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Oxford Cambridge and RSA

GCE

Electronics

Unit **F614:** Electronic Control Systems

Advanced GCE

Mark Scheme for June 2017

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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.

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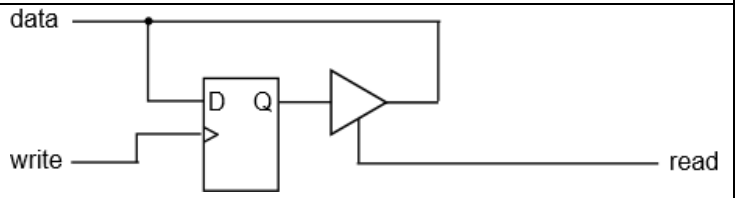
Annotations

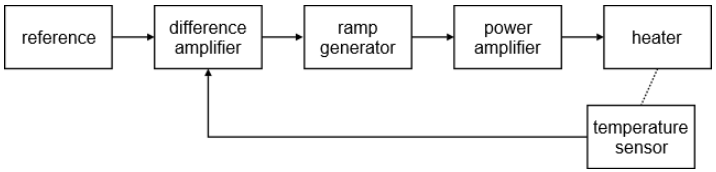
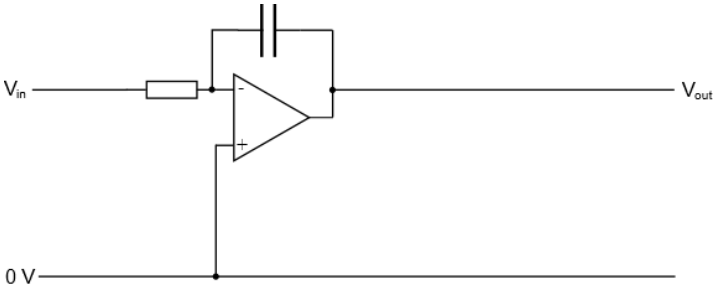
1	BOD	31	BOD	Benefit of doubt
2		21	Cross	Cross
3	ECF	241	ECF	Error carried forward
4	NBOD	191	NBOD	Benefit of doubt not given
5		1841	Not Relevant	Expandable vertical wavy line
6	REP	271	REP	Repeat
7	TV	201	TV	Too vague
8		11	Tick	Tick
9	0	1741	ZERO	Zero (big)
10				
11				
12				
13				
14				

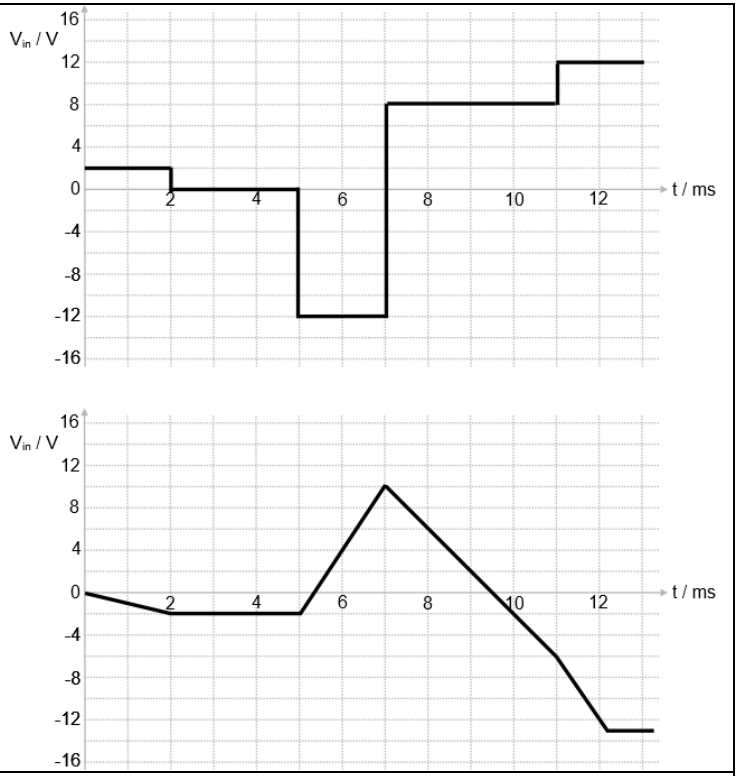
question	grade	expected answer	mark	additional guidance
1a	E	Use of 10M, 6.8M and 15V	1	
	E	8.9 V	1	
1bi	E	2 V	1	Allow values between 1.9 V and 2.2 V
1bii	D	V_{GS} = 2.5 V from graph	1	Look for 2.5 V in answer
	C	8.9 – 2.5 = 6.43 V	1	Accept 9 – 2.5 = 6.5 V or ecf from a
1biii	D	6.43/0.02 = 320 Ω e.c.f. voltage from bii	1	6.5 / 0.02 = 325 Ω
1biv	D	Same shape and frequency	1	
	B	In phase	1	
	A	Same amplitude	1	
	A	Wobbles around 6.43 V (ecf from bii)	1	
1c	CC	Max 2 from: To increase the current/power owtte Of a signal from a high impedance/low current source owtte Because it has a high input impedance a relatively low output impedance	2	Allow any valid concrete example which makes these points Accept increase offset, reduce clipping

