OCR
RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced Subsidiary GCE

Unit **F612:** Signal Processors

Mark Scheme for June 2013

Oxford Cambridge and RSA Examinations

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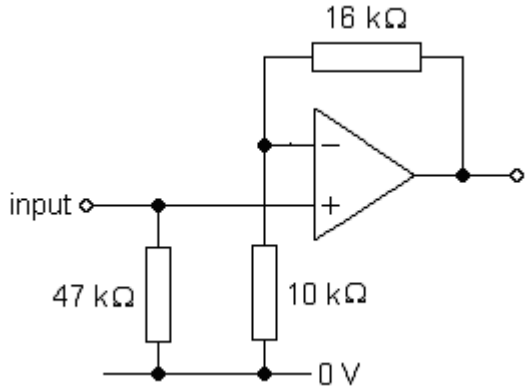
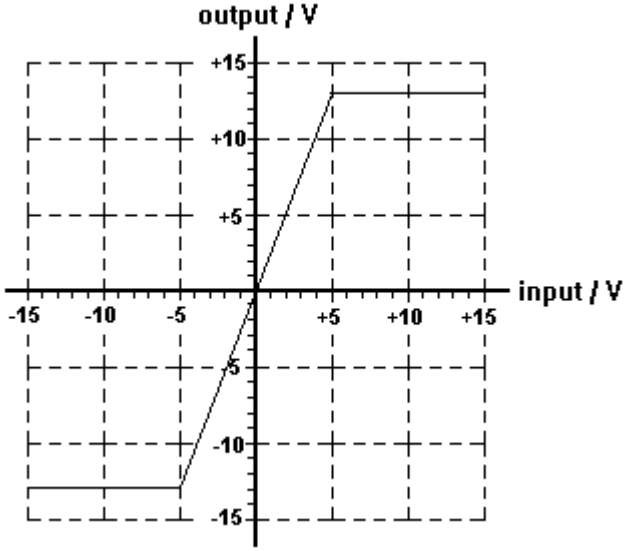
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

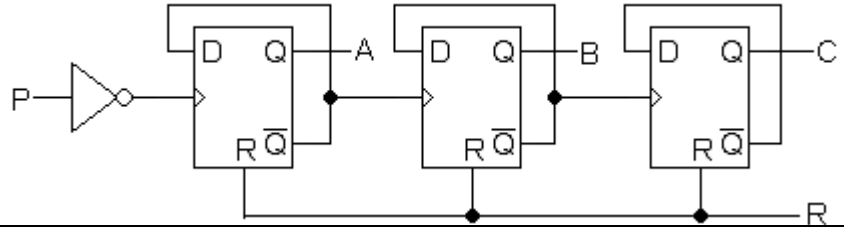
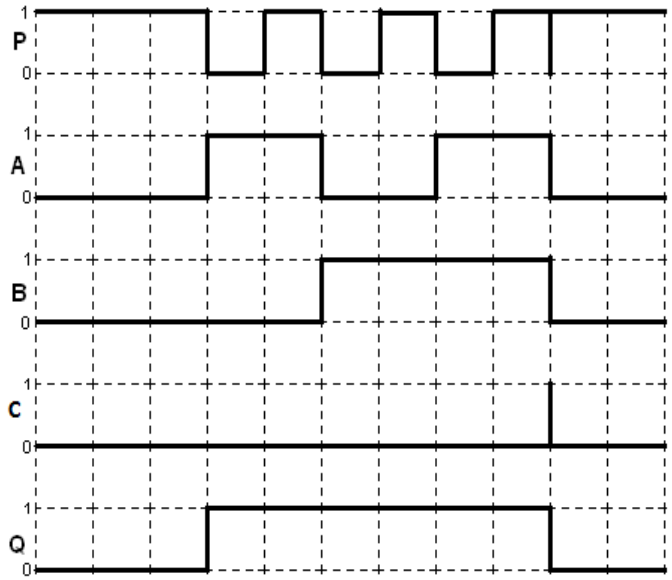
All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

