GCE MARKING SCHEME

ELECTRONICS
AS/Advanced

JANUARY

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCE ELECTRONICS. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

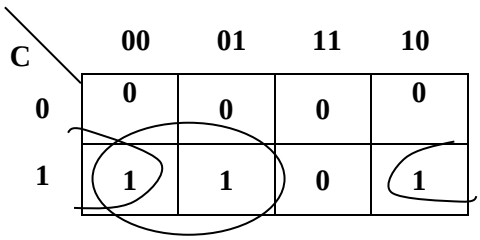
WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Question			Marking details	Marks Available
1.	*(a)*		<table><tr><td>B</td><td>A</td><td>S</td><td>T</td><td>Q</td></tr><tr><td>0</td><td>0</td><td>**1**</td><td>**0**</td><td>**1**</td></tr><tr><td>0</td><td>1</td><td>**0**</td><td>**0**</td><td>**0**</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>**1**</td></tr></table> One mark for each correct column (Q **ecf** S and T)	3
	(b)	(i)	EXNOR or **ecf** for Q	1
		(ii)	Correct symbol for EXNOR gate allow **ecf** from (i)	1
				[5]
2.			D_0, D_3, D_4 and D_6 to 0 V D_1, D_2, D_5 and D_7 to 5 V Completely correct (award 2 marks) Inversion of table (only 1 mark)	2
				[2]
3.	*(a)*		$\overline{A}.0 =$ **0**	1
	(b)		Two correct groups of 4 identified (1) Any correct term from groups identified (1) Simplest overall expression (1) $Q= B.A + \overline{C}.\overline{A}$	3
	(c)		$Q= \overline{\overline{A}.B + \overline{A}} = (\overline{A} + \overline{B}).A = \overline{A}.A + \overline{B}.A = 0 + \overline{B}.A = \overline{B}.A$ Correct DeMorgan (1) Correct use of brackets (1) Correct final answer (1)	3
				[7]
4.	*(a)*		Each mark for 4 correct connections Correct clock connections (1) $\overline{Q}$ to D (1) Q to Resistor/LED (1)	3
	(b)		Q_B and Q_D connected to a 2 input logic gate (1) AND gate selected and connected to at least 1 reset (1) Output of logic gate to ALL R terminals (1)	3
	(c)	(i)	6	1
		(ii)	1 0 0 1	1
				[8]

Question			Marking details	Marks Available
5	*(a)*			

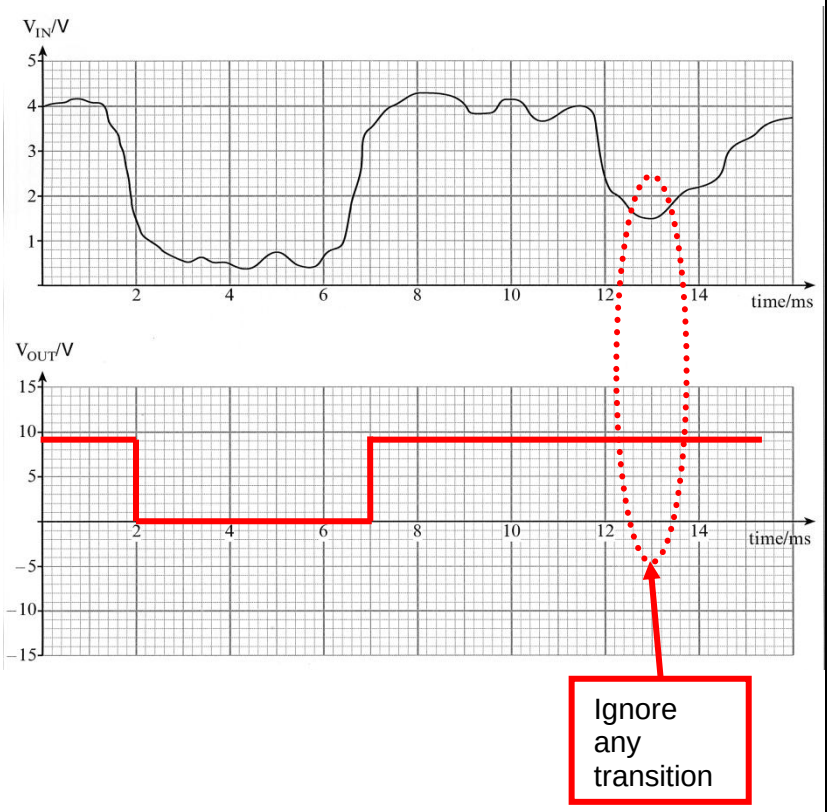
Clock Pulse	C	B	A	**R**	**Y**	**G**
0	0	0	0	**1**	**1**	**0**
1	0	0	1	**1**	**1**	**0**
2	0	1	0	**1**	**0**	**1**
3	0	1	1	**0**	**0**	**1**
4	1	0	0	**1**	**1**	**1**
5	1	0	1	**1**	**1**	**0**
6	1	1	0	**1**	**0**	**0**
7	1	1	1	**0**	**0**	**0**

