AQA

Level 3 TECHNICAL LEVEL IT

Fundamental Principles of Computing
Mark scheme

Unit Number: H/506/6107 and Y/507/6424
Series: June 2017

Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

MARKING METHODS

In fairness to candidates, all examiners **must** use the same marking methods. The following advice may seem obvious, but all examiners **must** follow it as closely as possible.

1 If you have any doubt about how to allocate marks to an answer, consult your Team Leader.

2 Refer constantly to the mark scheme and standardising scripts throughout the marking period.

3 Use the full range of marks. Don't hesitate to give full marks when the answer merits them.

4 The key to good and fair marking is **consistency**.

INTRODUCTION

The information provided for each question is intended to be a guide to the kind of answers anticipated and is neither exhaustive nor prescriptive.
All appropriate responses should be given credit.

Where literary or linguistic terms appear in the Mark Scheme, they do so generally for the sake of brevity. Knowledge of such terms, other than those given in the specification, is not required. However, when determining the level of response for a particular answer, examiners should take into account any instances where the candidate uses these terms effectively to aid the clarity and precision of the argument.

DESCRIPTIONS OF LEVELS OF RESPONSE

The following procedure must be adopted in marking by levels of response:

- read the answer as a whole

- work up through the descriptors to find the one which best fits

- where there is more than one mark available in a level, determine the mark from the mark range judging whether the answer is nearer to the level above or to the one below.

Since answers will rarely match a descriptor in all respects, examiners must allow good performance in some aspects to compensate for shortcomings in other respects. Consequently, the level is determined by the 'best fit' rather than requiring every element of the descriptor to be matched. Examiners should aim to use the full range of levels and marks, taking into account the standard that can reasonably be expected of candidates.

Section A

0 1   Which **one** of the following is both an input and an output device?

[AO2no, 1 mark]

1 mark for:

D   Touch screen

0 2   There are several types of Read Only Memory (ROM) chip.

0 2 .1   One of these is the Erasable Programmable ROM chip (EPROM).

What method is used to erase data stored on the EPROM?

[AO2i, 1 mark]

1 mark for:
- Exposure to Ultraviolet (UV) light.

Accept: prolonged exposure to daylight – roughly a year.

0 2 .2   State **two** uses of a ROM chip.

[AO2i, 2 marks]

1 mark (max. **2 marks**) for any of these correct answers:
- firmware storage
- embedded devices
- as a BIOS chip (or similar)
- boot device

Allow:
- game cartridge
- flash memory (type of ROM)
- memory stick.

Accept: any other valid use.

0 3 The Central Processing Unit (CPU) of a modern computer contains cache memory.

0 3 .1 Which type of cache memory is the fastest to access?

[AO2a, 1 mark]

1 mark for:

A Level 1

0 3 .2 Explain how cache memory speeds up the operation of a computer.

[AO2a, 3 marks]

1 mark (max. **3 marks**) for:
- Cache memory stores frequently used data and instructions.
- When the CPU needs data or an instruction it first checks the cache.
- If what is required is there then it does not need to request the data or instruction from other memory which would take more time.
- Cache is faster than RAM.

Example answer (3 marks):
It is quicker to access cache memory within the CPU than to access RAM **(1 mark)** on the motherboard. Removing the need to repeatedly round-trip to RAM **(1 mark)** by caching recently accessed data and instructions **(1 mark)** in the CPU speeds up the computer.

Allow proximity to CPU

0 4 .1 Which component of a computer system responds to a hardware interrupt?

[AO2d, 1 mark]

1 mark for:

B Central Processing Unit

0 4 .2 Name the type of interrupt that cannot be ignored.

[AO2d, 1 mark]

1 mark for:
- Non-Maskable Interrupt (NMI).

Accept: either full name of abbreviation.

0 4 .3 Give an example of how a software interrupt can be generated.

[AO2d, 1 mark]

1 mark for any relevant example, such as:
- completion of read/write operation from/to a disk
- program writing directly to the screen
- programmable interrupt e.g. timer
- dividing by zero (considered software interrupt or exception).

0 5 The result of arithmetic operations in computer programs depends on the order of operator precedence.

0 5 .1 What does 'order of operator precedence' mean and how does it work?

[AO4f, 2 marks]

1 mark (max. **2 marks**) for:
- The order of operator precedence is the order in which mathematical expressions are evaluated.
- There is a set order, often referred to as (BODMAS, PEMDAS, PEMA, BIDMAS).

OR
- Equivalent description of the order **(1 mark)** showing an understanding of the process – does not have to be a complete explanation as long as the order of components is correct.

