

Page 5	Mark Scheme
	Cambridge International A Level – May/June 2015



(c) (i)	temperature reading in location 5 has been processed	
(ii)	0100 0000 1111 1011 1 mark per byte	2
(d) (i)	AND #B00010000 // AND #&10 // AND #16 1 mark for AND, 1 mark for address mode, 1 mark for mask, 1 mark for indication of numbering system	1 + 1 + 1 + 1
(ii)	OR #B00000001 // OR #&01 // OR #1 1 mark for OR, 1 mark for mask	1 + 1

QUESTION 2.



6 (a)	Control system	
(b)	Any three different items – max 6 marks heater / water pump / blinds pump ... for altering temperature / watering / light level actuator for... fan for distributing air / water pump / blinds motor analogue to digital converter / digital to analogue convertor ... converts analogue signal from sensor to digital value for processing / converts digital signal to analogue signal for controlling actuator microprocessor ... executes control software warning device (speaker/buzzer/light)... to give warning if conditions out of range / hardware malfunction	1 1 1 1 1 1 1 1 1 max 6
(c) (i)	output of system (alter temperature / light level / soil moisture) affects input from sensors continuous	3
(ii)	min / max / ideal / mean / extreme temperature // sampling rate // tolerance interval	1
(iii)	reading from sensor is compared with parameter appropriate action is taken (by example)	2
(d) (i)	reading available for processing reading value is 4	1 1
(ii)	AND #B00000100 // AND #04 // AND #4 1 mark for AND, 1 mark for address mode, 1 mark for mask, 1 mark for indication of numbering system	max 3
		Total: 18

QUESTION 3.



2 (a)

Symbol	Token	
	Value	Type
Counter	60	variable
1.5	61	constant
Num1	62	variable
5.0	63	constant

[1]

[1+1]

(b)

6	0	6	5	6	4	6	0	6	4	6	0	6	0	6	4
0	1	1	1	2	A	0	3	2	B	2	1	2	2	3	C

[1+1]

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(c) (i) Code optimisation

(ii) LDD 234
ADD 235
ADD 236
STO 233

1 mark for first 2 lines, 1 mark for last 2 lines, with no other lines added

(iii) Code has fewer instructions/occupies less space in memory when executed
minimises execution time of code // code will execute faster

[1]
[11]

QUESTION 4.



2 (a)

Symbol	Token	
	Value	Type
Start	60	Variable
0.1	61	Constant
Counter	62	Variable
10	63	Constant

[1]
[1+1]

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(b)

60	01	61	4E	62	01	60	50	63	52	62	02	60	53
----	----	----	----	----	----	----	----	----	----	----	----	----	----

(c) (i) syntax analysis

[1]

(ii) any **two** points from:

construct parse tree // parsing
checking syntax/grammar
produce error report

[max. 2]

(d) (i) Minimise the execution time // code runs faster

[1]

(ii) Compiler could calculate 2×6 and replace it with the value 12.

[1]

(iii) LDD 436
ADD 437
STO 612
ADD 438
STO 613

}
}
}
}
[1]
[1]
[1]

1 for each additional instruction; 0 for copy of original code

QUESTION 5.



6 (a) (i)	Monitoring system	1
(ii)	This is not a 'feedback' system // There is no 'control' taking place/use of actuators // No output other than from alarm	1



(b)	Examples: Pressure ... If intruder steps on sensor Infra-red ... If beam cut by intruder Motion / ultrasonic... Detects any movement in an area Contact / magnetic ... If door / window opened	 1 - 1 - justific Maximum 2 sensors Max 4																																																																																
(c) (i)	<table><thead><tr><th>BITREG</th><th>COUNT</th><th>VALUE</th><th>ACC</th></tr></thead><tbody><tr><td>B00001010</td><td>0</td><td>1</td><td>B00001010</td></tr><tr><td></td><td></td><td></td><td>B00000000</td></tr><tr><td></td><td></td><td></td><td>1</td></tr><tr><td></td><td></td><td>2</td><td>2</td></tr><tr><td></td><td></td><td></td><td>B00001010</td></tr><tr><td></td><td></td><td></td><td>B00000010</td></tr><tr><td></td><td></td><td></td><td>0</td></tr><tr><td></td><td>1</td><td></td><td>1</td></tr><tr><td></td><td></td><td></td><td>2</td></tr><tr><td></td><td></td><td>4</td><td>4</td></tr><tr><td></td><td></td><td></td><td>B00001010</td></tr><tr><td></td><td></td><td></td><td>B00000000</td></tr><tr><td></td><td></td><td></td><td>4</td></tr><tr><td></td><td></td><td>8</td><td>8</td></tr><tr><td></td><td></td><td></td><td>B00001010</td></tr><tr><td></td><td></td><td></td><td>B00001000</td></tr><tr><td></td><td></td><td></td><td>1</td></tr><tr><td></td><td>2</td><td></td><td>2</td></tr><tr><td></td><td></td><td></td><td>8</td></tr></tbody></table>	BITREG	COUNT	VALUE	ACC	B00001010	0	1	B00001010				B00000000				1			2	2				B00001010				B00000010				0		1		1				2			4	4				B00001010				B00000000				4			8	8				B00001010				B00001000				1		2		2				8	Mark as follows: 1 mark for: COUNT column VALUE column First two values in ACC column Rest of ACC column Max 4
BITREG	COUNT	VALUE	ACC																																																																															
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(ii)	#1	1																																																																																
(iii)	CMP #8	1																																																																																
	CMP #128	1																																																																																