One mark for each correct column — 3

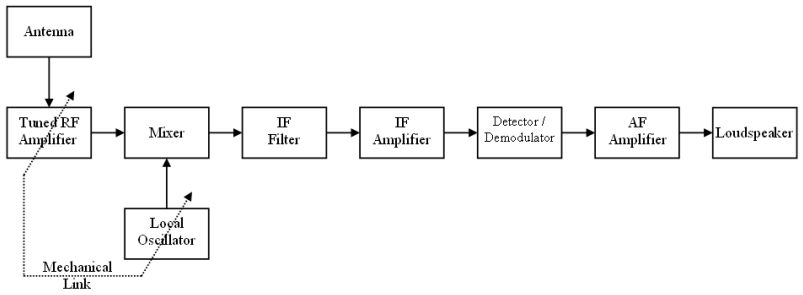
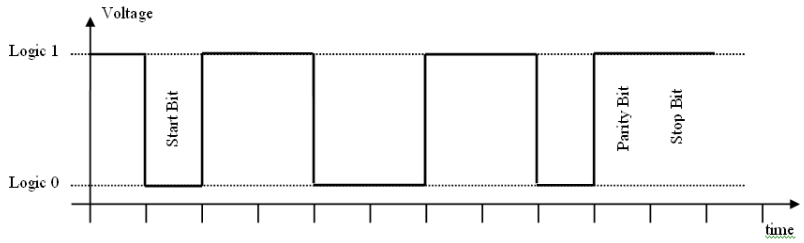
	(b)	(i)	40 seconds	1
		(ii)	**BOTH** correct for the mark $R = \overline{C}$ $Y = B.A$	1
		(iii)	 Correct map and groups (1) Correct terms $C.\overline{B} + C.\overline{A}$ – or – $C.(\overline{B} + \overline{A})$ -or- $C.(\overline{A.B})$ (2) Any of these answers gains the marks (**ecf** incorrect map)	3
		(iv)	NOT gate between C and R (1) AND gate A and B to Y (1) Working solution to G (1)	3
				[11]

Question			Marking details	Marks Available
6.	*(a)*		Switch and resistor correct orientation across power rails (1) Correct connection to R (1)	2
	(b)		When the D-type is reset the output Q will be at logic **0** and the LED will be **ON** **Both** answers needed for the mark	1
	(c)		Output Q Rises 0 to 1 on first and fourth clock edge (1) Falls 1 to 0 on third clock edge (1) Falls 1 to 0 on edge of reset (1) $\overline{Q}$ is inverse of Q (1)	4
				[7]
7.	*(a)*		Resistor between input terminal and inverting input (1) Feedback resistor between output and inverting input (1) Non-inverting input to ground (1)	3
	(b)		R_{IN} = 10 kΩ (1) R_F = 1.2 MΩ (1)	2
	(c)		Change R_F in proportion to R_{IN}. Don't accept same amount.	1
	(d)		$50/\sqrt{2}$ = 35.4. Line across at 35 approx (1) Bandwidth = 22.5 [kHz] **(1)** (Accept 22-23 kHz)	2
				[8]

Question			Marking details	Marks Available
8.	*(a)*		10 MΩ	1
	(b)		Max gain = 100/2+1= 51 (1) Min gain = 0/2+1= 1 (1)	2
	(c)	(i)	Bandwidth 1.2 x 10^6/30 (1) = 40 000 (1)[Hz] or 40 k[Hz] or 0.04 M[Hz]	2
		(ii)	Sine wave with same frequency as original (1) (allow ± ½ square division) In phase with original (1) Peaks at 12 (V) 12 000 m(V) clearly marked on axis or peak (1)	3
		(iii)	14/30 = 0.47 (V) or 467 m(V)	1
	(d)	(i)	Time = 14/5 = 2.8 (1) μs (1)	2
		(ii)	Reduces **distortion** for **high frequency** signals OR Reduces **distortion** for signals with **large voltage swings** Or by implication.	1 **[12]**

Question			Marking details	Marks Available
1.	*(a)*	(i)	Non inverting	1
		(ii)	1.5 V and 3.5 V, (any order)	1
	(b)		 Ignore any transition Action consistent with part (a) (1) Correct switching thresholds (1) Correct saturation (1)	3
				[5]

Question			Marking details	Marks Available
2	*(a)*		Diagram A – Amplitude Modulation **AND** Diagram B – Frequency Modulation	1
	(b)	(i)	$f_c = \frac{1}{14.3\times10^{-6}} = 70\,\text{kHz}$ (1) (Accept 66 kHz – 74 kHz)	3
		(ii)	$f_{sig} = \frac{1}{200\times10^{-6}} = 5\,\text{kHz}$ (1) (Accept 4.8 – 5.2 kHz)	
		(iii)	$\text{mod}.depth = \frac{6-0.9}{6+0.9}\times100\% = 74\%$ or $= \frac{12-1.8}{12+1.8}\times100\% = 74\%$ (1) (accept 71-77%)	
	(c)	(i)	$f_c = \frac{1}{0.4\times10^{-6}} = 2.5\,\text{MHz}$ (1) (Accept 2.4 – 2.6 MHz)	2
		(ii)	$f_{sig} = \frac{1}{4\times10^{-6}} = 250\,\text{kHz}$ (1) (Accept 242 – 258 kHz)	
				[6]

