

GCE

Electronics

Unit **F612**: Signal Processors

Advanced Subsidiary GCE

Mark Scheme for June 2016

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.










All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

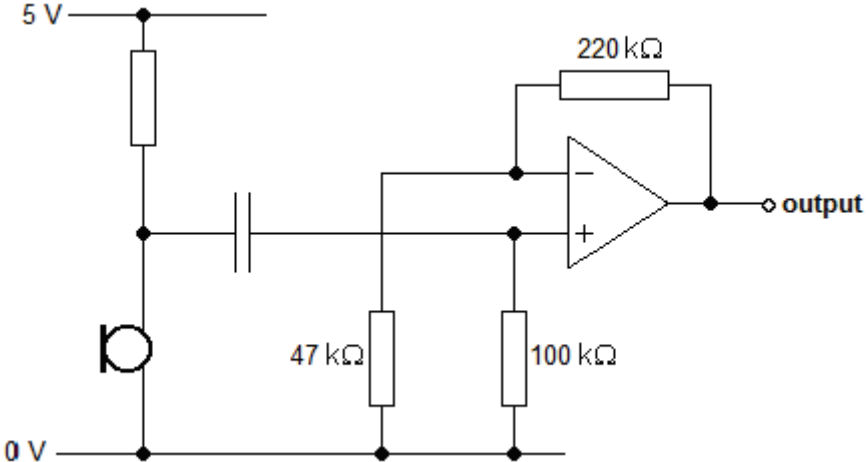
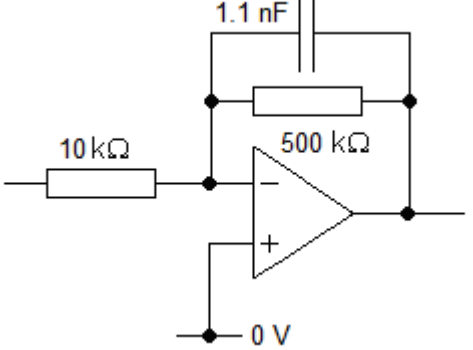
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

© OCR 2016

Annotations

	Annotation	Meaning of Annotation
1		Benefit of doubt
2		Cross
3		Error carried forward
4		Benefit of doubt not given
5		Expandable vertical wavy line
6		Repeat
7		Too vague
8		Tick
9		Zero (big)

Question			Answer	Marks	Guidance
1	a	i	still glows / stays on	1	
		ii	With M released; press (and then release) L.	1 1	
	b			2	correct feedback to make a bistable [1] correct connection of inputs [1]
Question			Answer	Marks	Guidance
2	a			1	completely correct for [1]
		b	when clock is low, output of bistable 2 is frozen / not transparent.; but bit at input can pass to P; as clock goes high, bit at P passes to output; when clock is high P is frozen / bistable 1 not transparent.	1 1 1 1	

Question	Answer	Marks	Guidance
3 a		2	correct symbols for microphone and capacitor [1] correct circuit [1]
b	gain = 5.7; amplitude = 284 mV; frequency = 450 Hz;	1 1 1	ecf: $G = -4.68$ gives (-) 234 mV for [1].
c	output saturates at 13 V; equivalent to an input of $13/5.7 = 2.3$ V	1 1	Evidence of appropriate calculation
d		6	correct circuit [1] resistors in range 1 kΩ to 1 MΩ [1] $R_F/R_{IN} = 50$ [1] justified by quoting and using $G = (-)\frac{R_F}{R_{IN}}$ [1] $R_F C = 530 \mu s$ [1]. justified by quoting and using $f_o = \frac{1}{2\pi RC}$ [1]

Question		Answer	Marks	Guidance																																								
4	a	$C = \frac{500 \times 10^{-3}}{0.5 \times 33 \times 10^3} = 30 \mu F$	2	correct use of $T = 0.5RC$ (evidence of rule) [1] correct answer [1]																																								
	b	<table border="1"> <thead> <tr> <th>P</th> <th>C</th> <th>B</th> <th>A</th> <th>X</th> <th>Y</th> <th>Z</th> <th>R</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>3</td> <td>0</td> <td>1</td> <td>1</td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td>1</td> </tr> </tbody> </table>	P	C	B	A	X	Y	Z	R	0	0	0	0	1	1	1	0	1	0	0	1	0	1	1	0	2	0	1	0	0	0	1	0	3	0	1	1				1	3	B column correct for [1] A and C columns correct for [1] X, Y and Z columns correct for [1] ignore content of grey squares
P	C	B	A	X	Y	Z	R																																					
0	0	0	0	1	1	1	0																																					
1	0	0	1	0	1	1	0																																					
2	0	1	0	0	0	1	0																																					
3	0	1	1				1																																					
	c	i	AND gate output to R; Inputs B and A;	1 1	ecf from (b).																																							
		ii	$X = \overline{C+B+A};$ $Y = \overline{C+B};$ $Z = \overline{C.(B.A)};$	1 1 1	ecf from (b).																																							