0 5 .2 This expression 3 + (2 / 5) * 2 produces the result 3.8

Show how changing the order of precedence in this expression can give **two** other results.

[AO4f, 4 marks]

1 mark for each expression, as long as they have the same values
1 mark for each correct, corresponding result

| Example | (3 + 2) / 5 * 2 | Result is | 2 |
| Example | 3 + 2 / (5 * 2) | Result is | 3.2 OR 3 1/5 |

Accept: other correct examples.
Accept: explanations of changing order of precedence of operators if the concept of how order of precedence works is shown

NB: Ensure **result is correct** before awarding marks for results.

Do not accept: changing order of numbers in calculation or changing order of operators in calculation without explanation detailed above

0 6   Two components within a modern CPU are the Arithmetic Logic Unit (ALU) and the Control Unit (CU).

Describe what each does.

[AO2a, 4 marks]

Maximum of **2 marks** for each component.

Arithmetic Logic Unit
- ALU carries out arithmetic operations such as adding two operands. **(1 mark)**
- ALU carries out logical operations such as NOT or OR. **(1 mark)**

DNA: Arithmetic or Logical without further explanation.

Control Unit
- The CU fetches and decodes (or manages) instructions **(1 mark)**.
- The CU controls data moving through the CPU **(1 mark)**.
- The CU controls the timing of operations within the CPU **(1 mark)**
- The CU controls instructions sent to peripheral devices **(1 mark)**

0 7   The Control Unit within a modern computer's CPU is regulated to a particular speed of operation. The clock that regulates it depends on the vibrations of a quartz crystal to keep accurate time.

0 7 .1   Explain how the computer's internal clock regulates the speed at which instructions are executed.

[AO2a, 2 marks]

Example answers (max. **2 marks**)**:**
- The clock is a signal that synchronises tasks **(1 mark)**. It has a cycle known as a 'tick' **(1 mark)**. Each cycle has a high and low state **(1 mark)**. Instructions can be started at each tick **(1 mark)**. The more ticks, the more instructions can be executed" **(1 mark)**.
- The crystal vibrates at a fixed number of oscillations per second **(1 mark)** which gives a regular period of time from which other calculations can be determined **(1 mark)**. The CPU conducts a single activity with every clock cycle **(1 mark)**.

0 7 .2   Two microprocessors run at the same clock speed but one appears to be faster than the other. Explain how this might be possible.

[AO2a, 2 marks]

1 mark (max. **2 marks**) for each of:
- different architectures cannot be compared by clock speed/will perform differently at same clock speed **(1 mark)**
- different bus width – 32 or 64 bit **(1 mark)**
- amount of work that each CPU can do during a clock cycle may be different **(1 mark)**
- one CPU may run more efficiently than another **(1 mark)**
- one CPU may have more cache memory **(1 mark)**
- different types of cache (eg L1/2/3) **(1 mark)**
- one CPU may have multiple cores **(1 mark)**

- one CPU may dynamically increase or decrease its speed **(1 mark)**
- Other components affecting overall performance (eg HD vs SSD). **(1 mark)**

0 7 .3 Describe an effective way to compare the performance of CPUs.

[AO2a, 2 marks]

1 mark (max. **2 marks**) for each of the following:
- benchmark testing / speed testing **(1 mark)**
- using websites dedicated to this task **(1 mark)**
- using a standard set of tasks **(1 mark)** with other factors kept the same **(1 mark)**
- I would use benchmark testing **(1 mark)** and there are websites which compare every CPU for this purpose **(1 mark)**

| 0 | 8 | | Some hard disk drives (HDDs) become fragmented over time. |

0 8 .1 What noticeable effect might this have on the computer's performance?

[AO2p, 1 mark]

1 mark (max. **1 mark**) for:
- The computer appears to slow down
- Read/write operations take longer / disk activity spikes
- When the computer is low on memory it hangs or lags (as the computer is caching to disk instead of memory, eg Pagefile)

0 8 .2 Explain why files become fragmented and how this affects performance.

[AO2p, 3 marks]

Example answers (max. **3 marks**)**:**
- As files are deleted from the HDD, or the disk fills up **(1 mark)**, files cannot be written in contiguous clusters of disk space/if a file is too big it will be split **(1 mark)** so, a file is written in gaps between other files **(1 mark)** so large files end up in many fragments **(1 mark)**
- When the read/write head of the HDD reads or writes these files it takes longer than if they were written contiguously **(1 mark)**
- Latency of read/write head because it must move more **(1 mark)** if files aren't stored on the same cylinder (allow track). **(1 mark)**

0 8 .3 What type of utility software could be used to rectify this problem?

[AO3d, 1 mark]

1 mark for:

C Disk optimiser

0 8 .4 Why is it less likely that fragmentation of a disk drive will occur on an Apple computer than a Windows computer?

[AO3j, 2 marks]

Example answers (max. **2 marks**)**:**
- The two types of computer have different operating systems which organise files on the HDD in different ways. **(1 mark)**
- Apple file system handles defragmentation automatically. **(1 mark)**
- Apple file system avoids free space gaps in the filesystem **(1 mark)** and will look for spaces large enough to store files contiguously. **(1 mark)**
- Apple computers use SSDs which have less tendency to fragment **(1 mark)**

Turn over ▶

0 9   System software is regularly updated by software companies.

Explain the need for updates and why it is important to check regularly for updates.

[AO3e, 3 marks]

Both parts of question must be addressed for maximum marks / max. **3 marks** overall.

Maximum of **2 marks** for the following reasons:
- Because security flaws are found that need to be rectified. **(1 mark)**
- New features are added to the software. **(1 mark)**
- Software flaws ('bugs') are found that need to be rectified. **(1 mark)**
- Driver updates for stability or performance. **(1 mark)**

Maximum of **2 marks** for the following reasons:
- Important because the security of the computer system may be compromised if the updates are not applied. **(1 mark)**
- Important to be able to get the best use out of the updates features. **(1 mark)**
- Important because the software may not work properly if the bug fixes are not installed. **(1 mark)**

Example answer:
- Software updates might provide security fixes **(1 mark)** to protect against malware. **(1 mark)**

1 0   Describe the function of thermal paste and where it is used.

[AO2g, 2 marks]

Example answers (max. **2 marks**):
- Thermal paste efficiently transfers heat **(1 mark)** between two adjacent surfaces. **(1 mark)**
- Thermal paste is used between the surface of the CPU / GPU and a heat-sink. **(1 mark)**
- The thermal paste fills in air pockets or microscopic gaps. **(1 mark)**

Accept: similar descriptions.

1 1 .1 Which of these storage devices is most likely to be found in a tablet computer?

[AO2p, 1 mark]

1 mark for:

D Solid State Drive

1 1 .2 Explain why the choice you made in 11.1 is the most suitable for a tablet computer.

[AO2p, 3 marks]

1 mark (max. **3 marks**) for each of the following:
- size - SSD is very compact/portable
- robustness/has no moving parts – less likely to be affected by knocking or being dropped
- runs cooler – no need for a cooling fan built into the tablet
- uses less electricity – increases the running time between charges/battery life.

A maximum of **2 marks** may be awarded for suitable expansions, such as the mode of use or environment of use, if they are related to the reasons above.

NOTE that if a candidate has chosed HDD in 11.1, but then goes on to justify choice that shows understanding of the requirements of a tablet then marks may be awarded

DNA: speed without qualification.

1 2 Sensitive internal components of a computer can be damaged by electrostatic discharge (ESD).

1 2 .1 Describe how components can be damaged by ESD.

[Unit Intro/2e, 2 marks]

1 mark (max. **2 marks**) for:
- definition of ESD – 'discharge of electricity' is not acceptable
- effect on components
- how static can build up

Example answer:
If a person is holding a charge of static electricity, then touching conductive computer components can pass this charge on and damage it **(2 marks)**.

1 2 .2 Name **two** items a user might make use of to prevent ESD when working on a computer.

[Unit Intro/2e, 2 marks]

1 mark (max. **2 marks**) for:
- anti-static wristband / grounding strap
- anti-static mat

BOD: for any other type of mechanism for initial discharge of ESD, such as touching radiator.

1 3 Computer programs are sometimes written in a combination of high- and low-level languages. For example, a program mostly written in C++ (a high-level language) may contain sections written in Assembly Language (a low-level language).

Using an example, explain why this is done.

[AO5fg, 3 marks]

NB: Candidates need to show that they understand the characteristics of **both** types of language for full marks.

1 mark for providing a real-life example
1 mark (max. **3 marks**) for any of the following points:

C++:
- quicker to develop in
- less prone to programmer errors
- English like instructions
- easy to maintain
- easy to understand.

Assembly language:
- slow to write but fast to execute
- used where speed or efficiency is critical.

Example answer:
Combination of both makes the program generally easy to maintain **(1 mark)** but provides maximum processing speed where that is necessary **(1 mark)**, for example in a time critical process. **(1 mark)**

Turn over ▶

Section B

| 1 | 4 | You have been asked to advise a client about purchasing a tablet computer.

Your client is an employee of a company with an existing network and wants to use the tablet for both personal and business use.

| 1 | 4 | .1 | Name the **three** main operating systems that should be considered.

[AO3g, 3 marks]

1 mark (max. **3 marks**) for each of the following:
- Android **OR** Google Android
- iOS **OR** Apple iOS
- Windows **OR** Microsoft Windows

Accept: any other appropriate examples of operating systems.

Do not accept: multiple versions or flavours of the same operating system

1 4 .2 Analyse the advantages and disadvantages of tablets operating on each of the operating systems you have named in 14.1.

[AO3g, 8 marks]

Note: this question is set in the context of an organisation that has a network. Full marks will require a student to consider the tablet in relation to the network as well as for personal use.

Descriptor	Marks
Candidate has made many comparisons and has drawn conclusions about the benefits of systems for personal OR business use	6 - 8
Candidate has made comparisons between systems and may have made limited analysis of the of systems for personal OR business use	3 - 5
Candidate has listed some advantages AND some disadvantages	1 - 2
No creditworthy content	0

Turn over ▶

14.2 Indicative content:

Android advantages:
- choice of sources for apps
- supported by Google
- syncs with other Google software
- customisable widgets make customised UI possible
- generally cheaper technology, eg devices, some apps
- easy cross-platform app development (so integrates with apps for other platforms such as Windows)
- large choice of devices – different manufacturers, screen sizes etc

Android disadvantages:
- poor scrutiny of apps – many contain malware etc
- large number of updates, because it is open source
- generally worst battery life
- harder for company to manage because of multiple Android OS variants

iOS tablet advantages:
- most popular tablet
- millions of apps available
- integrates easily with other Apple products
- easy to learn and use
- range of add-on hardware such as keyboard
- generally leads the way in high-quality technology
- closed system – stable apps, lack of malware in App Store
- standard OS across tablet range
- best track record for security vulnerabilities

iOS tablet disadvantages:
- comparatively expensive
- no easy file browser – each app has its own collection of files
- less expandable for storage of apps and files
- many Internet/intranet sites still only work properly with Internet Explorer
- limited to apps from App Store

Allow: (historical disadvantage, situation changing)
- no multitasking
- only one app on screen at a time

Windows advantages:
- choice of manufacturers
- legacy applications work well, eg MS Office
- familiarity with Windows interface
- corporate applications likely to be Windows
- many business intranet/Internet sites only work in Internet Explorer
- hubs and docking stations/ports to expand system with peripherals
- efficient multitasking
- more than one app on screen at the same time

14.2 Indicative content continued:

Windows disadvantages:
- lack of third party apps / lack of apps in Windows store Not all software is tablet-friendly
- legacy apps tend not to display well on high-res screens
- poor battery life

Business use
- compatibility with employer's network
- availability of office applications
- availability of productivity tools
- extension of working hours
- working from home

1 4 .3 Many employees now bring their own portable devices to work. These are often connected to the organisation's network to carry out work tasks.

Explain what issues might need to be considered by your client's employer before allowing employees to 'Bring Your Own Device' (BYOD).

Include both positive and negative aspects.

[AO3n, 8 marks]

Descriptor	Marks
Candidate has explained the importance of both positive and negative issues to the employer OR the employee	6 – 8
Candidate has described both positive and negative issues with reference to either employer OR employee	3 – 5
Candidate has listed some positive AND some negative aspects	1 – 2
No creditworthy content	0

Indicative content:

General issues:
- consideration for basis security controls (PIN, encryption etc.)
- separation of work and personal data
- whether connection to company network will be allowed, or just remote access to special services
- mobile device management, including basic security controls such as PIN, screen timeout, encryption.

Positive aspects may include:
- reduction of cost to employer – both hardware and software
- likelihood of employee using most up to date hardware and software
- effectiveness of employee using hardware and software that they are familiar with
- productivity/employee satisfaction as a result of above two points
- employee satisfaction from using familiar devices and workplace flexibility
- ability to remote wipe device in case of loss
- being able to work in more places
- cost savings if staff buy own devices.

Negative aspects may include:
- loss of control over hardware and software
- what is 'acceptable use' of employee hardware and software?
- security may be compromised
- compliance with data protection and other legislation
- what happens to company data when an employee leaves?
- difficulty of integrating diverse systems and devices
- reputational damage from data loss
- breach notification policy in case of lost devices containing customer/personal data
- leaver policy – will entire device be wiped or just corporate data?
- Are customers happy to have data stored and processed on a personal device? Any relevant local laws?
- financial repercussions from security breaches.

1 5   An organisation keeps records of all its clients in a large database.

1 5 .1   Describe **three** features of database software that allow records to be input and manipulated.

[AO3a, 6 marks]

            1 mark for each relevant feature (up to max. of 3)
            1 mark for each expansion (up to max. of 3)

1 5 .2   Name **one** piece of legislation that makes it a requirement for data to be stored securely.

[Unit Intro, 1 mark]

            UK:
- **Data Protection Act / DPA**

            EU:
- **Regulation 2016/679**
- **Directive 2016/680**
- **Data Protection Directive** (95/46/EC)
- General **Data Protection Regulation** (from 2018)

            Award for emboldened text. Note that year is not required.

1 5 .3   Describe **two** ways to check that data stored is accurate.

[AO4c, 4 marks]

            1 mark for each method (up to max. of 2)
            1 mark for each expansion (up to max. of 2)

            Marks may be awarded for measures that confirm the data's validity or verify the data.

            Examples might include:
- visual checks
- input masks
- drop down boxes
- checking against original
- print data and compare with original
- print data and send to the person it records data about.

Question	Assessment Outcomes (2015)					TOTAL
	1	**2**	**3**	**4**	**5**	
SECTION A						
1		2np (1)				1
2.1		2i (1)				1
2.2		2i (2)				2
3.1		2a (1)				1
3.2		2a (3)				3
4.1		2d (1)				1
4.2		2d (1)				1
4.3		2d (1)				1
5.1				4h (2)		2
5.2				4h (4)		4
6		2a (4)				4
7.1		2a (2)				2
7.2		2a (2)				2
7.3		2a (2)				2
8.1		2q (1)				1
8.2		2q (3)				3
8.3			3e (1)			1
8.4			3m (2)			2
9			3f (3)			3
10		2g (2)				2
11.1		2q (1)				1
11.2		2q (3)				3
12.1		Unit Intro/2k (2)				2
12.2		Unit Intro/2k (2)				2
13					5fg (3)	3
Total A	0	35	6	6	3	**50**
SECTION B						
14.1			3i (3)			3
14.2			3i (8)			8
14.3			3r (8)			8
15.1	1b (3)		3a (3)			6
15.2	Unit Intro (1)					1
15.3				4d (4)		4
Total B	4	0	22	4	0	**30**
Total A+B	4	35	28	10	3	**80**

Question	Assessment Outcomes (2016)					TOTAL
	1	**2**	**3**	**4**	**5**	
			SECTION A			
1		2no (1)				1
2.1		2i (1)				1
2.2		2i (2)				2
3.1		2a (1)				1
3.2		2a (3)				3
4.1		2d (1)				1
4.2		2d (1)				1
4.3		2d (1)				1
5.1				4f (2)		2
5.2				4f (4)		4
6		2a (4)				4
7.1		2a (2)				2
7.2		2a (2)				2
7.3		2a (2)				2
8.1		2p (1)				1
8.2		2p (3)				3
8.3			3d (1)			1
8.4			3j (2)			2
9			3e (3)			3
10		2g (2)				2
11.1		2p (1)				1
11.2		2p (3)				3
12.1		Unit Intro/2e (2)				2
12.2		Unit Intro/2e (2)				2
13					5fg (3)	3
Total A	0	35	6	6	3	**50**
			SECTION B			
14.1			3g (3)			3
14.2			3g (8)			8
14.3			3n (8)			8
15.1	1b (3)		3a (3)			6
15.2	Unit Intro (1)					1
15.3				4c (4)		4
Total B	4	0	22	4	0	**30**
Total A+B	4	35	28	10	3	**80**

Turn over ▶

Assessment Outcomes	Marks available in Section A	Marks available in Section B	Total mark
AO1: Identify the different types of computer	5 – 10 marks 6 – 13%	2 x 15 37.5%	5
AO2: Understand and evaluate the hardware requirements of a computer system	8 – 12 marks 10 – 15%		32
AO3: Evaluate the software requirements of a computer system	8 – 12 marks 10 – 15%		30
AO4: Understand how data is converted into information	8 – 12 marks 10 – 15%		10
AO5: Demonstrate how computers process user requirements	5 – 10 marks 6 – 13%		3
Total	**50 marks**	**30 marks**	**80**

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