question	grade	expected answer	mark	additional guidance
2a	C	Synchronise operations wtte	1	
2b	DE	Max 2 from: Makes program go back to start Makes PC = 0 Starts program again if stuck Registers set to default value / cleared	2	
2c	E C A	Programs stored in (program) memory in microcontroller Microcontroller needs program in binary/hex/machine code Max 1 from: Converted by from text owtte By a computer program	1 1 1 	 Allow compiler or assembler
2d	C A B C B	Instruction fetched (from memory) pointed at by PC Stored in (instruction) register Increment PC Execute instruction in (instruction) register All steps in the correct order	1 1 1 1 1	

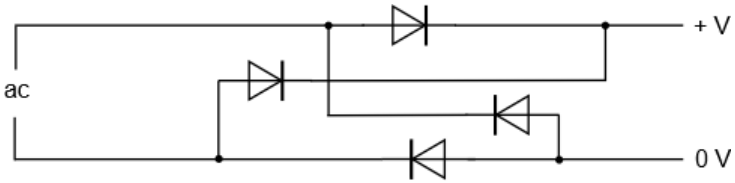
question	grade	expected answer	mark	additional guidance
3a	E	Contents/data/information lost when power turned off owtte	1	
3b	E E E D AA	Data lines labelled x4 Address lines labelled x2 max 2 from: read write r/ $\overline{w}$ enable	1 1 1 1 2	
3c	E	16	1	
3d	C B B D C	Write to clk only Tristate connected from Q To data D to data Read to tristate enable only	1 1 1 1 1	
3e	BB	Max 2 from: To allow the data bus to be bidirectional To allow more than one output device to be connected to the data bus To allow the contents of the memory to be changed without interference from Q	2	

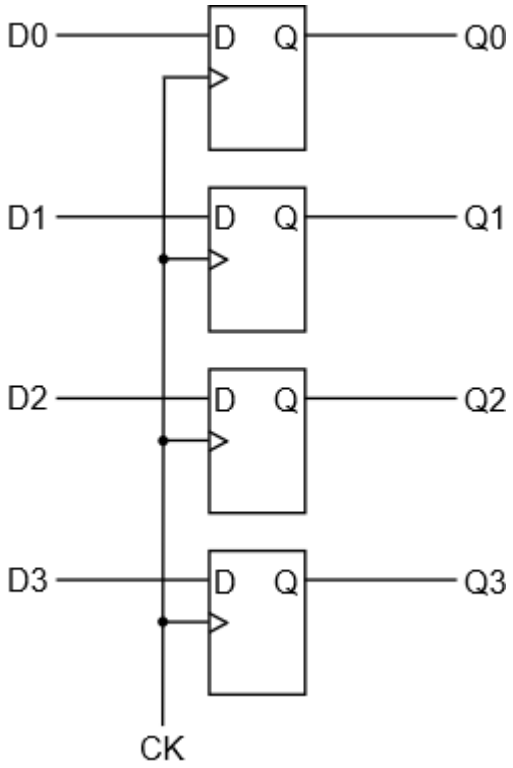
question	grade	expected answer	mark	additional guidance
4a	AAE	Max 3 from: • To provide a constant voltage at G [>V_T] • So that the MOSFET is always conducting • To make voltage at output between 0 V and 12 V • To allow output voltage to change up and down	3	Allow voltage/potential divider
4b	E	Amplitude of input is 0.6 V	1	Valid comment about input amplitude
	C	Amplitude of D is 4.2 V (11.5-3)/2	1	Valid comment about D ac amplitude
	D	D is inverse of input so –ve (-4.2/0.6 = -7) [ecf]	1	Must have – sign. Division of ΔD/Δinput
4c	E	Use of $G=-g_mR_D$	1	
	B	$-G/R_D=g_m$ = -(-7)/47	1	Correct values used
	A	=0.15 S	1	Correct calculation ecf and positive result
4d	A*	$I = \left(\frac{12}{910k + 470k}\right) = 8.697 \times 10^{-6}$ Voltage at $G = 8.697 \times 10^{-6} \times 470k = 4.09$ V	1	
	A*	I_{DS}=(12-7.2)/47=0.102 A	1	
	A*	$g_m = \frac{\Delta I}{\Delta V}$, $\Delta V = V_{GS} - V_T$, $\Delta I = I - 0$ $\therefore \Delta V = \frac{I}{g_m} = \frac{0.102}{0.15} = 0.68V$	1	
	A*	$V_T = 4.08 - 0.68 = 3.4V$	1	

