OCR
Oxford Cambridge and RSA

GCE

Electronics

Unit **F612:** Signal Processors

Advanced Subsidiary GCE

Mark Scheme for June 2016

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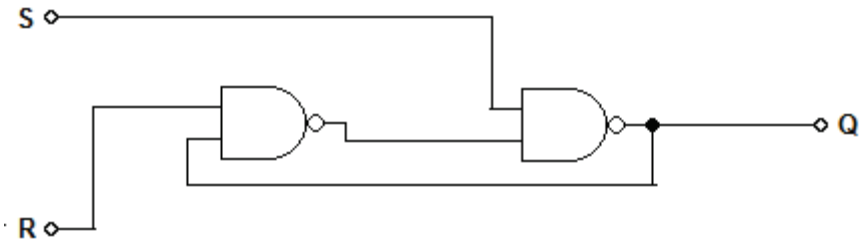
All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

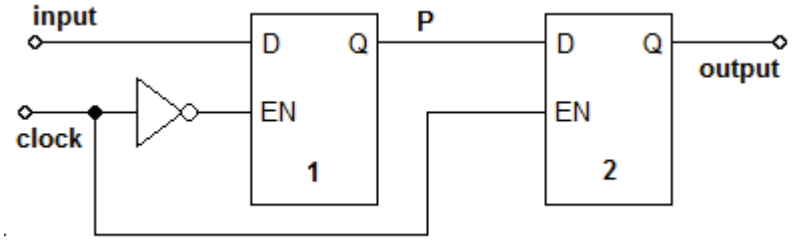
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

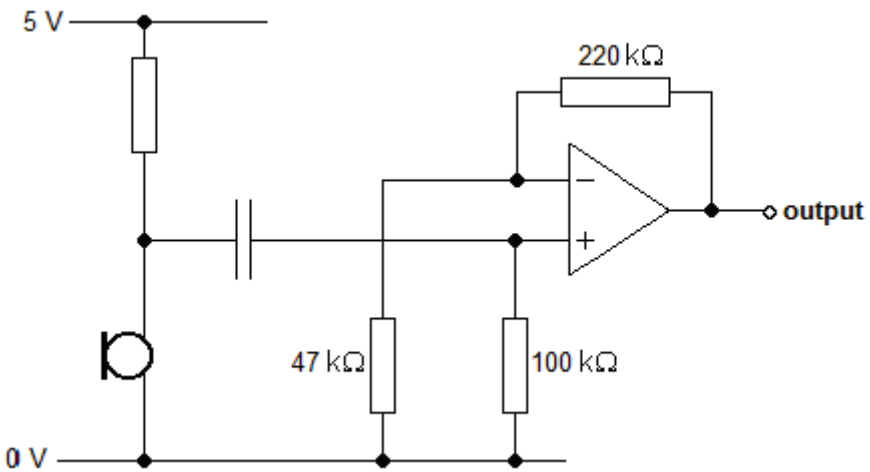
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations

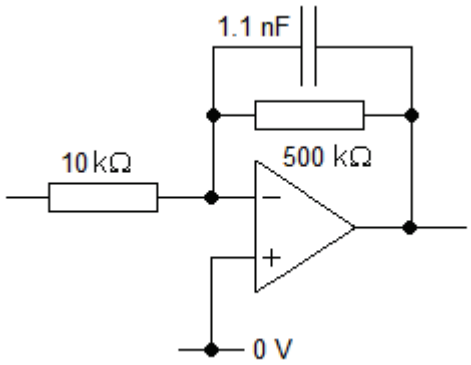
Annotation		Meaning of Annotation
1	BOD	Benefit of doubt
2		Cross
3	ECF	Error carried forward
4	NBOD	Benefit of doubt not given
5		Expandable vertical wavy line
6	REP	Repeat
7	TV	Too vague
8		Tick
9	0	Zero (big)

