GCSE
COMPUTER SCIENCE

Unit 2 – Computing Fundamentals
Mark scheme

4512/2
June 2014

Version/Stage: v1.0 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

GENERAL GUIDANCE NOTES FOR EXAMINERS

Overall guidelines

- Do not expect the candidate to use the exact wording given in the mark scheme. If you are in doubt as to the correctness of an answer given by the candidate, consult your Team Leader.
- The answers given in the mark scheme are exemplars. Credit must be given for other correct answers not given in the mark scheme. Please refer to Team Leaders where there is any doubt.
- The meaning of Computing-specific words and phrases are generally as defined by *BCS Glossary of Computing and ICT* (current edition).

Specific marking guidelines

- **BOD** – where the benefit of the doubt is given for the point the candidate is making. This is generally where poor writing or English is an issue. Its widespread use should be avoided.
- An omission sign **^** should be used where the candidate has given insufficient information to gain a mark. This is particularly useful when a teacher or student looks at scripts against a mark scheme.
- For questions where candidates' answers are assessed for **QWC**, no individual ticks should be written on the script as it should be marked holistically.
- When to award **'0'** (zero) 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.

Mark Scheme Annotation

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
^ - means not enough
I - means ignore

Qu	Part	Sub-Part	Marking Guidance	Marks
1	a		151;	1
1	b		7D; **If there is no hexadecimal answer then** do not reward any working; **If the answer given is 7D then** reward any attempt at working; **If the hexadecimal answer given is not 7D then** a maximum of 1 mark can be awarded for any of the following working out stages: • convert to binary 0111 1101 • convert each of their nibbles to hex **A**. If incorrect bit pattern is converted to its corresponding hex value • show division of 125 by 16 giving the quotient and remainder;	2
1	c		1 mark each for any correct answer. Examples include: Hexadecimal is easier (for humans) to read (than binary); Hexadecimal is easier to convert (to binary) than denary; Numbers are displayed in a more compact way (in hexadecimal than in binary); It is quicker to type in (hexadecimal numbers than binary numbers); It is more accurate to type in (hexadecimal numbers than binary numbers); **R.** anything that implies less memory is used.	1
1	d		128 (characters) // 2^7 (characters);	1
1	e		1 mark if **1** stage correct 2 marks if **2** stages correct 3 marks if **all 4** stages correct The correct stages are: 4, 1, 3, 2	3
1	f		The image is represented as a series/grid/sequence of pixels; Each pixel/dot is represented by one bit; White is represented by a 0; Black is represented by a 1; **A.** White=1; Black=0; **A.** White and black are represented using different bit patterns (1 mark); **R.** Same bit pattern used for black and white Metadata about the image is also stored; A. examples of	3

			metadata **MAX 3**	

2	**a**	**i**	Memory content is lost when power is turned off; A. Any statement that implies temporary	**1**
2	**a**	**ii**	The computer's BIOS//initial instructions//bootstrapping instructions; **A.** Qualified answers about embedded systems eg washing machines. **A.** Operating system	**1**
2	**b**		Frequently used data/instructions are stored in the cache; Meaning they don't have to be fetched from main memory; Data/instructions stored in the cache memory can be accessed faster (than data/instructions stored in the main memory); **MAX 2**	**2**
2	**c**		1 mark each for any correct answer. Examples include: the number of cores/processors; the processing speed/clock speed/number of cycles (per second) of the processor; the bus width; the word size; the architecture of the processor/CPU; the type of cache memory; **R.** amount of cache memory **MAX 2**	**2**

3	**a**		1;	**1**
3	**b**		(line) 3;	**1**
3	**c**		(line) 4;	**1**
3	**d**		(line) 2;	**1**
3	**e**		The variable `i` can only be accessed/used/changed within those lines; The variable `i` is only defined within those lines; Trying to access the variable `i` outside of those lines will not work;	**1**

4	**a**		Two or more computers//a group of computers; That have been connected together//That can communicate with/send messages to one another;	**2**

4	**b**		line 1 (Displaying an HTML Page): Client; Line 2 (Receiving messages): Both; Line 3 (Starting the handshaking process): Client;	**3**

5	**a**		1 mark each for any correct input method. Examples include: Microphone; Camera/Video camera; GPS device; Motion sensor; Accelerometer; Light sensors; Proximity sensors; **R.** Touchscreens **R**. Any reference to external devices	**3**
5	**b**		Examples include: Difference: No mechanical parts in solid state media//Magnetic media has mechanical parts. Explanation: Magnetic media are often unsuitable for mobile use because the mechanical parts cannot function during movement // mechanical parts are less robust during movement. Difference: Speed of read access higher in solid state drives. Explanation: Data can often be read more quickly from solid state media than magnetic media. Difference: Solid state media can be more compact than magnetic media. Explanation: The smaller size enables better mobility; Reason: The battery will last longer Explanation: Solid state media uses less power Difference: Less heat generated when using solid state Explanation: Utilising the power more efficiently//allows for more miniaturisation. Difference: Solid state is silent Explanation: Makes it more attractive to use.	**4**

