigilated. There must be no communication between candidates and communication with the invigilator must be restricted to matters relating to the administration of the test. The time allowed will be 2 hours. Evidence of all Knowledge and/or Skills in Outcome 1 should be assessed by 15 extended response questions. There should be two questions covering each bullet point with the exception of bullet point two (Function of fuses and Residual Current Devices) where this will be three. This Outcome can be assessed together with Outcome 2 as an end of Unit test which combined extended response and multiple-choice/response questions.

Outcome 2

The assessment must be undertaken in a supervised closed-book environment where candidates have no access to the Internet, books, handouts, notes or other learning material. In order to ensure that candidates will not be able to foresee what items they will be questioned about, a different sample of **four** of the six knowledge items is required each time the Outcome is assessed. Evidence of all the Knowledge and/or Skills in this Outcome will be assessed using 20 multiple-choice questions. Each of the **four** bulleted points sampled for this assessment must be covered **at least three** times. The sample of the Knowledge and/or Skills areas must change on **each** assessment occasion and the questions presented must change on **each** assessment occasion.

Testing can be done in either a machine-based or paper-based format and must be invigilated. There must be no communication between candidates and communication with the invigilator must be restricted to matters relating to the administration of the test. The time allowed will be 1 hour 10 minutes. The assessment for the Knowledge and/or Skills component of Outcome 2 must be undertaken at the end or middle of the Unit. The candidate's capabilities will be examined by 20 multiple-choice/response questions with appropriate sampling as above. This assessment can be combined with Outcome 1.

The questions presented must significantly change on **each** assessment occasion.

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

Outcome 3

Assessment of Outcome 3 should test candidates' competence in installation, testing, fault-finding, repair and maintenance holistically. For example, each could be presented as a fault-finding exercise on misconfigured or faulty equipment; installation of a replacement part would then follow a correct diagnosis. Any relevant routine maintenance exercises (either hardware or software, such as cleaning DVD's and CD's, using air dusters to clean inside the PC or running DEFRAG on a PC hard drive, or using Norton Utilities on a Mac, for example) should then be demonstrated. Each assignment should be attempted at an appropriate stage throughout the delivery of the Unit following teaching and practice on each topic.

Logs must be based on a pro forma given to candidates, and must as a minimum be properly titled with the candidate's name and date, and signed by the assessor confirming that each task is the candidate's own work. The practical exercise for Outcome 3 must be evidenced by completion of a practical exercise that requires that the candidate can submit evidence to satisfy this Outcome in the form of at least one completed log for each of the four areas of work listed in the Outcome.

The assessor must endorse each pro forma, together with the candidate, to confirm whether the candidate uses safe working practices. Assessment is open-book under supervised conditions. Assessors should assure themselves of the authenticity of each candidate's submission.

Online and Distance Learning

This Unit could be delivered by distance or online learning. It should be noted that this type of delivery may require additional scheduling and planning by the centre to arrange supervision of assessment completion and authenticity of evidence produced by candidates.

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*.

Opportunities for developing Core Skills

There is no automatic certification of Core Skills or Core Skill components in this Unit.

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.

History of changes to Unit

| Version | Description of change | Date |
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General information for candidates

Unit title: Computer Hardware: Hardware Installation and Maintenance

This Unit is designed to enable you to work effectively in a computer hardware technical support role. It prepares you for this task by giving you the underpinning knowledge required to understand the operation of modern personal computer hardware at a sub-system level. You will gain practical experience of installation, maintenance and main failure modes of all major personal computer sub-systems, including the installation and configuration of low-level software such as device drivers.

On completion of the Unit you should be able to:

- 1 Identify risks and use safe working practices.
- 2 Describe the major sub-systems and operation of a modern personal computer.
- 3 Install and configure system hardware components and peripherals and perform routine maintenance, basic fault-finding and rectification at sub-system level.

As the Unit progresses, you will be presented with information on the construction, components and operation of a personal computer and its main sub-systems including:

- ◆ Case and power supply
- ◆ Motherboard, CPU and memory
- ◆ Storage devices such as SATA and PATA hard disks, CD-ROM, CD-RW, DVD, Solid State Hard Drives, SD, SDHC and xD (or relevant current standard) Memory cards, USB pen drive storage devices
- ◆ Video display
- ◆ Input/output devices such as the keyboard and mouse
- ◆ Peripheral devices such as printers and scanners
- ◆ Networking devices such as Network Interface Cards, Wireless Network Interface Cards, ADSL/Cable Modems and Routers.

Each of these elements will be described in detail and you will be given the opportunity to install and configure such equipment in practical exercises.

This Unit is also designed to enable you to develop a logical and effective approach to basic fault-finding and repair at the sub-system level. This means that as functional elements and sub-systems are introduced and described, you will also examine their main failure modes and typical fault symptoms. By completion of the Unit you should be able to identify effectively the most likely reasons for any system failure and find and replace the faulty element.

To succeed in this Unit you must achieve a satisfactory level of performance in assessments covering the knowledge-based elements of the Unit and a set of practical tasks covering the practical installation, configuration and fault-finding elements.

You will produce evidence for your success in practical tasks by maintaining a log using pro forma record sheets. You will receive more detailed guidance on the content, style and quality required for your log entries during your progress through the Unit. Your assessor will observe you carrying out the assessment tasks, and will certify on each of your logs 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.