AQA

AS
Computer Science

Paper 2 (7516/2)
Mark Scheme

7516
June 2016

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

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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.

01	1	**Mark is for AO1 (understanding)** B; **R.** More than one lozenge shaded	1
01	2	**Mark is for AO1 (understanding)** A; **R.** More than one lozenge shaded	1
01	3	**Mark is for AO1 (understanding)** C; **R.** More than one lozenge shaded	1

02	1	**Mark is for AO2 (apply)** 39; **A.** #39	1
02	2	**Mark is for AO1 (understanding)** More compact when displayed; Easier (for people) to understand/remember; **A.** read Lower likelihood of an error when typing in data; Saves (the programmer) time writing/typing in data; **NE** takes up less space **R.** if answer states that hexadecimal uses less memory/storage **Max 1**	1
02	3	**Marks are for AO2 (apply)** 3 9/16 // 3.5625 **Mark as follows:** **1 mark** for correct integer part (3) **1 mark** for correct fractional part (9/16 or .5625) **Alternative answer** 57/16;;	2
02	4	**Mark is for AO2 (apply)** 57;	1

02	5	**Mark is for AO1 (understanding)** 9; **I**. Quotes around answer **I.** subscript 10 after the answer 9	1
02	6	**Marks are for AO1 (understanding)** The number of 1s (in the other 7 bits) has been counted // there are four 1s (in the 7 bits); there are an even number of 1s so the parity bit has been set to 0 (to keep the number of 1s even); **Alternative answer** The 7 data bits have been XORed; The result is a 0 so the parity bit has been set to 0 (so the result of XORing the 8 bits will be 0);	2
02	7	**1 mark is for AO1 (knowledge) and 1 mark for AO1 (understanding)** **AO1 knowledge – 1 mark:** Each bit is sent multiple times; **A.** A specified (odd) number greater than 2, instead of multiple **Marking guidance – to get this mark sent/sender must be clear** **AO1 understanding – 1 mark:** The receiver checks the bits it has received and if they are not all the same it assumes the one it received the most copies of is the correct value for the bit; **R.** receiver knows that the bit is correct **A.** receiver takes as correct (or similar) **Marking guidance – to get this mark received/receiver must be clear** **A. alternative answer using majority voting with a whole byte instead of individual bits** **AO1 knowledge – 1 mark:** The bit pattern (**R.** data) is sent multiple times; **A.** A specified number greater than 2, instead of multiple **Marking guidance – to get this mark sent/sender must be clear** **AO1 understanding – 1 mark:** The receiver checks the bit patterns (**R.** data) it has received and if they are not all the same it assumes the one it received the most copies of is the bit pattern (**R.** data) that was sent; **R.** receiver knows that the bit pattern is correct **A.** receiver takes as correct (or similar) **Marking guidance – to get this mark received/receiver must be clear**	2

03		**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: $\overline{\mathrm{A}}.\mathrm{B}$ **Max 3** for working; **Max 3** if answer is correct but any incorrect working or significant steps of working is missing: **1 mark** for a successful application of De Morgan's Law that would lead to a simpler expression. **Max 2** for applications of De Morgan's Law. **1 mark** for applying an identity other than cancelling nots that produces a simpler expression. **Max 2** for applying identities. **1 mark** for expanding brackets or putting an expression into brackets that would lead to a simpler expression. **Max 2** for expanding brackets or putting an expression into brackets. **Note:** a simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators. **Example working (1)** $= (\overline{\mathrm{A}} + \mathrm{B}).(\overline{\mathrm{A}}.(\mathrm{B} + \mathrm{A}))$ [application of De Morgan's law] $= (\overline{\mathrm{A}} + \mathrm{B}).(\overline{\mathrm{A}}.\mathrm{B} + \overline{\mathrm{A}}.\mathrm{A})$ [expansion of brackets] $= (\overline{\mathrm{A}} + \mathrm{B}).(\overline{\mathrm{A}}.\mathrm{B})$ [use of identities $\mathrm{X}.\overline{\mathrm{X}} = 0$ and $\mathrm{X}+0 = \mathrm{X}$] $= \overline{\mathrm{A}}.\overline{\mathrm{A}}.\mathrm{B} + \mathrm{B}.\overline{\mathrm{A}}.\mathrm{B}$ [expansion of brackets] $= \overline{A}.B + \overline{A}.B$ [use of identity $X.X = X$ twice] $= \overline{A}.B$ [use of identity $X + X = X$]	4

Alternative example working (2)

$= (\overline{\overline{A} + B}) + (A + (\overline{B + A}))$ [application of De Morgan's Law]

$= \overline{A.\overline{B} + \overline{A}.(B + A)}$ [application of De Morgan's Law twice]

$= \overline{A.\overline{B} + (\overline{A.B} + \overline{A}.A)}$ [expansion of brackets]