6			1 mark for every correct point that explains the functionality of reading data from an optical medium such as a CD up to a maximum of 5 marks. Examples include: The tracking mechanism moves the laser into the correct position over the CD; The CD is spun to ensure all data can be read; The CD spins slower when the laser/read-head is above the outer tracks; The laser is shone on to the disk; The laser is reflected; Bumps/pits are raised parts of the disk; Bumps/pits form a spiral from the centre to the outside of the disk; A (opto-electric) sensor detects changes in reflectivity; Bumps/pits and lands represent the two possible bit values	**5**

7	**a**		Because Boolean only allows two possible return values (and this function requires three).	**1**
7	**b**	**i**	0	**1**
7	**b**	**ii**	1	**1**
7	**b**	**iii**	-1// Allow follow through **only** for the following cases: Answer is 1 if the answer to 7(b)(i) is greater than the answer to 7(b)(ii), or Answer is 0 if the answer to 7(b)(i) is the same as the answer to 7(b)(ii).	**1**

8	**a**		E (Record) D (Primary key) F (Relationship) C (Index)	**4**
8	**b**	**i**	Third box `WHERE DayTaught = 'Monday' OR DayTaught = 'Wednesday'`	**1**
8	**b**	**ii**	CompB10, Friday Red7, Monday One mark for each of the following: Displays the correct fields in the correct field order (ClassID followed by DayTaught even if the wrong ClassID and DayTaught values are shown); **R.** If additional fields present OR if data given is not from the table.	**4**

			One correct result with no more than one incorrect result shown; **I.** Additional fields A second correct result and no incorrect results shown; **I.** Additional fields Correct sort order for results; **A.** correct sort order for incorrect results as long as sorted on ClassID Ignore punctuation	

9	**a**	**i**	Logical	**1**
9	**a**	**ii**	4//7;	**1**

9	**a**	**iii**	Any correct answer, examples include:
			If the answer given for 9 (a) (ii) is 4 then
			`WHILE n > 0`
			`WHILE n ≥ 1`
			`WHILE n ≥ 3`
			
			A. `Equivalent logic`
			
			R. If answer to 9 (a) (ii) is not 4
			If the answer given for 9 (a) (ii) is 7 then
			
			`IF n = -3 THEN`
			
			`A. Equivalent logic`
			
			R. If answer to 9 (a) (ii) is not 7
				1

9	**b**		Runtime error // Type error	**1**
9	**c**		1 mark for every correct feature to a maximum of 3. Examples include: Watch/Variable table; Breakpoint; Step through; Use of an Integrated Development Environment/IDE; Syntax colouring; Code completion; Automated/Integrated testing; Compiler/interpreter; **R** Testing	**3**

10			**No creditworthy material**	0		**6**
			Lower mark range Unit testing and one other type of testing are stated but with simple or vague description // There are a few simple or vague statements relating to two different tests. The comparison of different types of testing is not given or is not creditworthy. // Only one correct type is given and is correctly described. Quality of written communication: The candidate has used a form and style of writing which has many deficiencies. Ideas are not often clearly expressed. Sentences and paragraphs are often not well-connected or at times bullet points may have been used. Specialist vocabulary has been used inappropriately or not at all. Much of the text is legible and some of the meaning is clear. There are many errors of spelling, punctuation and grammar but it should still be possible to understand much of the response.	1-2 marks		
			Mid mark range There is evidence of some comparison of the differences of the two tests shown through the use of mostly correct technical explanation. The answer covers a few of the ideas below or includes other correct answers. The statements are supported by relevant reasoning. // Two correct types are given and at least one is well described although no comparison is made between the two. Quality of written communication: The candidate has mostly used a form and style of writing appropriate to purpose and has expressed some complex ideas reasonably clearly and fluently. The candidate has usually used well linked sentences and paragraphs. Specialist vocabulary has been used on a number of occasions but not always appropriately. Text is legible and most of the meaning is	3-4 marks		

			clear. There are occasional errors of spelling, punctuation and grammar.			
			High mark range There is evidence of at least one detailed comparison. There is a correct, detailed description of unit testing. Quality of written communication: The candidate has selected and used a form and style of writing appropriate to purpose and has expressed complex ideas clearly and fluently. Sentences and paragraphs follow on from one another clearly and coherently. Specialist vocabulary has been used appropriately throughout. Text is legible and the meaning is clear. There are few if any errors of spelling, punctuation and grammar.	5-6 marks		
			Quality of written communication skills The candidate's quality of written communication skills will be one of the factors influencing the actual mark an examiner will give within a level of response. The quality of written communication skills associated with each level is indicated above.			
			Tests and their features (features are given although comparative differences will be marked depending on the tests chosen by the candidate): Unit tests or modular tests are performed by the programmer as they are developing the program. They test the correctness of small blocks of code in isolation. Integration testing is performed when all of the different parts of code, such as functions or modules, are complete. This tests whether the units of code work together correctly. System testing takes place after the code has been individually tested and is done without having to have any knowledge of the code itself (black box testing). This tests that the entire system functions correctly.			

