GCE MARKING SCHEME

SUMMER 2016

ELECTRONICS ET4
1144/01

INTRODUCTION

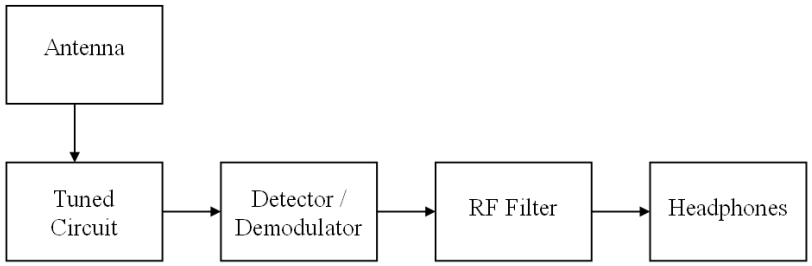
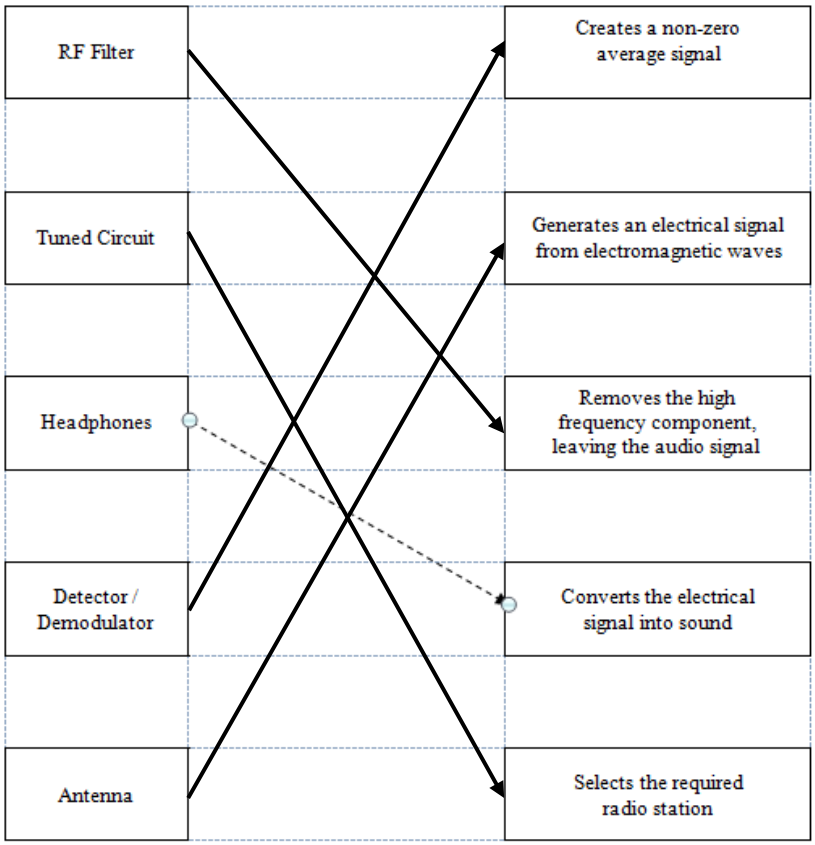
This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