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	

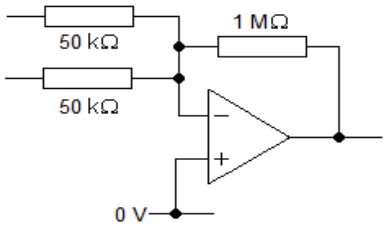
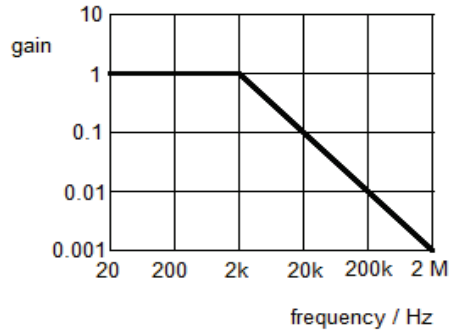
Question			Answer	Marks	Guidance
3	a			2	correct symbols for microphone and capacitor [1] correct circuit [1]

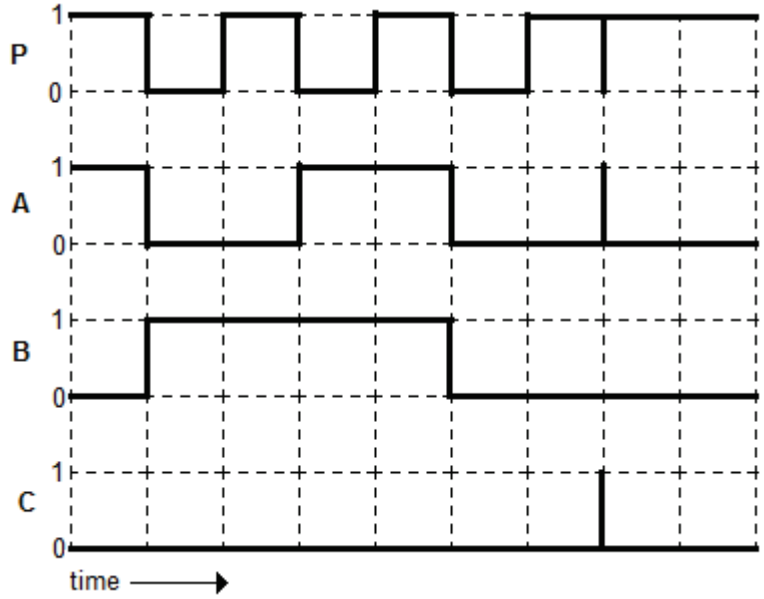
	b		gain = 5.7;
			amplitude = 284 mV;
			frequency = 450 Hz;
				1
				1
				1
					ecf: *G* = -4.68 gives (-) 234 mV for [1].

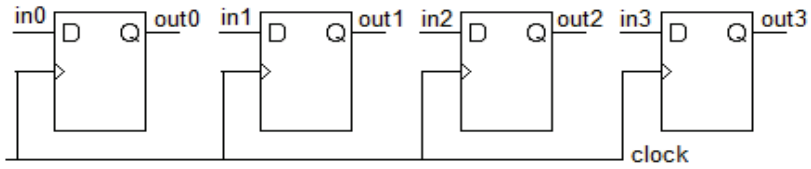
	c		output saturates at 13 V; equivalent to an input of 13/5.7 = 2.3 V	1 1	Evidence of appropriate calculation
	d			6	correct circuit [1] resistors in range 1 kΩ to 1 MΩ [1] R_F/R_{IN} = 50 [1] justified by quoting and using $G = (-)\frac{R_F}{R_{IN}}$ [1] R_FC = 530 μs [1]. justified by quoting and using $f_o = \frac{1}{2\pi RC}$ [1]