$= \overline{A.\overline{B} + \overline{A.B}}$ [use of identities $\overline{A}.A = 0$ and $X + 0 = X$]

$= \overline{\overline{A} + B} + \overline{A.B}$ [application of De Morgan's Law]

$= (\overline{A} + B).(\overline{A}.B)$ [application of De Morgan's Law]

$= \overline{A}.\overline{A}.B + B.\overline{A}.B$ [expansion of brackets]

$= \overline{A}.B + \overline{A}.B$ [use of identity $X.X = X$ twice]

$= \overline{A}.B$ [use of identity $X + X = X$]

Alternative example working (3)

$= \overline{(\overline{\overline{A} + B}) + (A + (\overline{B + A}))}$ [application of De Morgan's Law]

$= \overline{A.\overline{B} + \overline{\overline{A}.(B + A)}}$ [De Morgan's Law twice]

$= \overline{A.\overline{B} + (\overline{A.B} + \overline{A}.A)}$ [Expansion]

$= \overline{A.\overline{B} + \overline{A.B}}$ [Identity $\overline{A}.A = 0$ and $A + 0 = A$]

$= \overline{\overline{A} + B} + \overline{A.B}$ [application of De Morgan's Law]

$= (\overline{A} + B).(\overline{A}.B)$ [application of De Morgan's Law]

$= \overline{A}.\overline{A}.B + B.\overline{A}.B$ [Expansion]

$= \overline{A}.B + \overline{A}.B$ [Identity $\overline{A}.\overline{A} = \overline{A}$ and $B.B = B$]

$= \overline{A}.B$ [Final answer via identity $A + A = A$]

04	1	**Mark is for AO1 (knowledge)** Machine code; **A.** bytecode **A.** object code **I.** reference to binary **A.** machine (language) as BOD	1
04	2	**Mark is for AO2 (analyse)** `#1;` **R.** 1 **I.** zeroes between # and 1 **Refer answers that start with #1 and then have any other writing to senior examiner**	1
04	3	**2 marks for AO3 (design) and 4 marks for AO3 (programming)** **AO3 (design) – 2 marks:** **1 mark:** Identifying that a comparison and branch are required to have the same effect as the `IF` statement, even if the syntax or comparison made are incorrect **1 mark:** Identifying that one or more labels are needed for branching to work **AO3 (programming) – 4 marks:** For the AO3 (programming) marks, the syntax used must be correct for the language as described on the question paper. **1 mark:** Comparing `R3` against 1 or 0 and having a branch with the correct logical condition **1 mark:** For moving `69` to `R2` in the equivalent of the THEN part **A.** moving `69` to `R2` in equivalent of ELSE part if this is appropriate for compare and branch statements used **1 mark:** For having an unconditional branch that results in skipping over 2nd move instruction or HALT in appropriate place **1 mark:** For moving `79` to `R2` in the equivalent of the ELSE part **A.** moving `79` to `R2` in equivalent of THEN part if this is appropriate for compare and branch statements used **Max 3** marks for programming if any syntax incorrect or program does not work correctly under all circumstances **I.** Missing `AND` instruction at start of answer. **I.** Incorrect `AND` instruction at start of answer.	6

I. Load instruction to setup `R1` from `A`.
I. Store instruction to store `R2` into `B`.
A. Labels given in any sensible format
A. Answers that use hexadecimal or binary values
A. Line numbers as equivalent to labels if they are used as the target of branches. **Note: in future this will not be accepted as line numbers are not part of the AQA assembly language.**
DPT Missing hash for immediate addressing
DPT incorrect use of commas, colons, semi-colons, etc…

Refer alternative answers to team leaders

```
  AND R3, R1, #1
  CMP R3, #1
  BEQ odd
  MOV R2, #69
  B end
odd:
  MOV R2, #79
end:
```

//

```
  AND R3, R1, #1
  CMP R3, #1
  BEQ odd
  MOV R2, #69
  HALT
odd:
  MOV R2, #79
```

//

```
  AND R3, R1, #1
  CMP R3, #1
  BNE even    A. BLT instead of BNE
  MOV R2, #79
  B end
even:
  MOV R2, #69
end:
```

//

```
  AND R3, R1, #1
  CMP R3, #0
  BNE odd     A. BGT instead of BNE
  MOV R2, #69
  B end
odd:
  MOV R2, #79
end:
```

//

		`  AND R3, R1, #1`
		`  CMP R3, #0`
		`  BEQ even`
		`  MOV R2, #79`
		`  B end`
		`even:`
		`  MOV R2, #69`
		`end:`	

04	4	**Mark is for AO1 (understanding)** Immediate; **R.** More than one lozenge shaded	1
04	5	**Mark is for AO1 (knowledge)** A memory/storage location inside the processor; **A.** CPU instead of processor **NE** memory/storage location	1

