

Mark Scheme for June 2010

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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.

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ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

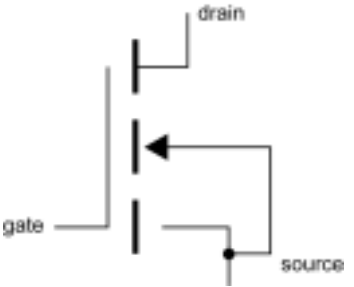
- 1 Please ensure that you use the **final** version of the Mark Scheme.
You are advised to destroy all draft versions.
- 2 Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. Ticks should **not** be placed in the right-hand margin. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks ($\frac{1}{2}$) should never be used.
- 3 The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

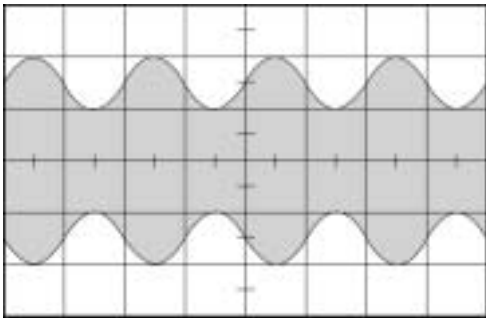
×	= incorrect response (errors may also be underlined)
^	= omission of mark
bod	= benefit of the doubt (where professional judgement has been used)
ecf	= error carried forward (in consequential marking)
con	= contradiction (where candidates contradict themselves in the <u>same</u> response)
sf	= error in the number of significant figures
up	= omission of units with answer
- 4 The marks awarded for each part question should be indicated in the right-hand margin. The mark total for each double page should be ringed at the bottom right-hand side. These totals should be added up to give the final total on the front of the paper.
- 5 In cases where candidates are required to give a specific number of answers, mark the first answers up to the total required. Strike through the remainder.
- 6 The mark awarded for Quality of Written Communication in the margin should equal the number of ticks under the phrase.
- 7 Correct answers to calculations should obtain full credit even if no working is shown, unless indicated otherwise in the mark scheme.
- 8 Strike through all blank spaces and pages to give a clear indication that the whole of the script has been considered.

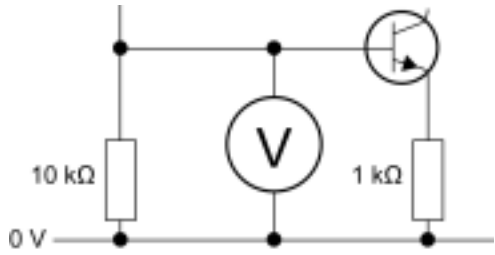
The following abbreviations and conventions are used in the mark scheme:

wtte	= words to that effect
/	= alternative correct answers
;	= separates marking points
NOT	= answers which are not worthy of credit
()	= words which are not essential to gain credit
___	= (underlining) key words which must be used to gain credit
ecf	= error carried forward
ora	= or reverse argument
eor	= evidence of rule

