OCR
Oxford Cambridge and RSA

GCE

Electronics

Unit **F614:** Electronic Control Systems

Advanced GCE

Mark Scheme for June 2014

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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.

Quality of Written Communication

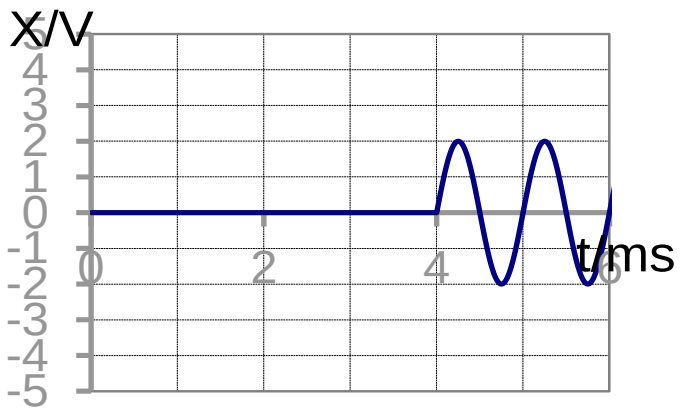
3 The candidate expresses complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.

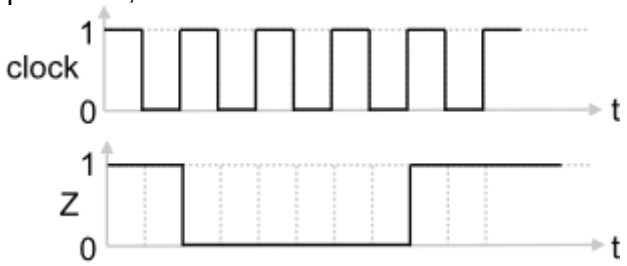
2 The candidate expresses straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a 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.

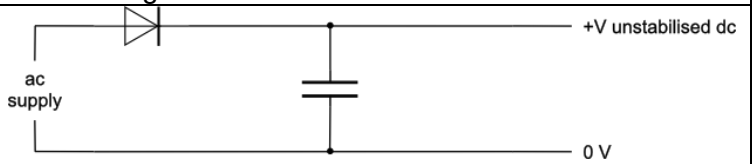
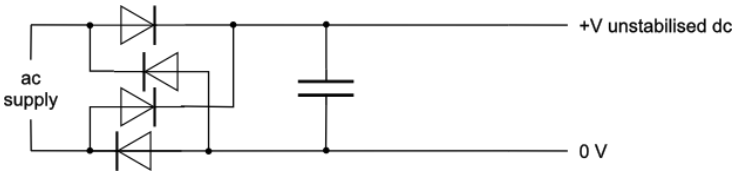
question	grade	expected answer	mark	additional guidance
1a	E	2.9 V	1	Allow 2.8 V – 2.9 V
1bi	D	G from switch is -5 V S is 0V so VGS = -5 V	1	
	C	VGS < threshold	1	
	C	so MOSFET not conducting	1	Resistance of MOSFET very high
1bii	E	line at 0 from t=0 to t=4	1	
	D	oscillation from 4 to end around 0V	1	
	D	same amplitude, shape and phase as input	1	

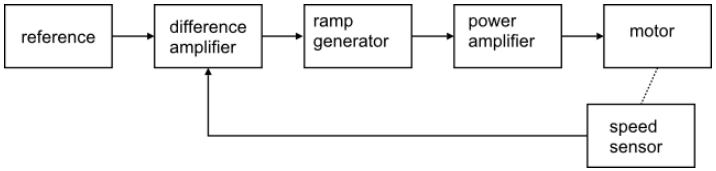


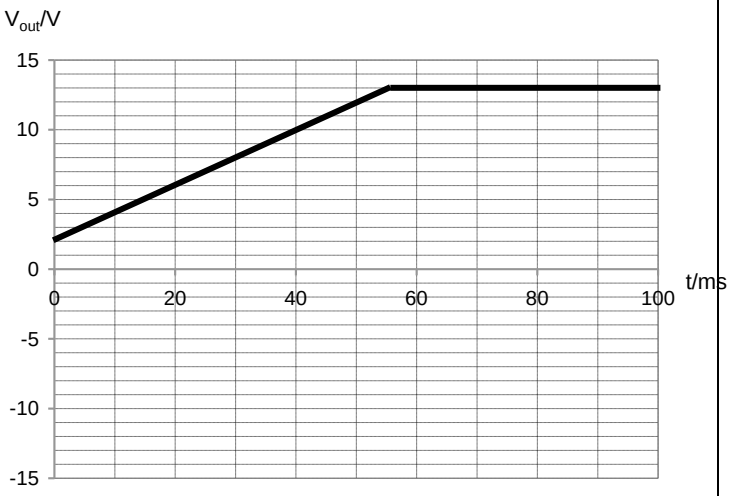
question	grade	expected answer	mark	additional guidance
2a	E E E E E	six D-type flip-flops 5 x Q to next D clocks connected together and labelled serial in correctly labelled at first D outputs correctly labelled at all Qs	1 1 1 1 1	
2bi	C D A	first two clock periods correct periods 3 & 4 correct periods 5, 6 correct 	1 1 1	correct shape but changing on falling edge [2]
2bii	A	110001 no ecf	1	beware of reversing order of bits
2biii	C	49 (ecf from bii)	1	