QUESTION 6.



Question	Answer	Marks																																																																																
6(a)(i)	Control system	1																																																																																
6(a)(ii)	System is controlling devices // turns heaters on and off // use of actuators maintain the environment // makes use of feedback	1																																																																																
6(b)	Computer/microprocessor ... to process the sensor readings Analogue to digital convertor ... <u>Sensor</u> produces analogue signal but processor requires digital data Digital to analogue convertor ... <u>Processor</u> produces digital signal but actuator may require analogue sign Actuator ... May be required to turn heater on or off 1 mark for device, 1 mark for justification, max 2 devices	4																																																																																
6(c)(i)	One mark per column excluding LOWTEMP <table><tr><th>LOWTEMP</th><th>LOWREG</th><th>COUNTER</th><th>ACC</th><th>IX</th></tr><tr><td>15</td><td>B00000000</td><td>1</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>0</td></tr><tr><td></td><td></td><td></td><td>17</td><td></td></tr><tr><td></td><td></td><td></td><td>1</td><td></td></tr><tr><td></td><td></td><td></td><td>2</td><td></td></tr><tr><td></td><td></td><td>2</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>1</td></tr><tr><td></td><td></td><td></td><td>14</td><td></td></tr><tr><td></td><td></td><td></td><td>B00000000</td><td></td></tr><tr><td></td><td>B00000010</td><td></td><td>B00000010</td><td></td></tr><tr><td></td><td></td><td></td><td>2</td><td></td></tr><tr><td></td><td></td><td></td><td>4</td><td></td></tr><tr><td></td><td></td><td>4</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>2</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table>	LOWTEMP	LOWREG	COUNTER	ACC	IX	15	B00000000	1							0				17					1					2				2							1				14					B00000000			B00000010		B00000010					2					4				4							2						4
LOWTEMP	LOWREG	COUNTER	ACC	IX																																																																														
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				2																																																																														
6(c)(ii)	- COUNTER has an initial value of 1 - Test for final value is before COUNTER updated - COUNTER is doubled in value each time around loop - six sensors values/bits to check - COUNTER is doubled in value 6 times // 2⁵ - Values of COUNTER at test will therefore be 1 – 2 – 4 – 8 – 16 – 32 1 mark for valid point, max 2	2																																																																																



Question	Answer
6(c)(iii)	• Load the contents of <code>LOWREG</code> into <code>ACC</code> • Check bit position in <code>LOWREG</code> • For each of the least significant 6 bits • Use <code>AND</code> operation / mask to isolate a bit • Jump to code corresponding to bit being looked at • if value of bit is 1 • Send signal to appropriate actuator to turn on the heater 1 mark for valid point, max 3

QUESTION 7.



Question	Answer	
6(a)	One mark for suitable sensor, one mark for justification Max one sensor, max two marks humidity ... to ensure that the plants have the right level of moisture in the air pressure / proximity ... to detect whether the windows are open or closed condone '<i>check</i>' moisture ... to ensure the water levels in the soil are correct light ... to ensure the light levels in the greenhouse are correct for plant growth ... to ensure the windows are closed when night falls Accept pH sensor for one mark only Accept CO₂ sensor for one mark only, accept gas or O₂ for one mark only Justification needs to answer the question why? Not just describe the sensor Accept suitable actions resulting from sensor readings as justification	
6(b)	Three from: • Actions taken by system // or by example: e.g. adjust heater / turn on sprinkler / open windows • May affect the readings taken by the sensors // or by example • Which in turn may cause a change in the actions taken by the system // or by example • This is a continuous process...	3
6(c)(i)	One from: • Lowest allowable temperature • Highest allowable temperature • Sampling time interval	1



