Level 3 Technical Level
IT: PROGRAMMING
Y/507/6469

Unit 5 Mathematics for programmers

Mark scheme

January 2019

Version: 1.0 Final

1 9 1 A Y 5 0 7 6 4 6 9 / M S

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

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.

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 - in some questions a specific error made by a candidate, if repeated, could result in the candidate failing to gain more than one mark. The DPT label indicates that this mistake should only result in a candidate failing to gain 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.

Question	Guidance	Mark
01 D	**Mark is for AO1** A7F2; **R.** more than one box ticked	1
02 B	**Mark is for AO2** (A AND C) OR B; **R.** more than one box ticked	1
03 B	**Mark is for AO4** 33; **R.** more than one box ticked	1
04 C	**Mark is for AO4** x = 1 or x = −3; **R.** more than one box ticked	1
05 C	**Mark is for AO3** 26; (sequence is n^2+1) **R.** more than one box ticked	1

Question	Guidance	Mark
06	**2 marks for AO2** 2 marks for: not(a) and b and c ;; **A.** equivalent expressions/notation If not fully correct: 1 mark if only 1 error, eg not(a) **or** b and c	2
07.1	**Mark is for AO3** 2/5; **A.** equivalent values, eg 0.4, 2 in 5	1
07.2	**Mark is for AO3** 6/25; **A.** equivalent values, eg 24%	1

Question	Guidance	Mark
08.1	**Mark is for AO4** Maximum 1 from: inputs; parameters; arguments; **A.** variables;	1
08.2	**2 marks for AO4** f = 0.8, k = 1 + 0.5 = 1.5 2 marks for correct answer: 1.36… // 15/11 ;; **A.** equivalent answers, eg 1 / (11/15), 1 and 4/11 **A.** 1.4 **A.** 36% (speed up) If answer given is not correct then: Maximum of 1 from: 1 mark for correct substitution, ie f=0.8 and k=1.5; 1 mark for correct answer from the (wrong) numbers substituted;	2
09.1	**1 mark for AO1** **1 mark for AO2** SR AND/OR: AND 7 6 5 4 3 2 1 0 0 0 0 0 1 0 0 0 1 mark for OR; 1 mark for the correct data pattern;	2
09.2	**1 mark for AO1** **1 mark for AO2** SR AND/OR: OR 7 6 5 4 3 2 1 0 1 0 1 1 1 1 1 1 1 mark for AND; 1 mark for the correct data pattern;	2

<table>
<tr><th>Question</th><th>Guidance</th><th>Mark</th></tr>
<tr><td>10.1</td><td>3 marks for AO1

3 marks for correct answer:

101111.01_2 // $1.0111101 * 2^5$;;;

A. without binary suffix $_2$

If answer is not correct, award working marks as follows:

1 mark for (showing 47 is) 101111_2 ;
1 mark for (showing 0.25 is) 0.01_2 ;

A. sight of binary only.
A. without binary suffix $_2$</td><td>3</td></tr>
<tr><td>10.2</td><td>3 marks for AO1

1 mark for each correct box

A. C without leading 0

<table>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>1</td><td>10000100</td><td>01111010000000000000000</td></tr>
</table>

If table is not fully correct award working marks as follows:

1 mark for $1.0111101_2 \times 2^5$;
1 mark for 5 + 127 // 132 ;

DPT. error carried forward from 10.1, for which the method required is:

Take answer to 10.1.