question	grade	expected answer	mark	additional guidance
3a				n≠m n&m≤7
	A	`go:  MOVI Sn,04`	1	
	E	`  IN  Sm,I`	1	
	B	`  AND Sn,Sm`	1	OR `AND Sm,Sn`
	C	`  JZ  go`	1	Lose 1 mark if `SUB Sm,Sn  JNZ go` (does not work
	E	`  RET`	1	if X pressed or other I float high)
3b		44 4C 55 5D 77		
	C	first one correct	1	
	B	next two correct	1	
	B	last two correct	1	
3c		Max 7 of:	7	
	D	Initialise pointer to start of look-up table		
	C	output number from table		Make dice show 1
	A	move pointer to next item in table		Allow loop 6 times owtte
		check to see if at end of table		
		if so reset to start of table		
	D	Mask for X		
	B	check to see if switch is pressed		
	E	if not go back and output next number from table		
	E	if pressed return to main program		

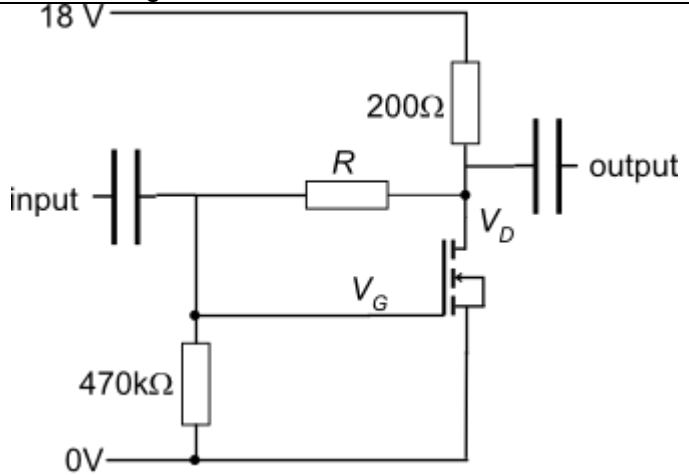
question	grade	expected answer	mark	additional guidance
3d	D	make Q7 high	1	0<j≤7, 0<k≤7, j≠k
	B	without changing Q0-Q6	1	`beep: MOVI Sk,80`
	C	inititialise counter with C8 (hex for 200)	1	
	C	time delay	1	`EOR S0,Sk`
	A	make Q7 low without changing Q0-Q6	1	`OUT Q,S0`
	E	return	1	
				`MOVI Sj,C8`
				`lbl: RCALL wait1ms`
				`DEC Sj`
				`JNZ lbl`
				`EOR S0,Sk`
				`OUT Q,S0`
				`RET`

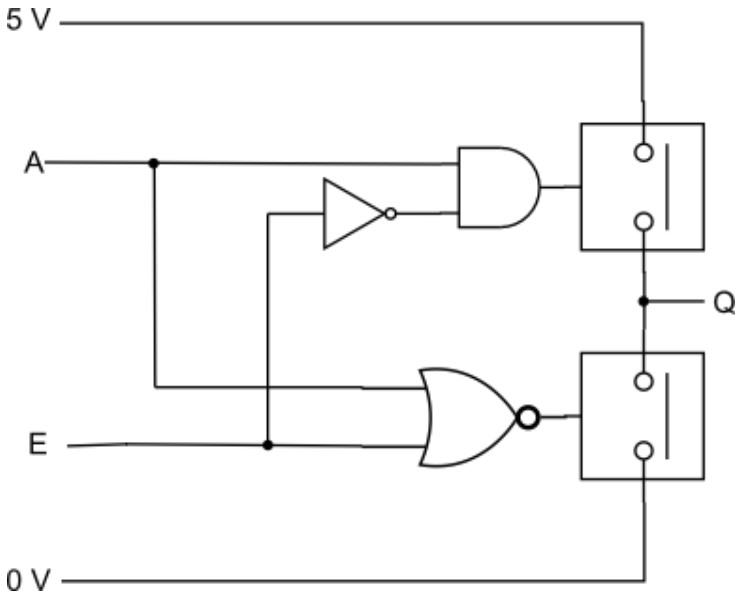
question	grade	expected answer	mark	additional guidance
4a	E E	diodes used to produce rectifier with correct polarity	1 1	 OR  capacitor used in parallel with output or in 4(c)
4b	CD	Max 2 of: unstabilised has (a large) ripple (wtte) unstabilised output voltage depends on ac input (wtte) regulated output has no/very little ripple (wtte) regulated output fixed/not dependent on input (wtte) regulator keeps the voltage at a constant voltage (wtte)	2	
4c	C C A A	correct reference with zener and resistor connected to op-amp input MOSFET used correctly at output negative feedback from regulated output	1 1 1 1	