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

XOR // EOR // Exclusive OR;</td><td>1</td></tr>
<tr><td>05</td><td>2</td><td>Mark is for AO2 (apply)

$\overline{C}$;</td><td>1</td></tr>
<tr><td>05</td><td>3</td><td>Mark is for AO2 (apply)

C;</td><td>1</td></tr>
<tr><td>05</td><td>4</td><td>Marks are for AO2 (apply)

<table>
<tr><th>C</th><th>B</th><th>A</th><th>T</th><th>S</th><th>R</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</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></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
</table>
Mark as follows:
1 mark: column T correct;
1 mark: column S correct;
1 mark: column R correct;</td><td>3</td></tr>
<tr><td>05</td><td>5</td><td>Mark is for AO2 (analyse)

Use this circuit on the binary number to be subtracted and add the result to the other binary number;

A. Any equivalent answers
R. Number to be added IS negative</td><td>1</td></tr>
<tr><td>05</td><td>6</td><td>3 marks for AO1 (knowledge) and 3 marks for AO1 (understanding)

1 mark for AO1 (knowledge): (increase the) data bus width;
1 mark for AO1 (understanding): enables more bits (A. data) to be transferred between main memory and the processor <u>at one time</u> (so fewer read/write operations needed);

1 mark for AO1 (knowledge): (increase the) clock speed;
1 mark for AO1 (understanding): enables more instructions to be executed per unit of time/second (A. calculations/operations/commands instead of instructions) // each individual instruction could be executed sooner / more quickly (A. calculation/operation/command instead of instruction);

1 mark for AO1 (knowledge): (increase the) amount of cache memory;
1 mark for AO1 (understanding): cache memory is faster than main memory so the more that can be stored in cache memory the less frequently the main memory needs to be accessed;</td><td>6</td></tr>
</table>

		1 mark for AO1 (knowledge): (increase the) word length; **1 mark for AO1 (understanding):** larger word size means that the processor can process more bits <u>in one go</u>; **1 mark for AO1 (knowledge):** (change the) type of cache memory; **1 mark for AO1 (understanding):** some types of cache memory can be accessed faster; **A.** using memory with a faster access speed **1 mark for AO1 (knowledge):** (increase the) number of general purpose registers; **1 mark for AO1 (understanding):** more intermediate results/variables can be kept in processor registers rather than in main memory; **1 mark for AO1 (knowledge):** (increase the) address bus width; **1 mark for AO1 (understanding):** enables the processor to access a larger number of main memory locations (meaning it will not need to make as much use of virtual memory this will mean that system performance is improved); **A.** allows more main memory to be installed **R.** How improves mark if it is not relevant for the factor stated. **NE** How improves of "program will execute faster" **Note:** marks for the factor can be awarded in either the "factor" or "how improves" part of an answer	

06	1	**Marks are for AO2 (apply)** 16 * 16 * 2 / 8 = 64 **Mark as follows:** **1 mark:** working out that there are 256 (16*16) pixels in the image **1 mark:** multiplying by 2 **1 mark:** dividing by 8 so that number of bits needed is converted to number of bytes needed **Max 2** if final answer is not correct. Award all 3 marks if final answer is correct.	3
06	2	**Mark is for AO1 (understanding)** Because metadata will also be stored // other data about the image will be stored; **A**. by example eg width in pixels / height in pixels / (colour) depth of image will also be stored	1
06	3	**Mark is for AO2 (apply)** 1;	1
06	4	**Marks are for AO2 (analyse)** Store the colour of a pixel and a count; **A.** by example the count indicates the number of pixels of that colour there are before a pixel of a different colour is used in the image // the count indicates the total number of pixels of that colour there are in a run // the count indicates the number of consecutive pixels of the same colour;	2

07	1	**Mark is for AO1 (knowledge)** **Mark as follows:** One of: wireless/network/wireless network Followed by one of: adapter/dongle/card/interface card; **A.** NIC	1
07	2	**Marks are for AO1 (understanding)** MAC address white list/filtering; **A.** description of a whitelist Wireless access points check MAC address of device trying to connect to network against list of allowed addresses; Only devices with an allowed MAC address are able to connect // devices without an allowed MAC address are not able to connect; **DPT** wrong type of address, eg IP address, or no type of address specified **Note for examiners:** refer other plausible methods to team leader	3

07	3	**Marks are for AO1 (understanding)** A network has limited bandwidth; (Preventing some devices from using the network will mean that) more bandwidth available for other devices/users // (preventing some devices from using the network) will decrease network traffic; (Fewer devices on the network means) reduced likelihood of two devices transmitting simultaneously or transmissions interfering with each other/colliding; **Max 2**	2
07	4	**1 mark for AO1 (knowledge) and 1 mark for AO1 (understanding)** **AO1 (knowledge):** **1 mark:** SSID is a (locally unique) identifier for a wireless network; **AO1 (understanding):** **1 mark:** A wireless client must use the same SSID as the one put in the access point to join // which prevents clients from accessing the wireless network unless they are using the same SSID as the access point;	2
07	5	**Marks are for AO1 (knowledge)** Set of rules; that allow two devices to communicate;	2

08	1	**Marks are for AO2 (analyse)**	6

Level	Description	Mark Range
3	A detailed summary of the suitability / non-suitability has been given, indicating a comprehensive understanding of all three devices/technologies. The answer is well structured and a line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. A well-reasoned conclusion has been included featuring at least two reasons for RFID being most suitable for 5 marks and three reasons for RFID being most suitable for 6 marks.	5-6
2	Appropriate reasons, linked to the scenario in the question, have been given for the suitability / non-suitability of all three devices/technologies – though there may not be a reasoned conclusion and the reason(s) for RFID readers being suitable may be brief. The answer is satisfactorily structured.	3-4
1	A small number of reasons for the suitability / non-suitability of one or more of the devices have been given indicating some understanding of the input devices. However, there is no comparison and the understanding shown is not well-linked to the scenario described in the question.	1-2
No creditworthy material		0

Indicative subject content

Digital camera

- Advantage: no tag/code that can be lost / damaged
- Disadvantage: difficulties with taking a clear picture eg caused by blocked line of sight due to other competitors
- Disadvantage: high data storage requirements for the number of photos that will be needed in a large event
- Disadvantage: face recognition may not work eg due to costumed runners
- Disadvantage: face recognition software not always reliable
- Disadvantage: with a lot of competitors a lot of operators/cameras might be needed

Barcode reader

- Advantage: barcodes are very cheap
- Advantage: often smaller and lighter than an RFID tag so less of a burden to competitors
- Disadvantage: barcode could be obscured (e.g. by clothing)
- Disadvantage: difficult to scan a code that is being moved around and is not on a flat surface
- Disadvantage: some codes might be missed if a large number of competitors pass a checkpoint at roughly the same time
- Disadvantage: with a lot of competitors a lot of operators/barcode readers might be needed

		• Disadvantage: scanner needs to be quite close to code / runners may need to stop to have their barcode scanned • Disadvantage: barcode more likely to be damaged than RFID tag – when it is damaged it is unreadable RFID reader • Advantage: RFID can be read faster than the other devices and competitors may be going past the checkpoint quickly • Advantage: tags potentially reusable – saving money in future years of the event • Advantage: no line-of-sight issues • Advantage: no need for runner to stop at checkpoint • Disadvantage: potential for RFID dead spots **Note:** advantage/disadvantage for device must be an advantage/disadvantage compared to (at least) one of the other devices listed in the question for mark to be awarded.	
08	2	**Marks are for AO1 (understanding)** Because hard disk drives are cheaper (per unit of storage) than solid state drives // because SSDs are more expensive (per unit of storage) than hard disks; Because hard disk drives have a higher capacity than solid state drives // because SSDs have a lower capacity than hard disk drives;	2
08	3	**Marks are for AO1 (knowledge)** NAND (flash) memory; **A.** NOR (flash) memory **A.** Floating gate transistor **A.** flash memory **NE** memory **NE** logic gates Controller; (SATA) interface; **Max 2**	2

09	1	**Marks are for AO1 (knowledge)** Instructions are executed in a programmer-defined order // Imperative high level language programs define sequences of commands for the computer to perform; Imperative high level languages describe *how* to solve a problem (in terms of sequences of actions to be taken);	2
09	2	**Marks are for AO1 (understanding)** Programs written in a high-level language are machine independent / portable; People find it easier to debug high-level language programs; People find it easier to read/write/understand high-level language program code; High-level languages save time for programmers as they use fewer lines of program code; Programs written in a high-level language may not make best use of specific features of a particular processor; Programs written in a high-level language may not execute as quickly; Some programs cannot be (easily) written using a high-level language – particularly some parts of a computer's operating system; Programs written in a high-level language may use more memory; **Max 4** **Max 3** if all advantages of one type of language or all disadvantages of one type of language	4
09	3	**Marks are for AO1 (understanding)** A compiler produces object/machine code (**A.** executable file) whilst an interpreter does not // once code has been compiled it does not (normally) need to be recompiled whilst an interpreter has to translate code every time a program is run // if using an interpreter it needs the source code each time it executes the program whereas a compiler only needs to use the source code once; A compiler translates the whole of the source code into object code (prior to execution) whilst an interpreter translates and executes line by line; The object code produced by a compiler will execute faster once it is compiled than interpreting the source code (every time the program is run); An interpreter can run (syntactically correct) parts of a program whilst there are syntax errors in other parts of it, which a compiler cannot; **Max 2**	2