			Other correct answers could include, but are not limited to, alpha testing, compatibility testing, benchmark/performance testing, black box/functional testing and white box testing. Comparisons between the tests could include but are not limited to: • The point of development at which they are carried out. • The purpose of the test. • The types of errors that the tests would normally uncover.			

11			Reward any valid technical reason along with an appropriate justification of why developing their libraries would benefit the company. Some examples are given in the section below.			**6**

No rewardable material	0
Lower mark range One technical reason is given and is vaguely described. // Two or more technical reasons are given but are not correctly described. // Two or more technical reasons are stated and there are a few simple or vague statements relating to the ideas below. Quality of written communication: The candidate has used a form and style of writing which has many deficiencies. Ideas are not often clearly expressed. Sentences and paragraphs are often not well-connected or at times bullet points may have been used. Specialist vocabulary has been used inappropriately or not at all. Much of the text is legible and some of the meaning is clear. There are many errors of spelling, punctuation and grammar but it should still be possible to understand much of the response.	1-2 marks
Mid mark range Three technical reasons are stated and there is evidence of some evaluation shown through the use of mostly correct	3-4 marks

				analysis of the some advantages/disadvantages. The statements are supported by some relevant reasoning. The examples cover a few of the ideas below. Quality of written communication: The candidate has mostly used a form and style of writing appropriate to purpose and has expressed some complex ideas reasonably clearly and fluently. The candidate has usually used well linked sentences and paragraphs. Specialist vocabulary has been used on a number of occasions but not always appropriately. Text is legible and most of the meaning is clear. There are occasional errors of spelling, punctuation and grammar.			
				High mark range There is evidence of a clear, reasoned discussion shown through the use of correct advantages/disadvantages of all three technical reasons. Quality of written communication: The candidate has selected and used a form and style of writing appropriate to purpose and has expressed complex ideas clearly and fluently. Sentences and paragraphs follow on from one another clearly and coherently. Specialist vocabulary has been used appropriately throughout. Text is legible and the meaning is clear. There are few if any errors of spelling, punctuation and grammar.	5-6 marks		
				Quality of written communication skills The candidate's quality of written communication skills will be one of the factors influencing the actual mark an examiner will give within a level of response. The quality of written communication skills associated with each level is indicated above.			
				Possible advantages include: The programmer may not have the expertise to develop that particular piece of code themselves.			

			It could speed up the development of their own projects by reducing the amount of developing and testing that developers would have to complete. The libraries could be updated by an external body (to more efficient code for instance) thereby increasing the efficiency of the developers' own code.			
			Disadvantages Relying on the correctness of someone else's program takes control away from the developer. You may need to become familiar with how to use the external code source (the API). The external code source may not be well documented. The external code source may cost money to use. There is a risk of shoe-horning the project if the external code sources do not do exactly what the developer would like them to.			

<table>
<tr>
<td>12</td>
<td>a</td>
<td></td>
<td>The correct, completed trace table should look like this:

<table>
<tr><th>carriages</th><th>total</th><th>max</th><th>index</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td></td><td>100</td><td>100</td><td>2</td></tr>
<tr><td></td><td>80</td><td></td><td>3</td></tr>
<tr><td></td><td>150</td><td>150</td><td>4</td></tr>
<tr><td></td><td>100</td><td></td><td>5</td></tr>
<tr><td></td><td>0</td><td></td><td>6</td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
</table>

Marks awarded as follows (do not penalise if values appear on different lines to the above trace table as long as the sequence of values within the column is correct):

1 mark for the index incremented by 1 at each step up to at least 5;

1 mark for the index ending at 6;

1 mark for max set to 100 ;

1 mark for final max value set to 150;

1 mark for all total values correct;

1 mark for carriages changed once to 3//1 mark follow through for carriages changed once to a non-zero number which is the last value of max divided by 50;

I all other values.</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>b</td>
<td></td>
<td>Marks awarded as follows (allow any logically equivalent and correct answer). The marks are labelled A – G and shown in the examples where they are awarded:

1 mark for assigning user input to a variable (permit any variable name); [mark A]