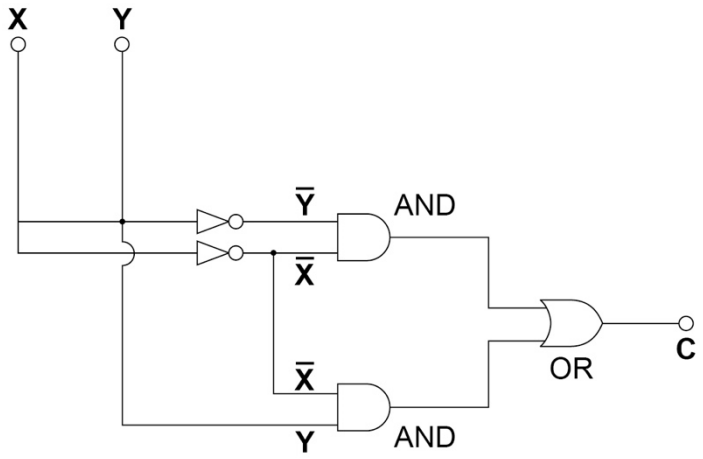
Positive number, so A = 1 and apply excess 127:

Normalise:
101111.01_2, giving $1.0111101_2 \times 2^5$

Exponent 5 is converted to excess 127 by 5 + 127 = 132 = 10000100_2

Fractional part prefixes C (23 bits in total)</td><td>3</td></tr>
</table>

Question	Guidance	Mark
11.1	**Mark is for AO2** **X** **Y** **R** **A** **G** **C** 0 0 1 0 0 1 0 1 1 1 0 1 1 0 0 0 1 0 1 1 0 1 0 0 1 mark for correctly filling each of the **R**, **A**, **G** and **C** columns **A.** all 1s filled but 0s omitted	1
11.2	**3 marks for AO2** 3 marks for: C = $\overline{X}$. $\overline{Y}$+ $\overline{X}$. Y ;;; If equation is not fully correct, award a maximum of 2 marks from: 1 mark for identifying either of the two products in the sum of products of the equation; 1 mark for sum of products; **A.** equivalent expressions **A.** without C = **DPT.** error carried forward from 11.1	3

Question	Guidance	Mark
11.3	**3 marks for AO2**  **3 marks** for fully correct circuit **A.** incorrect symbols labelled correctly in words If circuit is not correct awarding working marks as follows: Maximum 2 from: 1 mark for the correct identification of gates; **A.** incorrect symbols labelled correctly in words 1 mark for either AND gate correct; 1 mark for outputs from AND gates that go into OR gate; **DPT.** error carried forward from 11.2	3

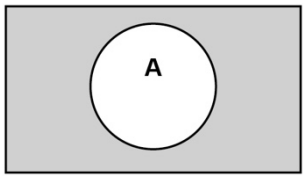
Question	Guidance	Mark
12.1	**3 marks for AO1** (Convert 67 to binary =) 01000011_2 ; 010_2 // 2 ; 00011_2 // 3 ;	**3**
12.2	**Mark is for AO1** 32 // 30 **Note:** The host number is 5 bits. This will support a maximum of 32 hosts. In reality, it is 32 -2 = 30 hosts. **R.** 31	**1**

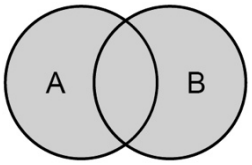
<table>
<tr><th>Question</th><th>Guidance</th><th>Mark</th></tr>
<tr><td>13.1</td><td>2 marks for AO3

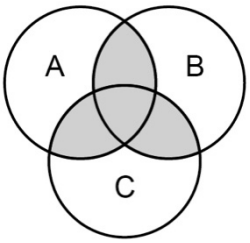
1 mark for each correct definition.

<table><tr><td>Finite set</td><td>Has determined number of elements</td></tr><tr><td>Overlapping set</td><td>Two or more sets have some common elements</td></tr></table>
A. Different wording with similar meaning</td><td>2</td></tr>
<tr><td>13.2</td><td>3 marks for AO3

1 mark for each correct answer.