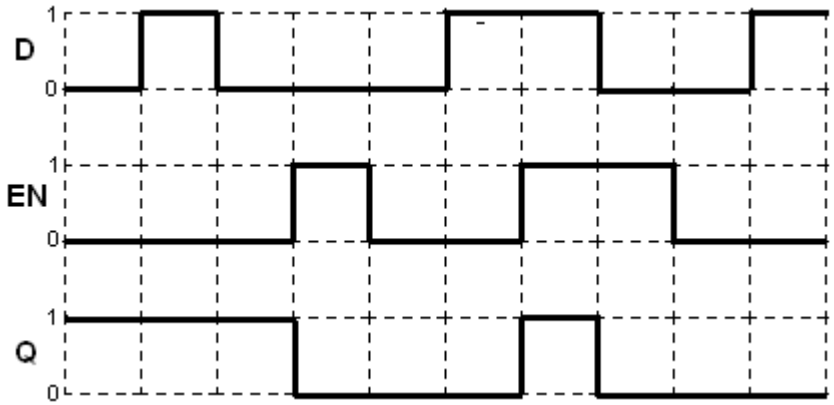
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Question			Answer	Marks	Guidance
1	(a)	(i)		1	**not** next to + input **look for** the word INPUT near the circle
		(ii)	47 kΩ	1	
	(b)	(i)	1 + 16k/10k; 2.6;	2	quote and use correct formula with incorrect resistors from circuit (1) evaluation (1) (no ecf on incorrect formula or values)
		(ii)	inverting input = 0.6 V; output = 1.56 V;	2	ecf gain of (b)(i) to output e.g. G = -1.6 gives -0.96 V accept 1.6 V

Question			Answer	Marks	Guidance
		(iii)		3	straight line through the origin (1) correct gradient of +2.6 (1) **accept** gradient of gain of (b)(i) saturating at +13 V and - 13 V (1)
	(c)		EITHER difference in voltage between inputs; is amplified by a large amount; OR when V_+ less than V_- output is negative; when V_+ more than V_- output is positive; OR $V_{out} = A(V_+ - V_-)$ where A is large value; V_+ is non-inverting (+) input voltage, V_- is inverting (-) input voltage, THEN output saturates at $\pm$ 13 V;	3	**not** just differential amplifier **accept** A at least 1000

Question			Answer	Marks	Guidance
2	(a)		rising edge (i.e. 0 V to +5 V) at CK; high/1/+5V at D; copied to Q;	3	**accept** clock (input) for CK **not** hold/send/pulse CK high, **accept** goes high **not** just flip-flop transparent
	(b)		*R* at least 1 kΩ; *RC* = 8.0 s	2	**look for** 8 000 ms
	(c)			4	D to $\overline{Q}$ for all three flip-flops (1) $\overline{Q}$ to CK between flip-flops (1) R in parallel (1) all five labels correct (1) ignore connection from C to R
	(d)			4	A changes on each falling edge of P except on final spike (1) B changes on each falling edge of A (1) Q goes high on first fall of P and stays high until spike on C (1) Q goes low and stays low when C spikes high (1) **ignore** changes to C

Question			Answer	Marks	Guidance
3	(a)		where bytes / words; enter **and** leave the microcontroller / copied to and from registers;	2	**look for** idea of sets of bits in parallel, not serial accept download a program for [1]
	(b)		any three of the following, (1) each: stores byte/data/word; from input (port) / adc; for the output (port); for calculations; for comparison;	3	**ignore** state / information / number **not** for processing
	(c)		outputs/stores/creates a byte/word/binary code; which represents a voltage;	2	**not** just digital signal, high or low, 1 or 0, binary not analogue signal / wave / variable signal
	(d)		67; 11010010;	2	
	(e)		any two of the following reason-explanation pairs, (1) + (1) each: • smaller circuit • because only one chip • can be easily updated/changed • because program easily changed • cheaper circuit • because of economies of scale / mass production • easier to design • because program can be simulated • different circuits from the same hardware • because different program can be loaded	4	look for two reason-explanation pairs for full marks **ignore** reasons to do with supply rails