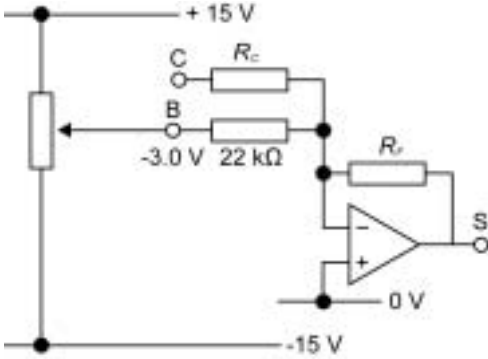
Question			Grade	Expected Answer	Mark	Rationale
1	(a)	(i)	de bcd de	$I = V/R$ (eor) $(V = 9 - 0.9) = 8.1 \text{ V}$ $I = 8.1/220 = 3.7 \times 10^{-2} \text{ A}$ or <u>37</u> mA	[1] [1] [1]	ecf incorrect V: 9V gives 41 mA (accept 40 mA)
		(ii)	de de bcd	$P = IV$ (eor) $P = 37 \times 10^{-3} \times 0.9 = 3.3 \times 10^{-2} \text{ W}$ or 33 mW (36mW for 40mA) ecf incorrect P: LED will not overheat / fail	[1] [1] [1]	
	(b)		ab de de bcd bcd	$h_{FE} = 75$ $I_B = I_C/h_{FE}$ (eor) ecf incorrect h_{FE} and I_C : $I_B = 37 \times 10^{-3} / 75 = 4.9 \times 10^{-4} \text{ A}$ $V = 2.5 - 0.7 = 1.8 \text{ V}$ ecf incorrect V: $R = V/I = 1.8 / 4.9 \times 10^{-4} = 3.7 \times 10^4 \Omega = 3.7 \text{ k}\Omega$	[1] [1] [1] [1] [1]	
2	(a)		bcd	$2^3 = 8$	[1]	
	(b)		de bcd ab	start and stop bits start bit informs (receiver) that word is about to arrive stop bit (resets signal level) so that a start bit can be recognised	[1] [1] [1]	
	(c)	(i)	de	bits per field = $5 \times 640 \times 350 = \underline{1\,120\,000}$	[1]	
		(ii)	de	ecf incorrect bits per field: bit rate = $42 \times 1\,120\,000 = \underline{47\,040\,000 \text{ s}^{-1}}$	[1]	
	(d)		ab bcd eu	10101010 is signal with highest frequency 10 is one cycle of square wave so $47\,040\,000 / 2 = 24 \times 10^6$ cycles per second	[1] [1] [1]	

Question			Grade	Expected Answer	Mark	Rationale
5	(b)	(i)	de	 <p>accept g, d and s</p>	[1]	
		(ii)	de bcd ab	source follows gate with source below gate by approximately constant value / threshold voltage	[1] [1] [1]	accept a formula with defined variables for [3]
		(iii)	de bcd ab	larger signal/more sensitive narrower bandwidth/more selective because of high input impedance/no current in gate/less loading of tuned circuit	[1] [1] [1]	accept higher / better Q
	(c)	(i)	de de	show: $T = 1/f$ $T = 1/5 \times 10^3 = 2.0 \times 10^{-4} \text{ s}$	[1] [1]	ignore 200 μs

Question			Grade	Expected Answer	Mark	Rationale
		(ii)	de bcd bcd ab	AM signal correct period of modulation sine wave modulation (any amplitude) carrier shown as blur 	[1] [1] [1] [1]	
	(d)	(i)	de bcd ab	diode rectifies signal RC act as treble cut filter to remove r.f. but transmit a.f. signals	[1] [1] [1]	accept converts ac to dc
		(ii)	bcd bcd	break frequency = $1/2\pi \times 10 \times 10^3 \times 2 \times 10^{-9} = 8\text{ kHz}$ above 2.5 kHz signal, but below 920 kHz carrier	[1] [1]	accept calculation of C for reasonable f_0
6	(a)	(i)	de de	show: $I = VIR$ $I = 0.8 / 1 \times 10^3 = 8.0 \times 10^{-4} \text{ A}$ or 0.8 mA	[1] [1]	
		(ii)	de	ecf incorrect I: 0.8 mA	[1]	accept 1 mA
		(iii)	de bcd ab	$V = IR$ (eor) $V = 0.8 \times 10^{-3} \times 4.7 \times 10^3 = 3.8 \text{ V}$ $V_C = 9 - 3.8 = 5.2 \text{ V}$	[1] [1] [1]	ecf incorrect I: 1 mA give 4.7 V and $V_C = 4.3 \text{ V}$

Question			Grade	Expected Answer	Mark	Rationale
	(b)	(i)	de de bcd	$I = V/R$ (eor) $I = 9 / 57 \times 10^3 = 1.58 \times 10^{-4} \text{ A}$ $V = IR = 1.58 \times 10^{-4} \times 10 \times 10^3 = \underline{1.58} \text{ V}$ rule [1], substitution [1], evaluation [1]	[1] [1] [1]	
		(ii)	de de	correct symbol correct connection 	[1] [1]	
		(iii)	bcd ab	current in base of transistor reduces current in 10 kΩ resistor / increases current in 47 kΩ resistor	[1] [1]	
	(c)	(i)	de de	$G = -R_C/R_E$ (eor) $G = -47 / 1 = -4.7$	[1] [1]	
		(ii)	de bcd ab	increased voltage at emitter increased collector/emitter current greater voltage drop across 4.7 kΩ so (collector voltage falls)	[1] [1] [1]	