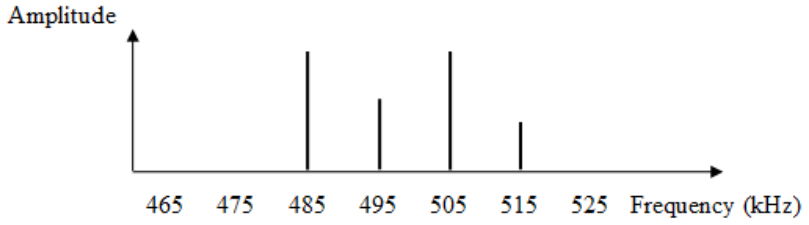
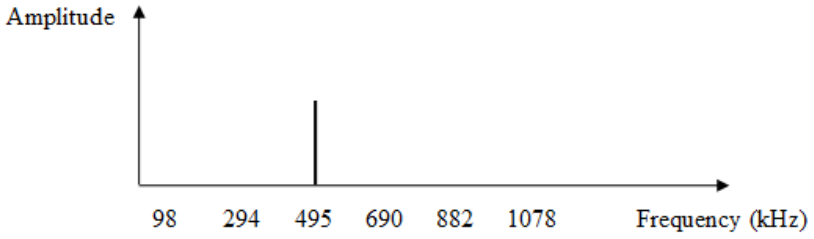
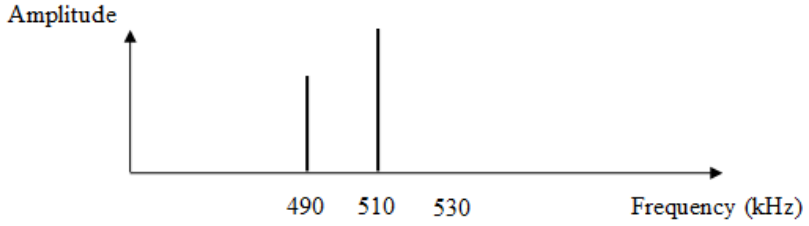
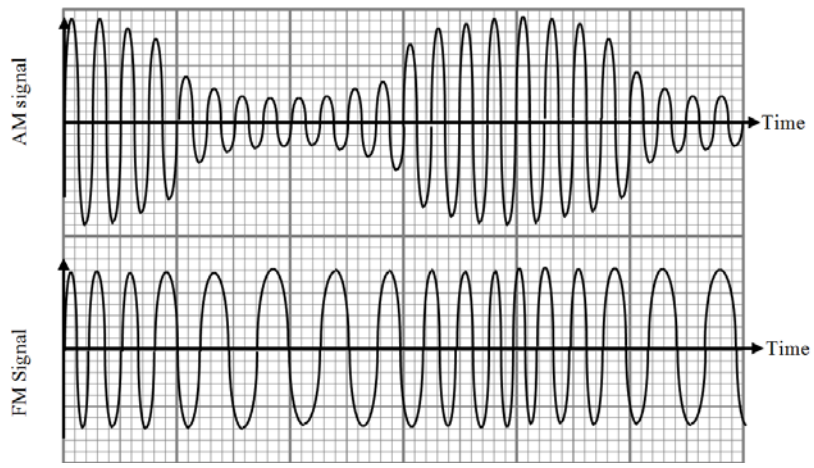
It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

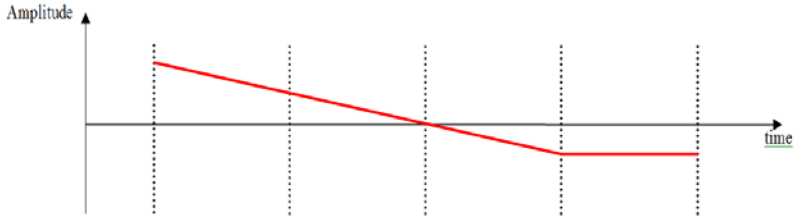
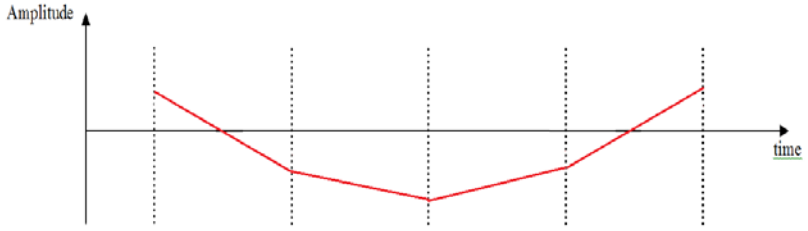
WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