Question	Answer	
6(c)(ii)	If answer to c(i) is highest allowable or lowest allowable temperature: - The sensor reading is compared to a stored parameter (1) - Depending upon result of comparison an action may or may not be carried out (1) If answer to c(i) is sampling time interval: - The higher the sampling rate... (1) ...The better / more efficient is the control system (1)	
6(d)(i)	20	1
6(d)(ii)	<pre>LDD 4002 // load the contents of the 16 bit location containing the value for Sensor 5 into the Accumulator LSR #8 // move the bits in the Accumulator so that the Accumulator stores the value of Sensor 5 as unsigned 16-bit binary integer</pre> 1 mark for 4002 1 mark for LSR 1 mark for #8	3

QUESTION 8.



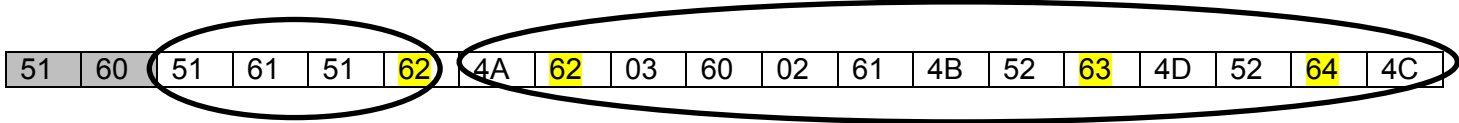
Question	Answer	Marks																				
6(a)	1 mark for each correct row <table><tr><th rowspan="2">Symbol</th><th colspan="2">Token</th></tr><tr><th>Value</th><th>Type</th></tr><tr><td>Start</td><td>60</td><td>Variable</td></tr><tr><td>1</td><td>61</td><td>Constant</td></tr><tr><td>Number</td><td>62</td><td>Variable</td></tr><tr><td>Counter</td><td>63</td><td>Variable</td></tr><tr><td>12</td><td>64</td><td>Constant</td></tr></table>	Symbol	Token		Value	Type	Start	60	Variable	1	61	Constant	Number	62	Variable	Counter	63	Variable	12	64	Constant	3
Symbol	Token																					
	Value	Type																				
Start	60	Variable																				
1	61	Constant																				
Number	62	Variable																				
Counter	63	Variable																				
12	64	Constant																				
6(b)	1 mark for each circled section <table><tr><td>60</td><td>01</td><td>61</td><td>51</td><td>62</td><td>4E</td><td>63</td><td>01</td><td>60</td><td>50</td><td>64</td><td>52</td><td>62</td><td>02</td><td>63</td><td>53</td></tr></table>	60	01	61	51	62	4E	63	01	60	50	64	52	62	02	63	53	2				
60	01	61	51	62	4E	63	01	60	50	64	52	62	02	63	53							

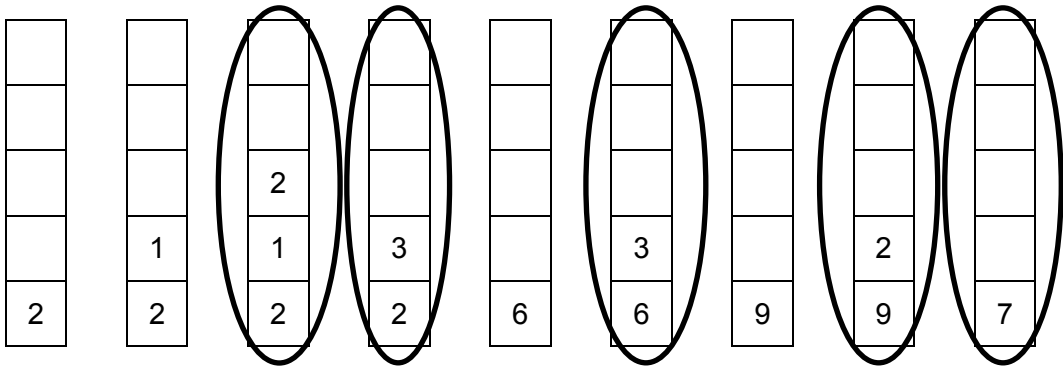


Question	Answer	
6(c)	1 mark per bullet point to max 2: - constructing parse tree // parsing - checking the table of tokens to ensure that the rules/syntax/grammar of the language are/is obeyed - producing an error report	
6(d)(i)	shortens execution time of program// time taken to execute whole program decreases	1
6(d)(ii)	1 mark for each of the following: - LDD 236 ADD 237 STO 512 ADD 238 STO 513 ADD 239 STO 514 - Remove line 4 LDD 236 correct lines 3 and 6 in original code - Remove line 5 ADD 237 correct lines 3 and 6 in original code - Remove line 8 and 9 LDD 236 and ADD 237 correct lines 7 and 11 in original code - Remove line 10 ADD 238 correct lines 7 and 11 in original code	5

QUESTION 9.