<table>
<tr>
<td>4</td>
<td>(a)</td>
<td></td>
<td> 
</td>
<td>3</td>
<td>Q low for squares 4, 5 and 6 (1)
Q high for square 7 (1)
Q low for squares 8, 9 and 10 (1)</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>
<table>
<tr><th>D</th><th>EN</th><th>A</th><th>S</th><th>R</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
</table>
</td>
<td>3</td>
<td>A correct (1)
S correct (1)
R correct (1)

allow ecf for R = EN.A on incorrect A</td>
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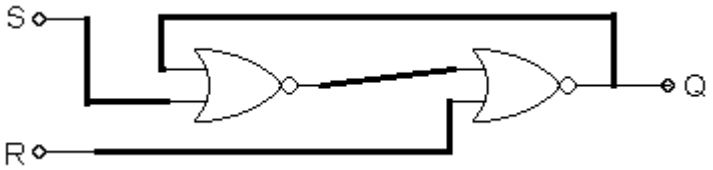
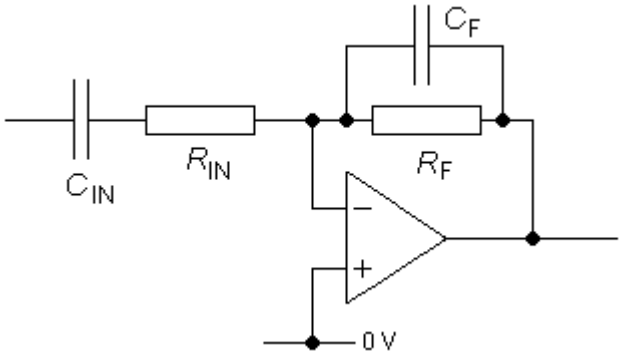
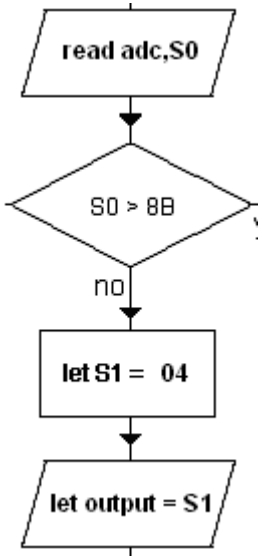
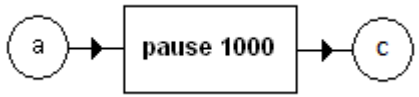
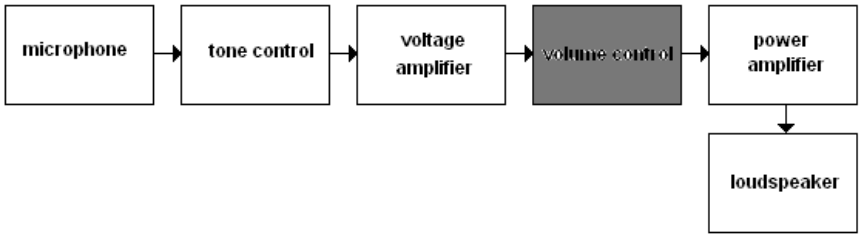
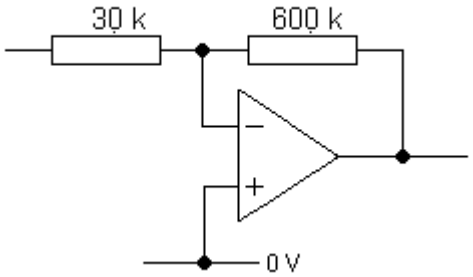
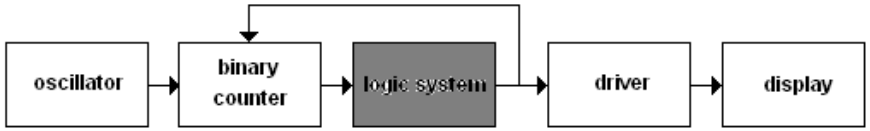
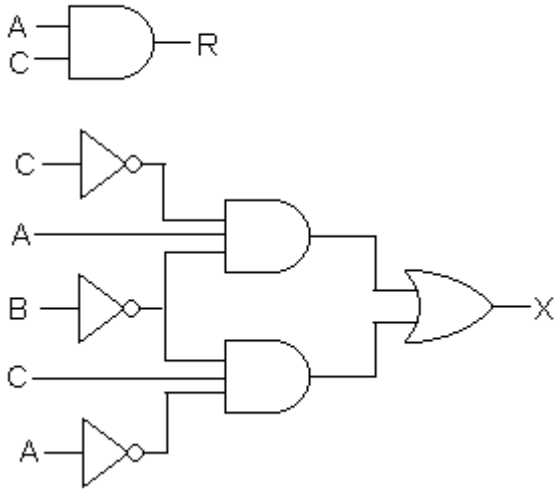
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td> 
</td>
<td>2</td>
<td>ouput of each gate to input of the other (1)
S and R correct (1)</td>
</tr>
</table>