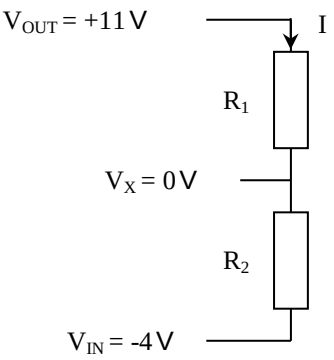
GCE ELECTRONICS - ET4

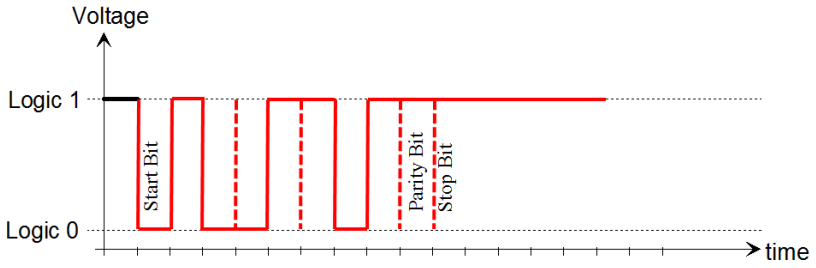
MARK SCHEME - SUMMER 2016

Question			Marking details	Marks Available
1.	*(a)*			1
	(b)			
			4 Correct links or Any two correct links	2 or 1 **[3]**

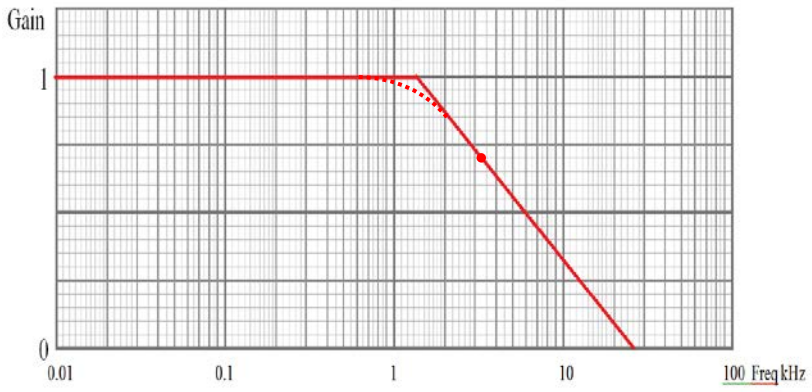
Question			Marking details	Marks Available
2.	*(a)*		Band Pass Filter	1
	(b)			1
	(c)			1
	(d)			1 **[4]**
3.	*(a)*		 For AM – indication of varying amplitude with an attempt at constant frequency required. For FM – indication of constant amplitude and varying frequency.	1 1

Question			Marking details	Marks Available
3.	*(b)*	(i)	$\beta = \frac{\Delta f_c}{f_i} = \frac{80}{20} = 4$	1
		(ii)	$\text{Bandwidth} = 2(1+\beta)f_i$ $= 2(1+4)20\text{kHz}$ $= 200\,\text{kHz}$	1 1
			or	or
			$\text{Bandwidth} = 2(\Delta f_c + f_i)$ $= 2(80+20)$ $= 200\,\text{kHz}$	1 1
				[5]
4.	*(a)*	i)	Pulse Width Modulation	1
		ii)	 Consistency of Shape (1) Accuracy (1)	2
	(b)	i)	Pulse Amplitude Modulation	1
		ii)	 Consistency of Shape (1) Accuracy (1)	2
				[6]