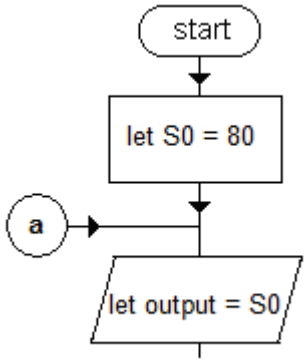
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>a</td><td></td><td>$C = \frac{500 \times 10^{-3}}{0.5 \times 33 \times 10^{3}} = 30\ \mu F$</td><td>2</td><td>correct use of $T = 0.5RC$ (evidence of rule) [1]
correct answer [1]</td></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<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>
<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></td><td></td><td></td><td>1</td></tr>
</table>
</td><td>3</td><td>B column correct for [1]
A and C columns correct for [1]
X, Y and Z columns correct for [1]

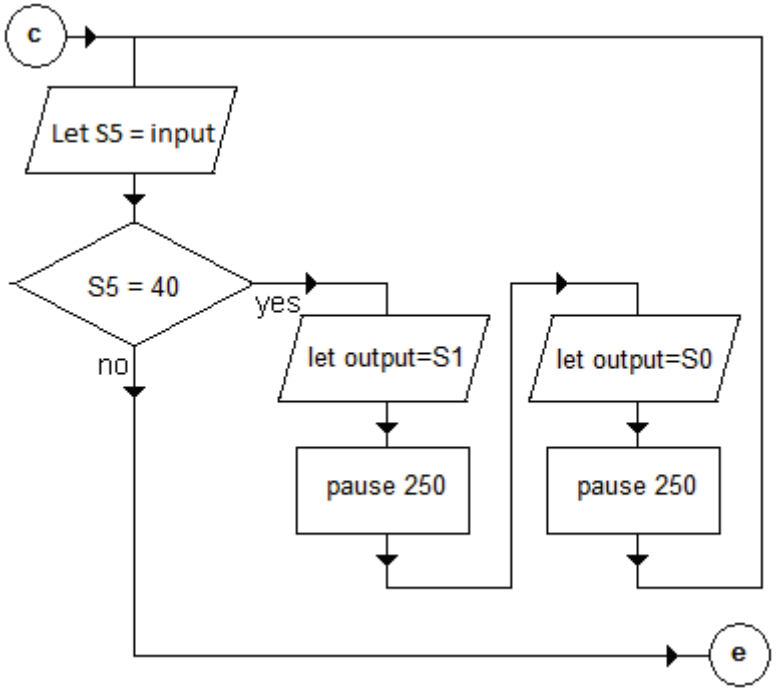
ignore content of grey squares</td></tr>
<tr><td></td><td>c</td><td>i</td><td>AND gate output to R;
Inputs B and A;</td><td>1
1</td><td>ecf from (b).</td></tr>
<tr><td></td><td></td><td>ii</td><td>X = $\overline{C + B + A}$;
Y = $\overline{C + B}$;
Z = $\overline{C}.(\overline{B.A})$;</td><td>1
1
1</td><td>ecf from (b).</td></tr>
</table>

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	removes high frequencies / treble; EITHER: reducing high frequency noise / hiss OR: to match characteristics of loudspeaker OR: to allow the sound to have the correct frequency balance	1 1	
	d	i	increase the current (delivered to loudspeaker); EITHER: loudspeaker has a low input impedance/ resistance OR: tone control outputs small current only.	1 1	not ”increase power”
		ii	0 V; negative feedback; maintains same voltage at both inputs of op-amp; because of high (open-loop) gain of the op-amp;	1 1 1 1	 not ‘’infinite gain”

Question			Answer	Marks	Guidance
6	a		Any 3 of the following [1] each: • 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			4	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] Award marks, as appropriate, to answers which begin with A=0.
	c		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; $\overline{Q}$ goes high and resets counter / display shows zero;	1 1 1 1 1	Not binary equivalents

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: • 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		2	correct byte in process box. First 'nibble' must be 8, second 'nibble' consistent with O_1=0 [1] correct output box [1] Look for correct use of capitals and lower case
		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 Sn = input; Sn = 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
8	c			4	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]

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.

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