Question			Answer	Marks	Guidance
5				8	R_F and C_F drawn correctly (1) R_{IN} and C_{IN} drawn correctly in any order (1) R_{IN} and R_F between 1 kΩ and 1 MΩ (1) $R_{IN}C_{IN}$ = 800 μs (1) R_FC_F = 80 μs (1) quote rule and substitute into $f_0 = \frac{1}{2\pi R\ C}$ twice (1) $R_F = 50 \times R_{IN}$ (1) quote rule and substitute into $G = (-)\frac{R_f}{R_{in}}$ (1) accept a treble cut filter followed by a bass cut filter for full marks, provided overall gain and break frequencies are correct **not** $R_{IN}C_{IN}$ = 80 μs **and** R_FC_F = 800 μs
6	(a)			3	each correctly completed box for (1)

Question			Answer	Marks	Guidance
	(b)			1	must be completely correct for [1]
	(c)		1001 0000 placed at output; switch red LED on and turn on / activate MOSFET /speaker; 1000 0000 placed at output; turn off MOSFET / speaker, red LED on, (green LED off); test if input port = 0000 1000; if yes then switch is pressed so return to start of program; otherwise switch MOSFET on again ...;	7	**accept** Q7 and Q4 high **ignore** leave green LED off, **not** buzzer **accept** Q7 high **ecf** accept buzzer for speaker **accept** I3 high **not** just pass to **c** **accept** repeats program loop**,** goes back to **b**
7	**(a)**			4	microphone first and loudspeaker last (1) voltage amp anywhere before power amp (1) tone control anywhere before power amp (1) power amp just before loudspeaker (1)

Question			Answer	Marks	Guidance
	(b)			4	correct circuit (1) R_{IN} = 30 kΩ (1) $R_F = 20 \times R_{IN}$ (1) quote rule and substitute into $G = (-)\frac{R_f}{R_{in}}$ (1) **ignore** labels for input and output
	(c)	**(i)**	has a variable gain (from 1 to 0); allows changes of loudness of the sound (from the speaker);	2	**not** increases gain/signal, **accept** adjusts gain/signal ignore volume, control
		(ii)	has a gain which depends on frequency (owtte); EITHER to get the right amount of bass and treble from the speaker OR to compensate for transfer characteristic of microphone OR to keep correct balance for sound (played back at wrong volume); OR remove unwanted hiss / rumble	2	accept cuts/boosts different frequencies ignore tone, control
		(iii)	increases the amplitude/voltage/signal; because signal (from microphone) is too small / weak (for sound to be heard from speaker);	2	**ignore** amplify, **accept** boost

Question			Answer	Marks	Guidance
8	(a)			3	all four correct for (3) three or two correct for (2) one correct for (1)
	(b)		R = C.A; $X = \overline{C}.\overline{B}.A + C\,\overline{B}.\overline{A}$;	2	accept $C.\overline{B}.A$ accept $X = A\ \overline{B + C} + C\ \overline{B + A}$
	(c)			3	R correct for (1) X correct for (2) accept any NOT/AND/OR circuit which generates correct output ecf from incorrect (b)

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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