Question		Answer	Marks	Guidance
5	a	variable gain; between 0 and 1; blocks low frequencies / dc;	1 1 1	
	b		3	correct circuit [1] correct value resistors [1] quote and use $-\frac{V_{out}}{R_f} = \frac{V_1}{R_1} + \frac{V_2}{R_2}$ [1]
	c	i	4	calculated break frequency of 2 kHz [1] gain of 1 below break frequency [1] gain drops at 45° above break frequency [1] logarithmic scale on horizontal axis [1]
		ii	1 1	
	d	i	1 1	not "increase power"
		ii	1 1 1 1	not "infinite gain"

Question		Answer	Marks	Guidance
6	a	<p>Any 3 of the following [1] each:</p> <ul style="list-style-type: none"> input to X (from counter/DCBA) is a 4 bit / binary number/word output (gfedcba) produces codes for a decimal number LEDs / 7-seg display decimal number (0 – 9) X contains drivers for LEDs X contains logic gates to convert each input word to required output word; 	3	
	b	<p>The diagram shows four digital signals over time, marked by a grid. The vertical axis for each signal is labeled 0 and 1. The horizontal axis is labeled 'time' with an arrow pointing right. Signal P is a square wave with 7 pulses. Signal A is high during the first 4 pulses of P and low during the last 3. Signal B is high during the first 4 pulses of P and low during the last 3. Signal C is low until the 7th pulse of P, where it has a single high pulse.</p>	4	<p>A changes only on each falling edge of P [1] B changes on each falling edge of A [1] C goes high at end of 7th square [1] A, B and C low in 8th and 9th squares [1]</p> <p>Award marks, as appropriate, to answers which begin with A=0.</p>
	c	<p>pulse/rising edge at G copies 5 V at D to Q; pulses/falling edges at P recorded/counted by counter; (LED) display shows 1 then 2 then 3; then C goes high / after 4 pulses, flip-flop resets, so no more pulses at P; \bar{Q} goes high and resets counter / display shows zero;</p>	<p>1 1 1 1 1</p>	Not binary equivalent

Question			Answer	Marks	Guidance
7	a	i		3	inputs identified [1] outputs identified [1] clocks joined in parallel and labelled [1]
	a	ii	any three of the following, [1] each: <ul style="list-style-type: none"> • hold a word/code copied from input port; • hold a word from the ADC; • hold address of memory location; • hold a (program) instruction; • be used in calculations; • be used for comparisons. 	3	Not 'to output port', because given in question
	b		hardware is circuit components (inside microcontroller); software is program/instructions (loaded into memory);	1 1	Words to that effect “

Question			Answer	Marks	Guidance
8	a	i	<pre> graph TD Start([start]) --> Process[let S0 = 80] Process --> Output[/let output = S0/] A((a)) --> Arrow[] style Arrow width:0px,height:0px Arrow --- Process </pre>	2	<p>correct byte in process box. First 'nibble' must be 8, second 'nibble' consistent with $O_1=0$ [1]</p> <p>correct output box [1]</p> <p>Look for correct use of capitals and lower case</p>
		ii	D0 is 1101 0000; LED y is on / glows; left lamp cluster activated;	1 1 1	Not with x and/or z Not with right cluster
	b	i	Let $S_n = \text{input}$; $S_n = 08$;	1 1	n must be an integer, not 1, 2 or 3 not "8"
		ii	(places three in S4 to use as a counter); activates left cluster and LED y for 125 ms; turns off cluster and LED for 125 ms; reduces S4 by one then goes to c if S4 has reached zero; otherwise switch cluster and LED on and off again; so cluster and LED flash on and off three times	1 1 1 1 1	ecf (a)(ii)

Question	Answer	Marks	Guidance
<p>8 c</p>	<pre> graph TD C((c)) --> P1[/Let S5 = input/] P1 --> D{S5 = 40} D -- yes --> P2[/let output=S1/] P2 --> R1[pause 250] R1 --> P1 D -- no --> E((e)) </pre>	<p>4</p>	<p>uses Sn (n>4) to test input port for 40 [1] if 'yes', outputs S1 (12) followed by 250ms delay, then S0 (80) followed by 250ms delay, then returns to c [1] if 'no' then returns to e [1] correct shaped boxes and use of arrows [1]</p>

APPENDIX 1

Quality of Written Communication

3	The candidate expresses complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.
2	The candidate expresses straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.
1	The candidate expresses simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.
0	The language has no rewardable features.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

© OCR 2016