1 mark for using selection to check that a value greater than zero has been entered (two logically equivalent examples are given below although there are many logically equivalent ways to accomplish this); [mark B]

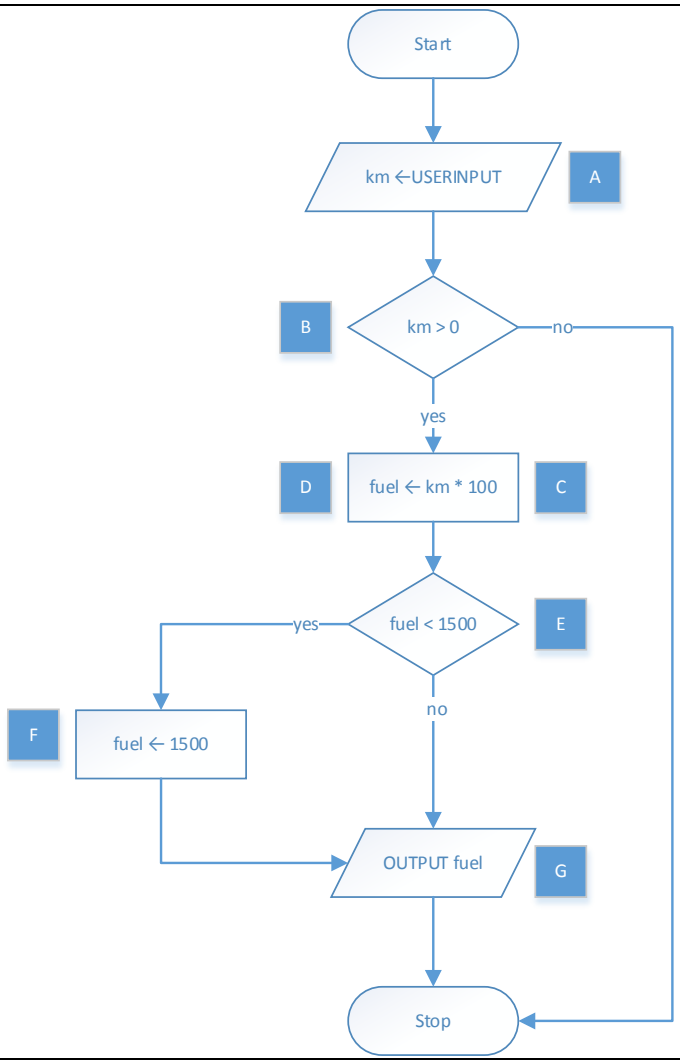
1 mark for the correct expression that multiplies whatever variable is holding the kilometres by 100; [mark C]

1 mark for assigning the value of the above expression to a variable (permit any variable name, the expression need not be correct); [mark D]

1 mark for using selection to check if the amount of fuel used is less than 1500 (two logically equivalent examples are given below although there are many logically equivalent</td>
<td>7</td>
</tr>
</table>

			ways to accomplish this); [mark E]
			
			1 mark for assigning the value 1500 to the above variable, or displaying the value 1500, within the selection above (the selection need not be correct); [mark F]
			
			1 mark for outputting the value of the above variable at the end of the algorithm; [mark G]
			
			If the sequence of these marks is incorrect then reward only the higher scoring statement. For example
			`fuel ← km * 100` *[D] [C]*
			`km ← USERINPUT` *[A]*
			The two statements are in the wrong sequence so reward the higher scoring statement (1st line).
			Example 1 (italicised square brackets indicate where marks are awarded):
			`km ← USERINPUT` *[A]*
			`IF km > 0 THEN` *[B]*
			`  fuel ←` *[D]* `100 * km` *[C]*
			`  IF fuel < 1500 THEN` *[E]*
			`  fuel ← 1500` *[F]*
			`  ENDIF`
			`  OUTPUT fuel` *[G]*
			`ENDIF`
			
			Example 2 (brackets indicate where marks are awarded):
			`km ← USERINPUT` *[A]*
			`IF km ≤ 0 THEN` *[B]*
			`  STOP`
			`ELSE`
			`  fuel ←` *[D]* `km * 100` *[C]*
			`  IF NOT (fuel ≥ 1500) THEN` *[E]*
			`  fuel ← 1500` *[F]*
			`  ENDIF`
			`ENDIF`
			`OUTPUT fuel` *[G]*
			
			Example 3 (dark squares indicate where marks are awarded, permit incorrect flowchart shapes although decision boxes must have two labelled arrows coming out for the relevant marks – B and E – to be awarded):	

12 (b) continues on the next page.


Start
km ←USERINPUT
A
B
km > 0
no
yes
D
fuel ← km * 100
C
yes
fuel < 1500
E
F
fuel ← 1500
no
OUTPUT fuel
G
Stop