9608/32

Question	Answer	Marks																				
4(a)	1 mark per row <table border="1"> <thead> <tr> <th rowspan="2">Symbol</th><th colspan="2">Token</th></tr> <tr> <th>Value</th><th>Type</th></tr> </thead> <tbody> <tr> <td>Number1</td><td>60</td><td>Variable</td></tr> <tr> <td>Number2</td><td>61</td><td>Variable</td></tr> <tr> <td>Answer</td><td>62</td><td>Variable</td></tr> <tr> <td>10</td><td>63</td><td>Constant//Literal</td></tr> <tr> <td>0</td><td>64</td><td>Constant//Literal</td></tr> </tbody> </table>	Symbol	Token		Value	Type	Number1	60	Variable	Number2	61	Variable	Answer	62	Variable	10	63	Constant//Literal	0	64	Constant//Literal	3
Symbol	Token																					
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Number1	60	Variable																				
Number2	61	Variable																				
Answer	62	Variable																				
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0	64	Constant//Literal																				
4(b)	1 mark for each circled section 	2																				
4(c)(i)	(Code) Optimisation	1																				
4(c)(ii)	1 mark per bullet point: - LDD 236 - ADD 237 - ADD 238 - SUB 239 - STO 235 Copy the instructions - Remove line 4 STO 540 correct lines 3 and 6 in original code - Remove line 5 LDD 540 correct lines 3 and 6 in original code	3																				

Question	Answer	Marks
4(c)(iii)	1 mark per bullet point: • Code has fewer instructions/occupies less space in memory • shortens execution time of program // time taken to execute whole program decreases	2
4(d)	 1 mark ← 1 mark → 1 mark 1 mark no operators on the stack anywhere	4

QUESTION 10.



Question	Answer																												
4(a)	1 mark for 2 correct rows, 2 marks for 3 correct rows, 3 marks for 4 correct rows <table><tr><th rowspan="2">Symbol</th><th colspan="2">Token</th></tr><tr><th>Value</th><th>Type</th></tr><tr><td>Counter</td><td>60</td><td>Variable</td></tr><tr><td>0</td><td>61</td><td>Constant</td></tr><tr><td>Password</td><td>62</td><td>Variable</td></tr><tr><td>"Cambridge"</td><td>63</td><td>Constant</td></tr><tr><td>1</td><td>64</td><td>Constant</td></tr></table>	Symbol	Token		Value	Type	Counter	60	Variable	0	61	Constant	Password	62	Variable	"Cambridge"	63	Constant	1	64	Constant								
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Password	62	Variable																											
"Cambridge"	63	Constant																											
1	64	Constant																											
4(b)	<table><tr><td>60</td><td>01</td></tr></table> First two cells given in question. 1 mark for next 3 cells <table><tr><td>61</td><td>51</td><td>62</td></tr></table> 1 mark for the remainder <table><tr><td>4E</td><td>4A</td><td>62</td><td>04</td><td>63</td><td>4B</td><td>51</td><td>62</td><td>4C</td><td>60</td><td>....</td></tr></table> <table><tr><td>....</td><td>01</td><td>60</td><td>02</td><td>64</td><td>4F</td><td>62</td><td>03</td><td>63</td><td>52</td><td>60</td></tr></table>	60	01	61	51	62	4E	4A	62	04	63	4B	51	62	4C	60			01	60	02	64	4F	62	03	63	52	60	2
60	01																												
61	51	62																											
4E	4A	62	04	63	4B	51	62	4C	60																				
....	01	60	02	64	4F	62	03	63	52	60																			
4(c)(i)	1 mark per bullet point • Removing the fourth line (LDD 238) ... • Changing operand for second ADD from 236 to 238 ... • ... First three lines and last line unchanged LDD 236 ADD 237 STO 236 ADD 238 STO 238	3																											
4(c)((ii)	1 mark per bullet point (max 2) • Optimisation means that the code will have fewer instructions • Optimised code occupies less space in memory • Fewer instructions reduces the execution time of the program	2																											