A-LEVEL
Electronics

ELEC5 – Communications Systems
Mark scheme

2430
June 2016

Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
1	(a)		(2480-2402)/2 = 39 spaces, therefore 40 channels ✓	1	**accept 39**
1	(b)		1600/40 ✓ = 40✓	2	**ecf, accept 41 ignore any units**
1	(c)	(i)	Class 1 ✓	1	
1	(c)	(ii)	It has shortest range ✓ reducing possibility of interference with other computers. ✓	2	**allow less battery power**
1	(d)		They need line of sight. OR Use more power.	1	
1	(e)		c=fλ λ=3x10^8 / 2.441x10^9 ✓ (appropriate f) = .123m✓ therefore λ/4 = .123/4 = 0.03m or 3cm✓ correct units✓	4	**any frequency in range**

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
2	**(a)**	**(i)**	5	**1**	
2	**(a)**	**(ii)**	3	**1**	
2	**(a)**	**(iii)**	2	**1**	
2	**(a)**	**(iv)**	4	**1**	
2	**(a)**	**(v)**	1	**1**	
2	**(b)**	**(i)**	select desired/transmitted frequency	**1**	
2	**(b)**	**(ii)**	L and C in parallel ✓ correct connection ✓	**2**	
2	**(b)**	**(iii)**	use $10x10^{-12}$, $434x10^{6}$ ✓ correctly rearranged formula ✓ 13nH ✓	**3**	

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
3	(a)		Pulse Width Modulation	1	
3	(b)		Electrical isolation or Fibre has low mass and/or volume, or can be used in potentially explosive environments, or less susceptible to interference, or more secure from tapping	Max 2	
3	(c)	(i)	Total internal reflection (or correct description)	1	
3	(c)	(ii)	TIR won't occur ✓ reference to effect of bend on angles/rays ✓	2	
3	(d)	(i)	Smaller rise time -> higher frequency	1	
3	(d)	(ii)	e.g. period of PWM signal = 20μs. ✓ 20μs is much greater than rise times. ✓	2	
3	(e)		After pulses travel through the fibre they may become distorted and lose their shape. ✓ The regenerator returns the pulse to a clean digital pulse. ✓ A Schmitt trigger can be used for this. ✓	3	**refer to distortion/dispersion, not noise**

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
4	(a)		Use of $43x10^{3}$ and $220x10^{-12}$ ✓ $t = (R_A + 2R_B)C/1.44$ ✓ (of rearrangement of frequency equation) $t = (43000 + 2x43000) \times 220x10^{-12}/1.44$ ✓ $=19.7 \times 10^{-6}$ ✓ ≈ 20µs	4	
4	(b)	(i)	$t = 1.1RC \quad R = t/1.1C$ ✓ $= 1.5 \times 10^{-6}/1.1 \times 220 \times 10^{-12}$ ✓ $= 6.20x10^{3}\Omega$ ✓	3	
4	(b)	(ii)	rectangular shape ✓ high for 1.5µs and low for 18.5µs ✓	2	

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
5	(a)		amplitude modulation and frequency modulation ✓ information is in amplitude/frequency of carrier ✓ level/value of audio signal alters/changes/affects amplitude of carrier OR level/value of audio signal alters/changes/affects frequency of carrier ✓ frequency constant (for am) or amplitude constant for fm ✓	4	
5	(b)		carrier at 27.395 ✓ side frequency at + or – 2kHz ✓ side frequency at + or – 3kHz ✓ labels and two pairs of side frequencies ✓	4	
5	(c)		only one at a time / one communication channel ✓ each person takes their turn ✓ must agree to 'hand over' ✓	3	
5	(d)		channel width 27.395 – 27.385 = 10kHz ✓ speech < 3kHz (e.g.) ✓ needs bandwidth of 6kHz (relate to 10kHz bandwidth) ