AQA

AS
Computer Science

Paper 2 (7516/2)
Mark scheme

7516
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

AS Computer Science

Paper 2 (7516/2)

June 2016

To Examiners:

- When to award '0' (zero) or '–' (hyphen) when inputting marks on CMI+

  A mark of 0 should be awarded where a candidate has attempted a question but failed to write anything creditworthy.

  Insert a hyphen when a candidate has not attempted a question, so that eventually the Principal Examiner will be able to distinguish between the two (not attempted / nothing creditworthy) in any statistics.

- This mark scheme contains the correct responses which we believe that candidates are most likely to give. Other valid responses are possible to some questions and should be credited. Examiners should refer responses that are not covered by the mark scheme, but which they deem creditworthy, to a Team Leader.

The following annotation is used in the mark scheme:

; - means a single mark
// - means alternative response
/ - means an alternative word or sub-phrase
A - means acceptable creditworthy answer
R - means reject answer as not creditworthy
NE - means not enough
I - means ignore
DPT - means "Don't penalise twice". In some questions a specific error made by a candidate, if repeated, could result in the loss of more than one mark. The **DPT** label indicates that this mistake should only result in a candidate losing one mark, on the first occasion that the error is made. Provided that the answer remains understandable, subsequent marks should be awarded as if the error was not being repeated.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Examiners are required to assign each of the candidates' responses to the most appropriate level according to **its overall quality**, then allocate a single mark within the level. When deciding upon a mark in a level examiners should bear in mind the relative weightings of the assessment objectives

eg

In the following questions the marks available are as follows:

Question 6.3 (max 6 marks)
AO1 (knowledge) – 2 marks
AO1 (understanding) – 4 marks

Question 9 (max 9 marks)
AO2 (analyse) – 9 marks

Question 10 (max 6 marks)
AO1 (knowledge) – 2 marks
AO1 (understanding) – 4 marks

Where a candidate's answer only reflects one element of the AO, the maximum mark they can receive will be restricted accordingly.

01	1	**Mark is for AO1 (understanding)** ℚ; **R.** more than one lozenge shaded	**1**
01	2	**Mark is for AO1 (understanding)** ℕ; **R.** more than one lozenge shaded	**1**
01	3	**Mark is for AO1 (understanding)** ℝ; **R.** more than one lozenge shaded	**1**
02	1	**1 mark for AO1 (understanding) and 1 mark for AO2 (apply)** **Mark as follows:** **AO1 (understanding) – 1 mark:** The bit pattern is split into 4-bit sections (**A.** A byte is split in half). Each section is then converted to decimal, with any values above 9 being represented as a letter from A to F / each group of bits is converted to a hexadecimal character; **NE.** 4-bits are converted to hexadecimal. **AO2 (apply) – 1 mark:** In the example, the sections are 0001 and 0111. 0001 is 1 in denary, and 0111 is 7 in denary, meaning we are left with the final answer of 17;	**2**

02	2	**Mark is for AO2 (apply)** 00011101; **I.** leading zeroes not given	**1**
02	3	**Marks are for AO2 (apply)** Figure 1a shifted left by 1: 000101110 Figure 1a shifted left by 2: 0001011100; Answer: 10001010; **Mark as follows:** **1 mark** for **both** correct shifts **1 mark** for correct answer // **2 marks** if correct answer and any relevant working shown. **I**. leading zeros not given. **A.** Alternative method of working.	**2**
02	4	**Mark is for AO2 (analyse)** 10011.011; **1 mark** for fixed point clearly between 5^{th} and 6^{th} digits.	**1**
02	5	**Mark is for A02 (apply)** 1;	**1**

02	6	**1 mark for AO1 (knowledge) and 1 mark for AO1 (understanding)** Majority voting can correct as well as identify errors; due to the majority bits being taken as the correct value (and discounting/ignoring the minority bit); // Majority voting can detect multiple (bit) errors; as each triplet/odd set of bits represents one bit of data and can identify an error on that bit (not just an error within a byte); // Majority voting is more efficient at detecting errors (through multiple bits being corrupted); as parity bit system may miss errors if an even number of bits are corrupted; **A**. points made in reverse, identifying weaknesses of parity bits. **NE.** bits are sent multiple times as an explanation **R.** implication that receiver knows that the bit is correct **R.** data for bit/bits/byte **AO1 (knowledge) – 1 mark:** Identifying an advantage of majority voting over using parity bits. **AO1 (understanding) – 1 mark:** Explaining how the point is an advantage for majority voting. **Must award knowledge mark to award corresponding understanding mark.** **Max 2 marks**	**2**
03	1	**Marks for AO2 (apply)** Identification of length (180 s/ 3 * 60), sample resolution (16 bit) and sample rate (44,000 Hz) in working ; **A**. 44 (kHz) for sample rate but do not allow follow through. Performing the correct calculation (3 * 60 * 16 * 44,000 // 180 * 16 * 44,000) **or** showing correct intermediary value (126,720,000 bits / 1,584,000 Bytes) ; **I.** Conversion Final answer 15.84(MB) ; **A.** to fewer significant places as long as 15.84 can be seen in working.	**3**

03	2	**Marks are for AO1 (understanding)** The ADC takes samples of the (analogue/continuous electrical) signal (at regular intervals); **R.** voltage for signal, soundwave, analogue data, sound, waveform for signal. Samples are quantised // the amplitude/height of each sample is approximated to an integer value // the amplitude/height of samples are measured; **A.** voltage for amplitude **A.** digital, number, value for integer value **A.** explanation of how the signal is quantised Each sample is assigned a binary value/encoded as a binary value; **R.** Digital value for binary value **A.** Stored, converted so long as sample is stated	**3**
03	3	**1 mark for AO1 (knowledge) and 1 mark for AO1 (understanding)** **Mark as follows:** **AO1 (knowledge) – 1 mark:** No/only redundant data is lost during the compression process (if using a lossless format); Data is lost when storing using a lossy format; **Max 1 mark** **AO1 (understanding) – 1 mark:** The song can be reproduced identically to the (recorded) original with no loss of quality (if using a lossless format); If stored in a lossy format the quality may limit later editing possibilities; **Max 1 mark** **A.** Recording will be of higher quality / quality of recording will be maintained. **NE.** music will be of higher quality.	**2**

<table>
<tr><td>04</td><td>1</td><td>4 marks for AO1 (understanding

A compiler produces object code/machine code/executable file;
An interpreter does not produce any object code;
A compiler translates the whole source code (at once);
An interpreter analyses the code line by line; A. Deals with, translates, processes, R. Runs through, reads, convert
A compiler will not produce an executable file if an error is encountered;
An interpreter will run the program up until the first error;
Interpreted code will execute slower than executing the object code produced by a compiler; A. opposite
You do not need the compiler to execute a compiled program;
When running interpreted code, the interpreter always needs to be present
Once compiled source code is no longer required to run the program;
An interpreter always needs source code at runtime;
Compiled code can only be executed on a machine with the same processor type / instruction set;
Interpreted code is more portable;

Max 3 if all points made about either interpreter or compiler.</td><td>4</td></tr>
<tr><td>04</td><td>2</td><td>Marks are for AO2 (analyse)

<table>
<tr><th>Point</th><th>Expansion</th></tr>
<tr><td>There may not/probably is not an interpreter/compiler for the chip</td><td>as it is bespoke / new</td></tr>
<tr><td>As the chip is probably slow (A. low powered) / low in memory</td><td>memory space needs to be used efficiently // code needs to be (time) efficient</td></tr>
<tr><td>For an interpreted solution the chip would have to incorporate an interpreter</td><td>which would increase the memory requirements // restrict the programmer to a specific language</td></tr>
<tr><td>Platform dependence is not relevant</td><td>since code will only run on one type of device</td></tr>
<tr><td>(Translated) assembly language (solution) would (probably) be faster / more efficient</td><td rowspan="3"></td></tr>
<tr><td>(Translated) assembly language (solution) would (probably) require less memory than high level code</td></tr>
<tr><td>Assembly language (solution) provides for direct control of hardware A. by example R. registers</td></tr>
</table>

Mark as follows:
1 mark for each point or expansion MAX 3 marks

Point needed for expansion mark to be awarded.</td><td>3</td></tr>
</table>

<table>
<tr><td>05</td><td>1</td><td>Mark is for AO1 (knowledge)

NAND;

A. NOT AND</td><td>1</td></tr>
<tr><td>05</td><td>2</td><td>Marks are for AO2 (apply)

<table>
<tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>$\mathbf{A}$</td><td>$\mathbf{B}$</td><td>$\overline{\mathbf{B}}$</td><td>$\mathbf{A}+\overline{\mathbf{B}}$</td><td>$\overline{\mathbf{A}}$</td><td>$\overline{\mathbf{A}}\cdot\mathbf{B}$</td><td>$\overline{\overline{\mathbf{A}}\cdot\mathbf{B}}$</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table>
Mark as follows:
1 mark for column 1 and 3 correct
1 mark for column 4 correct
1 mark for columns 2 and 5 correct and identical

I. order of columns</td><td>3</td></tr>
</table>

05	3	**Marks are for AO2 (apply)** **Marking guidance for examiners** • Award marks for working out until an incorrect step has been made. • If, in any one step, a candidate is simplifying different parts of an expression simultaneously award all relevant marks for this multiple stage but don't award any further marks for working in any parts simplified incorrectly. Example, if the expression P.P.(P+Q) + P.P.1 was changed to P.(P+Q)+P.0, the candidate would get one mark for simplifying the first part to P.(P+Q) and could get further marks for correctly simplifying this part of the expression further but should not be awarded marks for simplifying the incorrectly changed part P.0 (ie to 0) **Mark as follows** **1 mark** for final answer X **Max 3 marks for working**: • **1 mark** for each application of an identity other than cancelling NOTs that produces a simpler expression. • **1 mark** for expanding brackets • **1 mark** for putting an expression into brackets that would lead to a simpler expression. **Note:** a simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators. **Max 3** if answer is correct but any incorrect working or significant steps of working is missing. **Example working (1)** $X.X + X.\overline{Y} + Y.X + Y.\overline{Y}$ [expansion of brackets] $X + X.\overline{Y} + Y.X + 0$ [use of $X \cdot X = X$ and $Y.\overline{Y} = 0$] $X(1 + \overline{Y} + Y)$ or $X + X(\overline{Y} + Y)$ [taking X outside of brackets] **Alternative example working (2)** $X + (Y.\overline{Y})$ [Use of distributive law] $X + 0$ [$Y.\overline{Y} = 0$] X [Recognising X+0 = X]	**4**

06	1	**Marks are for AO1 (understanding)** Harvard uses separate memory/bus/address space // von Neumann uses combined memory/bus/address space; for instructions/program and data; **NE.** Places, locations, registers, areas of memory **A.** Main memory **NOTE:** It must be clear that instructions/data are stored in separate memory, not separately in memory.	**2**
06	2	**Mark is for AO1 (knowledge)** Harvard; **R.** more than one lozenge shaded	**1**

06	3	**2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)** **Level of response question** **Points may include:** **Fetch:** Contents of Program Counter / PC transferred to Memory Address Register / MAR Address bus used to transfer this address to main memory Transfer of content uses the data bus Contents of addressed memory location loaded into the Memory Buffer Register / MBR Increment (contents of) Program Counter / PC **A**. at any part of fetch process after transferring PC to MAR Increment Program Counter / PC and fetch simultaneously Contents of MBR copied to CIR **Decode:** Decode instruction held by the (Current) Instruction Register / (C)IR The control unit decodes the instruction Instruction split into opcode and operand **Execute:** If necessary, data is fetched If necessary, data is stored in memory The opcode identifies the type of operation/instruction to be performed (by the processor) Result (may be) stored in register/accumulator The operation (identified by the opcode) is performed by the processor. **A.** ALU Status register updated If jump / branch required Program Counter/PC is updated **NE.** Register notation **A.** Memory Data Register/MDR for Memory Buffer Register/MBR **I.** Incorrect headings	**6**

Level	Description	Mark Range
3	At least five of the steps of the cycle have been correctly identified in order/the steps are all in correct order and covering all three of the stages (fetch, decode, execute). For the top mark in this level thorough understanding of how the cycle works is evident.	5-6
2	At least three steps of the cycle have been identified in order, covering at least two of the stages (fetch, decode, execute). Some understanding of how the cycle works is evident.	3-4
1	At least one step of the cycle have been identified, covering at least one stage (fetch, decode or execute). The order of the steps may not be correct. Little understanding of how the cycle works is evident.	1-2

07	1	**Marks are for AO3 (program)** **Answer 1** 1. ADD R0, R0, #1 ; 2. CMP R0, #11 ; 3. BNE; startloop ; **Answer 2** 1. ADD R0, R0, #1 ; 2. CMP R0, #11 ; 3. BEQ endloop ; 4. B startloop ; **Answer 3** 1. CMP R0, #10 ; 2. BEQ endloop ; 3. ADD R0, R0, #1 ; 4. B startloop ; **Answer 4** 1. ADD R0, R0, #1 ; 2. CMP R0, #11 ; 3. BLT; startloop ; **Stop marking when the first incorrect command is encountered. Mark response against whichever alternative gives the highest mark.** **I.** Any extra commands which do not effect operation of program.	**4**
07	2	**Mark is for AO2 (apply)** 28_{10} // (000)11100_2; **TO.** If two answers given and one is incorrect. **I.** Lack of subscript.	**1**
07	3	**Mark is for AO1 (understanding)** Direct addressing means that the operand is the (memory) address/register number (of the datum) whereas immediate addressing means the operand is the datum ; **Note:** Must be clear that the operand is being used.	**1**

08	1	**2 marks for AO1 (knowledge) and 2 marks for AO1 (understanding)** 1. Parallel communication requires more wires (and hardware); • Higher cost • More difficult to manage when setting up the system • More difficult to repeat/switch 2. Parallel communication needs the data to be kept synchronised across wires / risk of data skew over long distances; • More chance of errors • Limiting factor on transmission speed (as problem worsens at higher speeds) • Limiting factor on cable length 3. Parallel communication carries the risk of crosstalk between wires; • More chance of errors • Limiting factor on transmission speed (as problem worsens at higher speeds) **2 marks for AO1 (knowledge)** for making any two of points 1,2,3 above – 1 mark per point. **2 marks for AO1 (understanding)** for making any of the bulleted points above and linking the points to an associated knowledge point – 1 mark per point. Note that only 1 mark can be awarded for a particular understanding point (e.g more chance of errors) even if it is made more than once and connected to different knowledge points. **A.** points made in reverse, for example serial communication has less chance of errors because it uses fewer wires so cross talk does not occur.	**4**
08	2	**Marks are for AO1 (knowledge)** **1 mark for each term defined** [Bit rate] The number of bits that can be sent/received/transferred in one second/unit of time // the frequency at which bits can be transmitted/transferred; **R.** Unexplained examples [Latency] The delay between an action being instigated and its effect being noticed; **A.** time delay between signal being transmitted and arriving **A.** time taken for transmitted data to arrive at the receiver **A.** lag for time delay **NE.** delay in transmission, transmission time	**2**

08	3	**Marks are for AO1 (understanding)** The SSID/Service Set Identifier of the network will not be visible when trying to connect to a network; this means that only users who know the SSID of the network can try to connect; **A.** name for SSID	**2**
08	4	**Marks are for AO1 (understanding)** A MAC/Media Access Control address is unique to every NIC/Network Interface Card; A white list only allows those MAC addresses that have been authorised to connect to the network // devices whose MAC addresses are not in the white list are not allowed to connect to the network; **A.** Device for NIC **A.** Address for MAC Address **R.** first mark if not clear that MAC address is unique to NIC/device **R.** IP address for MAC address	**2**