Question			Marking details	Marks Available
5.	*(a)*		V_{REF} / V_X is set at 0V. (therefore it does not matter whether V_{OUT} is at +11V or -11V, the voltage drop across R_1 is the same)	1
	(b)			
			$I = \frac{11-0}{R_1} = \frac{11}{R_1}$ *and* $I = \frac{0-(-4)}{R_2} = \frac{4}{R_2}$	
			The current I is the same so we can equate these equations.	
			$\frac{11}{R_1} = \frac{4}{R_2}$ $\frac{11R_2}{4} = R_1$ $2.75R_2 = R_1$	
			e.g. R_1 = 2.75k, R_2 = 1 kΩ R_1 = 5.5k, R_2 = 2 kΩ etc	
			OR	
			$V_{R_1} : V_{R_2}$ $11 : 4$ $2.75 : 1$ $\therefore R_1 : R_2$ $\therefore 2.75 : 1$	
			R_1 = ...27.5 kΩ..... R_2 = ...10 kΩ.....	
			Calculation of ratio = 2 marks Correct resistors >1 kΩ = 1 mark	2 1
	(c)		1.0 V < Lower Switching Threshold < 2 V	1
			2.5 V < Upper Switching Threshold < 3.6 V	1 **[6]**

Question			Marking details	Marks Available
6.	*(a)*	(i)	Parity Bit = 1	1
		(ii)	 Data reversed and correct = 2 marks Data correct but not reversed = 1 mark All three labels correct = 1 mark	2 or 1 1
	(b)	(i)	D_7 D_6 D_5 D_4 D_3 D_2 D_1 D_0 P_3 P_2 P_1 P_0 1 0 0 0 1 1 0 1 0 0 0 0 All four correct = 1 mark	1
		(ii)	D_7 D_6 D_5 D_4 D_3 D_2 D_1 D_0 P_3 P_2 P_1 P_0 1 1 1 1 0 1 1 0 1 0 1 1	1
			D_7 D_6 D_5 D_4 D_3 D_2 D_1 D_0 P_3 P_2 P_1 P_0 1 0 1 1 1 1 0 0 1 1 1 1	1
		(iii)	P_1 is the only bit that fails – this is linked to data bit D_7, so either P_1 or D_7 is incorrect. There is no way of knowing which bit is wrong as D_7 is not linked to any other parity bit. P_1 or D_7 is incorrect without explanation not acceptable.	1
				[7]

Question			Marking details	Marks Available
7.	*(a)*	i)	Block X = Low Pass Filter	1
		ii)	Block Y = Sampling Gate	1
		iii)	Block Z = PISO Shift Register	1
	(b)	i)	$2^{12} = 4096$	1
		ii)	Input voltage range = 2^{12} (4096) x 2 mV = 8.192 V	1
		iii)	Clock A = 39 kHz	1
			The highest frequency present at the input is 19.5 kHz (Audio Signal). Nyquist's sampling theorem states that sampling frequency must be at least 2x highest input frequency, = 2 x 19.5 kHz = 39 k Hz, is the lowest frequency permissible	1
			Clock B = 12 x 39 kHz = 468 kHz	1
			12 bits need to be output from the PISO register before the next sample is taken.	1
	(c)	i)	Digital to analogue converter	1
		ii)	Low pass filter	1
				[11]

Question			Marking details	Marks Available
8.	*(a)*		Low Pass Filter	1
	(b)		$X_C = \frac{1}{2\pi fC}$ $= \frac{1}{2\pi \times 50 \times 22 \times 10^{-9}}$ $= 144.7\,k\Omega \cong 145\,k\Omega$	
			substitution **and** multipliers = 1	1
			correct answer = 1	1
	(c)		$0.145\,k\Omega$ ($0.15\,k\Omega$) or (b) ÷ 1000	1
	(d)		$f_b = \frac{1}{2\pi RC}$ $f_b = \frac{1}{2 \times \pi \times 2400 \times 22 \times 10^{-9}}$ $f_b = 3.014\,kHz$	
			substitution **and** multipliers = 1	1
			correct answer = 1	1
	(e)			
			Shape consistent with (a)	1
			Break frequency consistent at 70% point with (d) (3.014 kHz)	1
				[8]