Question			Grade	Expected Answer	Mark	Rationale
7	(a)		ab bcd bcd de	correct pattern one or two mistakes for [3] three mistakes for [2] four mistakes for [1]	[4] [3] [2] [1]	
	(b)	(i)	de de	analogue can have any value within a range digital only two values	[1] [1]	
		(ii)	de bcd	levels of 1 and 0 can be restored by Schmitt trigger / NOT gate	[1] [1]	
	(c)	(i)	de de bcd ab	D to following Q all clocks in parallel and labelled parallel output identified serial input identified	[1] [1] [1] [1]	

Question			Grade	Expected Answer	Mark	Rationale
		(ii)	de de bcd	signal at D transfers to Q on rising <u>edge</u> at clock (not pulse); accept falling edge	[1] [1] [1]	
		(iii)	de bcd ab	bits arrive at input one after the other successive clock pulses latch each bit and pass all bits one place to the right	[1] [1] [1]	
8	(a)		de de	correct symbol correct connection (top to either 0 V or +15 V) 	[1] [1]	
	(b)	(i)	de de bcd	$I = V/R$ (eor) (ACCEPT inverting amplifier formula) $I = 3/22 \times 10^3 = 1.36 \times 10^{-4} \text{ A}$ $R = V/I = 12/1.36 \times 10^{-4} = 8.8 \times 10^4 \Omega$	[1] [1] [1]	
		(ii)	de de bcd	summing amplifier formula (eor) $12/88 = 5/R_C - 3/22$ $R_C = 18 \text{ k}\Omega$	[1] [1] [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.

Unit Name			2529	Communication Circuits						June	
Question			Spec ref	A01	A02	A03	Target grade			QWC	Total
			5	K & U	S & A	synoptic	A/B	B/C/D	D/E		
1	a	i	4.2b	1	2			1	2		3
1	a	ii	1.2e			3		1	2		3
1	b		4.2c	2	3		1	2	2		5
2	a		4.4a	1				1			1
2	b		4.5j	3			1	1	1		3
2	c		4.5d	1	1				2		2
2	d		4.5d	1	2		1	1	1	#	3
3	a		2.3g			5		1	4		5
3	b	i	2.3e			2	1		1		2
3	b	ii	2.3b			5	1	2	2		5
4	a		4.5a	2	2		1	1	2	#	4
4	b		4.5g	4	3		1	3	3		7
4	c	i	2.1g			3		1	2		3
4	c	ii	2.1e			6	1	3	2		6
5	a		4.1b	1	2		1	2			3
5	b	i	4.2j	1					1		1
5	b	ii	4.2j	3			1	1	1		3
5	b	iii	4.1c	3			1	1	1	#	3
5	c	i	1.1j			2			2		2
5	c	ii	1.1j			4	1	2	1		4
5	d	i	4.3g	3			1	1	1	#	3
5	d	ii	4.3g	1	1			1	1		2
6	a	i	4.2e	1	1				2		2
6	a	ii	4.2e	1					1		1
6	a	iii	4.2e	1	2		1	1	1		3
6	b	i	1.3b			3		1	2		3
6	b	ii	1.1j			2			2		2
6	b	iii	2.4b			2	1	1			2
6	c	i	4.2e	1	1				2		2
6	c	ii	4.2e	3			1	1	1	#	3
7	a		4.5i	2	2		1	2	1		4
7	b	i	1.4a			2			2		2
7	b	ii	4.5a	2				1	1		2
7	c	i	4.5f	4			1	1	2		4
7	c	ii	1.4e	3				1	2	#	3
7	c	iii	4.5e	3			1	1	1	#	3
8	a		1.1i			2			2		2
8	b	i	1.3c			3		1	2		3
8	b	ii	2.1c			3		1	2		3
											0
Totals				48	22	47	19	38	61	3	117
Targets				47	23	47	19	39	59	3	120

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