09

Marks are for AO2 (analyse) **9**

Level of response question

Level	Description	Mark Range
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers ethical, legal and cultural issues. In these areas, there is sufficient detail to show that the student has a thorough level of understanding of the issues involved. Although understanding would be indicated by two or three points being made in each of the areas, although potentially thorough coverage of two areas might exceptionally lead to a mark in this band.	7-9
2	A line of reasoning has been followed to produce a mostly coherent, relevant, substantiated and logically structured response that covers at least two of ethical, legal and cultural issues. In at least one of these areas, at least two valid points must have been made that demonstrates a good understanding, and typically students should have made at least two points in two areas.	4-6
1	A few relevant points have been made and there is limited evidence that a line of reasoning has been followed.	1-3

Points may include:

Ethical:
- Consider if material in images could be of harm to children
- Identifying and requesting permission from any members of public caught on the images.
- Members of the public may not be as happy being photographed in a building as they are on the streets.
- Recording of adverts could lead to unfair product placement
- Considering what harmful uses users of the system might use the captured images for.
- Considering how often Google should update the image data.
- Dealing with copyrighted information that might have been inadvertently captured.
- Considering that access via Street View might reduce the number of paying customers for museums.
- Are young people being dissuaded from leaving home to visit public buildings leading to poor health.
- Need to consider which areas of a building are appropriate to film (eg toilets, offices, research laboratories)

		Legal: - Does Google need permission to film in what might be a private building. - It may not be legal to film people without permission (on private land). - Aspects of data protection legislation might apply. - Copyrighted information might be inadvertently captured and may lead to legislation breach. - Consider if material in images is legally allowed to be viewed by children. - Could be a risk of identifying items to steal leading to liability for crimes being carried out. - Ability to identify locations and access could be used for crime or to carry out acts of terrorism. - Street View is a worldwide service so would need to consider different legal systems. - Consideration to the security of information storage needs to be made. - Laws for certain buildings or areas of buildings may be more restrictive than others. **Cultural:** - Some images of people or exhibits may be offensive to certain cultures. - Taking images inside religious buildings for some purposes may be considered inappropriate. - Some cultural beliefs may not allow photography of people. - Do people have the right to request the deletion of their images? - Could the culture of visiting places such as museums (e.g. family/school day trips) be affected by access them online? - Need for balance between cultural sensitivities and freedom of expression. **NE.** Without suitable context: Faces need to be blurred out, must comply with laws, invasion of privacy. **R.** Reference to private homes, implication that will be used for live monitoring.	

10		**2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)** **Level of response question** **Points may include:** Print drum coated in (positive static) charge Printer generates bitmap of page from the data Laser beams shone / directed at / draws on print drum Via rotating (octagonal) mirror Laser is modulated (turned on & off) Laser removes / neutralises / reverses electric charge on drum where image should be dark / black Toner is given (positive) charge Charged drum picks up toner For drum/laser mechanisms, one for each colour (cyan etc) Toner transferred (from drum) to paper / paper rolled over drum (to transfer toner) Toner is fused / bonded / melted / stuck to paper (by heated rollers / pressure) (must be clear that toner is already on paper when it is fused, not still on drum) **A.** Reversal or lack of polarity of static charge.	**6**

Level	Description	Mark Range
3	At least five points have been made showing knowledge of five steps in the process. The description shows a thorough level of understanding and all of the steps have been correctly sequenced.	5-6
2	At least three points have been made showing knowledge of three steps in the process. Good, mostly correct understanding of the process is demonstrated between 3 or more steps.	3-4
1	At least one point has been made showing knowledge of one step in the process. Some understanding may be shown if two steps are covered and correctly sequenced.	1-2