question	grade	expected answer	mark	additional guidance
5a	 E E	total R = 22k + 47k I = 6/69000 = 0.087 mA 0.000087 x 47000 = 4.09 V	 1 1	
5b	C E D	motor off until G = 1.8 V motor speeds up as G increases (from 1.8 V) as current increases or any reasonable point about what happens above 1.8 V	1 1 1	
5c	 C B	Max 2: speed depends on load (wtte) no feedback to monitor speed speed depends on supply voltage speed depends on MOSFET temp	 1 1	
5di	CCD DEE	1 mark for each correct label	6	
5dii	ABC	Max 3 of: output of difference amp non zero output of ramp generator goes up supply to motor increases	3	

question	grade	expected answer	mark	additional guidance
5e	D C B A	line of constant positive slope from 2 V attempt to use correct ramp generator formula gradient 4 V in 20 ms saturates at +13 V (ecf)	1 1 1 1	

question	grade	expected answer	mark	additional guidance
6a	DDEE	Max 4 of: • subroutines can be re-used • subroutines can be tested separately • programs easier to read • programs easier to write due to structure • saves memory because subroutine only needs to be stored once	4	1 mark for state, 1 mark for explain
6b	C C A	value retrieved from stack and stored in program counter to instruction after RCALL stack pointer changed by 1	1 1 1	
6c	A* A* A* A* A*	instructions unchanged program counter = 2E stack pointer changed by 1 (56 or 58) all but one data value unchanged one data value now 2C (address 56, 57 or 58)	1 1 1 1 1	 Allow 2D

question	grade	expected answer	mark	additional guidance
7a	E E E	input connected to V_G output connected to V_D each input connected through a capacitor	1 1 1	
7bi	A B A	from graph g_m = 0.05 S R = 200 Ω gain = - 0.05 x 200 = -10 (ecf g_m)	1 1 1	transconductance calculated 200 Ω used gain -ve
7bii	A* A* A* A* A* A*	V across 200Ω: 18 – 10 = 8 V I = 8 / 200 = 0.04 A from graph V_G = 2.3 V I in 470 kΩ: 2.3/470000 = 4.89 μA V across R: 10 – 2.3 = 7.7 V (ecf from 8bii) R = 7.7 / 4.89 x 10^{-6} = 1600 kΩ	1 1 1 1 1 1	
7c	A* A*	MOSFETs have different characteristics Affects bias design not so sensitive to different MOSFETs	1 1	

<table>
<tr><th>question</th><th>grade</th><th>expected answer</th><th>mark</th><th>additional guidance</th></tr>
<tr><td>8ai</td><td>E
E
E</td><td><table><tr><th>Q</th><th>U</th><th>L</th></tr><tr><td>0</td><td>open</td><td>closed</td></tr><tr><td>1</td><td>closed</td><td>open</td></tr><tr><td>High impedance</td><td>open</td><td>open</td></tr></table></td><td>1
1
1</td><td>1 mark for each correct row</td></tr>
<tr><td>8aii</td><td>D
D
D</td><td>logic to turn off both analogue switches with E
logic turns off both analogue switches when E high
logic turns reproduces A at Q (for one or more states of E)</td><td>1
1
1</td><td>E.g.
 
or any other working logic</td></tr>
<tr><td>8b</td><td>D
E</td><td>to disconnect the output from the bus
so that more than memory can be connected to the same bus</td><td>1
1</td><td></td></tr>
<tr><td>8c</td><td>E
E
E
D
D
B</td><td>tristates between on each Q
2Qs to each Data line
2Ds to each data line
Read operates tristates
write operates clocks
A0 routes read and write correctly</td><td>1
1
1
1
1
1</td><td></td></tr>
</table>

question	grade	expected answer	mark	additional guidance
8d	E	information lost when power is turned off	1	

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