Question			Marking details	Marks Available
3.	*(a)*		Antenna – Tuned Circuit – Detector/Demodulator – RF Filter - HP	1
	(b)		Unable to detect weak stations – poor sensitivity (1) Unable to reject nearby stations – poor selectivity (1)	2
	(c)	(i)	470 kHz /0.47 MHz 1.8 MHz 2.27 MHz 4.07 MHz 4 correct = 2 marks or 3 correct = 1 mark	2
		(ii)	470 kHz or 0.47 kHz	1
		(iii)		4
				[10]
4.	*(a)*		a, b, and d	1
	(b)		 incorrect start bit = -1 mark or incorrect parity bit = -1 mark or completely reversed data i.e. 0110011 = -1 mark or any incorrect label either start, parity or stop = -1 mark **to a minimum of zero marks**	3
	(c)		The single parity system cannot distinguish when there are two errors in the data transferred.	1
				[5]

Question			Marking details	Marks Available
5.	*(a)*		$\frac{10-V_{IN}}{10}=\frac{10-4}{7.5}$ $10-V_{IN}=\frac{6\times10}{7.5}$ $10-V_{IN}=8$ $V_{IN}=10-8$ $V_{IN}=2\,V$ correct formula / substitution (1) correct answer (1)	2
	(b)		$\frac{-10-V_{IN}}{10}=\frac{-10-4}{7.5}$ $-10-V_{IN}=\frac{-14\times10}{7.5}$ $-10-V_{IN}=-18.67$ $V_{IN}=-10+18.67$ $V_{IN}=8.67\,V$ correct formula / substitution (1) correct answer (1)	2
				[**4**]
6.	*(a)*		$f_b=\frac{1}{2\pi RC}$ $R=\frac{1}{2\times\pi\times3800\times100\times10^{-9}}$ $R=418.8\,\Omega$ correct formula (1) substitution **and** multipliers (1) correct answer (1)	3
	(b)		Minimum frequency = 12 x 8 kHz = 96 kHz (1) The PISO register must output 12 data bits before the next sample is taken. (1)	2
	(c)		$resolution=\frac{9}{2^{12}}=\frac{9}{4096}=2.197\,mV$ correct use of 2^{12} (1) answer (1)	2
	(d)		Schmitt trigger – SIPO – DAC – Low Pass Filter | SIPO Clock SIPO Clock – SIPO (1) Schmitt – SIPO (1) SIPO – DAC – LPF (1)	3
				[10]

Question			Marking details	Marks Available
7.	*(a)*	i)	448 kHz	1
		ii)	Use of 0.7 max to determine bandwidth. (1) bandwidth = 10 kHz (1)	2
	(b)		$\boldsymbol{Q} = \frac{\boldsymbol{f_o}}{\boldsymbol{B}} = \frac{448}{10} = 44.8$	1
	(c)		$\boldsymbol{Q} = \frac{2\pi \boldsymbol{f}_0 \boldsymbol{L}}{\boldsymbol{r}_L}$ $\boldsymbol{L} = \frac{\boldsymbol{Q} \times \boldsymbol{r}_L}{2\pi \boldsymbol{f}_o}$ $\boldsymbol{L} = \frac{44.8 \times 0.8}{2 \times \pi \times 448000} = 12.7 \times 10^{-6} = 12.7 \mu \boldsymbol{H}$ $\boldsymbol{L} = 12.8 \mu \boldsymbol{H} \boldsymbol{(Q} = 45\boldsymbol{)}$	1
	(d)		$\boldsymbol{C} = \frac{1}{4\pi^2 \boldsymbol{f}_o^2 \boldsymbol{L}}$ $\boldsymbol{C} = \frac{1}{4 \times \pi^2 \times 448000^2 \times 12.7 \times 10^{-6}}$ $\boldsymbol{C} = 9.93 \times 10^{-9} = 9.9 \boldsymbol{nF}$ $\boldsymbol{C} = 9.85 \boldsymbol{nF} \boldsymbol{(L} = 12.8 \mu \boldsymbol{H)}$ Multipliers (1) Answer (1)	2
	(e)	i)	$R_D = \frac{L}{r_L C}$ $R_D = \frac{12.7 \times 10^{-6}}{0.8 \times 9.9 \times 10^{-9}} = 1600\Omega$ $R_D = 1600\Omega$ Accept R_D (1585-1625 Ω)	1
		ii)	$\boldsymbol{I} = \frac{10}{1600} = 6.25 \boldsymbol{mA}$ or $\boldsymbol{R} = \frac{1600}{5} = 320\Omega$ $\boldsymbol{R} = \frac{2}{6.25 \times 10^{-3}} = 320\Omega$ Accept R in the range (317-325Ω) Substitution in formula (1) Answer (1)	2
				[10]

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