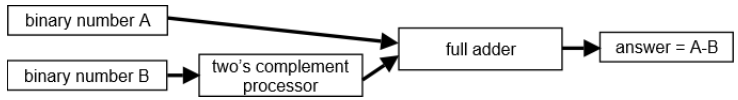
question	grade	expected answer	mark	additional guidance
5a	DD EEE	1 mark for each in correct place	5	
5b	E C D E C 	Op-amp, capacitor and resistor Capacitor between output and input of op-amp, resistor from input to Vin Non-inverting input to 0 V R > 1 kΩ RC = 2 ms Use of $\Delta V_{out} = -V_{in} \frac{\Delta t}{RC}$	1 1 1 1 1 1	

5c	E	Continues at same gradient to 2 ms	1	
	C	Flat between 2 – 5 ms	1	
	D	Rising between 5 – 7 ms	1	
	B	Rising at 6 V/ms between 5ms and 7ms	1	
	A	falling at -4V/ms between 7ms and 11ms (ecf)	1	
	A*	Falling at -6V/ms until saturating at -13V (no ecf)	1	

question	grade	expected answer	mark	additional guidance
6a	D	`wait180ms: MOVI Sn, B4 (n=0-6)`	1	
	E	`label: RCALL wait1ms`	1	
	E	`DEC Sn`	1	
	D	`JNZ label`	1	Label in correct place
	E	`RET`	1	
6b	E	`low: MOVI Sn, 70`	1	Line correct with instruction, register and value
		`OUT Q, Sn`		
		`RET`		
	E	`High: MOVI Sn, EC`	1	Correct EC
	E	`OUT Q, Sn`	1	Correct in both subroutine
	E	`RET`	1	Correct in both subroutine
6c	E	Turns on g and d	1	
	C	Make sound	1	
	A	At f = 250 Hz or T = 4 ms	1	
	B	For 128 ms	1	
6d	A*	Tests MSB to find out if adc≥128	1	
	A*	If not show L	1	
	A*	~~If~~ adc is compared with 7C	1	
	A*	If so make sound and show = (ecf)	1	
	A*	If adc>10000011 then show H	1	

question	grade	expected answer	mark	additional guidance
7a	D	Transformer works with ac only	1	
7b	E D	Produces correct polarity Fully correct circuit	1 1	
7c	D C C	Constant <u>voltage reference</u> independent of supply Compared with output <u>Negative feedback</u> adjusts output to reference	1 1 1	
7d	EE	Max 2 from: • More efficient • Lighter • Smaller	2	

question	grade	expected answer	mark	additional guidance
8a	E	4 D-type flip-flops used	1	
	D	all clocks connected together to CK	1	
	E	outputs from Qs	1	Qs not connected to anything else
	E	Inputs to Ds	1	Ds not connected to anything else
				
8b	E	0100101	1	

8c		1010110		
	C	First 4 bit correct	1	
	E	Last 3 bits correct	1	
8d	E	73 = 1001001	1	
	B	Add an extra bit for negative flag 01001001	1	128 – 73 = 55
	D	Invert all bits 10110110	1	55= 0110111
	C	Add 1 10110111	1	-128 +55 = 10000000 + 0110111 =10110111
8e	D	Two's complement processor before one input of adder	1	
	C	On output B	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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