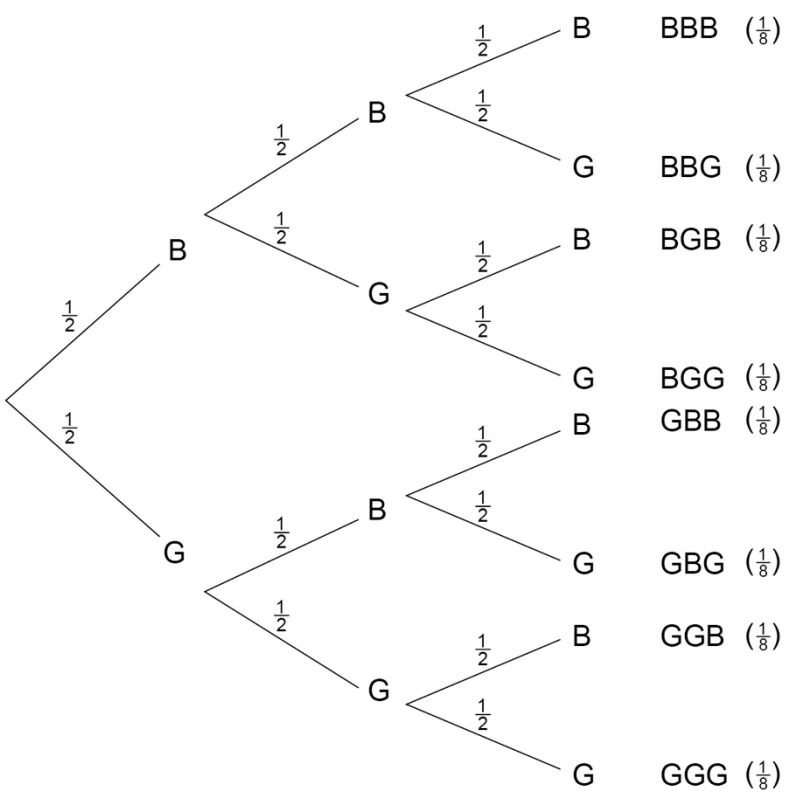

</td><td>3</td></tr>
</table>

Question	Guidance	Mark
14.1	**Mark is for AO3** A subroutine/function that calls itself.; **R.** It has a base case.	1
14.2	**Mark is for AO3** A loop (that executes steps n times);	1
14.3	**2 marks for AO3** 1 mark for each correct reason up to a maximum of 2 marks. Uses fewer resources, eg overhead of subroutine calls and returns removed; The stack does not grow and potentially overflow if too many recursive calls; **A.** Any other creditable answer	2

Question	Guidance	Mark
15.1	**6 marks for AO5** Maximum 6 marks overall. 1 mark for each column of algebraic matrix up to a maximum of 2 marks. $\begin{pmatrix} 3a+2b & 4a+3b \\ 3c+2d & 4c+3d \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ **A.** 1 mark if numbers have been used instead of letters and the working is clear 1 mark for each pair of equations up to a maximum of 2 marks. 3a + 2b = 1 4a + 3b = 0 3c + 2d = 0 4c + 3d = 1 **A.** Any pair 1 mark for each pair of equations up to a maximum of 2 marks. 9a + 6b = 3 8a + 6b = 0 (giving a = 3 and b = -4) 9c + 6d = 0 8c + 6d = 2 (giving c = -2 and d = 3) **A.** Any pair	**6**
15.2	**2 marks for AO5** Multiply each side by the inverse matrix of $\begin{pmatrix} 3 & 4 \\ 2 & 3 \end{pmatrix}$ (calculated in 15.1) 2 marks for: $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$ // x = 2 ; y = -1 ; If no marks given for the above, 1 mark for sight of either side of the equation (maximum 1 mark): $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 3 & -4 \\ -2 & 3 \end{pmatrix}\begin{pmatrix} 2 \\ 1 \end{pmatrix}$;	**2**

Question	Guidance	Mark
16.1	**3 marks for AO4** 2 marks for: 3 5 + 7 2 - * 1 mark for a reasonable explanation If answer not fully correct award working marks as follows: Maximum of 1 from: correct position of the numbers; correct order of the operators; **Indicative explanations:** Write 3 followed by 5 As these numbers are in brackets, add the + operator Write 7 followed by 2 As these numbers are in brackets, add the – operator Add the * operator Take the numbers either side of the operator then put the operator after them; the computer will only push/pop two numbers (on the stack). **A.** Different wording with similar meaning	**3**
16.2	**8 marks for AO4** 1 mark for either: Push (numbers 3 and 5) on top of stack Pop (numbers 5 and 3) from top of stack 1 mark for: Add (numbers 3 and 5) 1 mark for: Push the result (8) on top of stack 1 mark for both: Push (numbers 7 and 2) on top of stack Pop (numbers 2 and 7) from top of stack 1 mark for: Subtract (number 2 from number 7); 1 mark for: Push the result (5) on top of stack; 1 mark for **correct pop/push pair**, 1 mark for multiplication: **Pop numbers 5 and 8 from top of stack** Multiply number 8 and 5 **Push the final result (40) on top of stack** **A.** different numbers/expression to illustrate process (may be self-penalising)	**8**

Question	Guidance	Mark
17.1	**3 marks for AO1** 1 mark for each correct answer. 4; 256; 16; **A.** equivalent values/units	3
17.2	**4 marks for AO1** Convert 2D9F to binary // 0010 1101 1001 1111_2 ; (operation code) 00101_2 // 5; (data values) 1011001_2 // 89; (register selector) 1111_2 // 15;	4
17.3	**2 marks for AO1** 2 marks for correct hexadecimal value: 68CB ;; If answer is incorrect: 1 mark for 0110 1000 1100 1011 ;	2

Question	Guidance	Mark
18.1	**2 marks for AO3**  At the end of three births there are 8 possibilities. The probability of each is $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$ **1 mark** for the tree diagram with pathways labelled; **A.** if BBB column not present. **1 mark** for labelling probabilities, ie 1/2; **A.** without right hand column, ie (1/8).	**2**

Question	Guidance	Mark
18.2	**Mark is for AO3** 8;	1
18.3	**2 marks for AO3** 2/8 or 1/4; 1/8; **A.** equivalent values.	2
18.4	**2 marks for AO3** 1/36; 5/36; **DPT.** If candidate has omitted 36.	2
18.5	**Mark is for AO3** 1 mark for correctly completed Table 6; **D1** X X X X X **D2** X X X X **G1** X X X **G2** X X **G3** X **G4**	1
18.6	**2 marks for AO3** 1 mark for each correct answer up to a maximum of 2 marks. 9/15; 1/15; **DPT.** For correct interpretation of incorrect answer to 18.5 **DPT.** If incorrect denominator used	2

Assessment Outcomes						
Question	**AO1**	**AO2**	**AO3**	**AO4**	**AO5**	**Question Total**
SECTION A						
1	1a (1)					1
2		2b (1)				1
3				4c (1)		1
4				4d (1)		1
5			3b (1)			1
6		2c (2)				2
7.1			3c (1)			1
7.2			3c (1)			1
8.1				4e (1)		1
8.2				4d (2)		2
9.1	1c (1)	2c (1)				2
9.2	1c (1)	2c (1)				2
10.1	1c (3)					3
10.2	1c (3)					3
11.1		2b (1)				1
11.2		2c (3)				3
11.3		2d (3)				3
12.1	1d (3)					3
12.2	1c (1)					1
13.1			3a (2)			2
13.2			3c (3)			3
14.1			3c (1)			1
14.2			3c (1)			1
14.3			3c (2)			2
15.1					5b (6)	6
15.2					5c (2)	2
Total A	13	12	12	5	8	**50**

SECTION B						
16.1				4a (3)		3
16.2				4a (8)		8
17.1	1b (3)					3
17.2	1c (4)					4
17.3	1c (2)					2
18.1			3c (2)			2
18.2			3c (1)			1
18.3			3c (2)			2
18.4			3c (2)			2
18.5			3c (1)			1
18.6			3c (2)			2
Total B	9	0	10	11	0	**30**
Total A+B	22	12	22	16	8	**80**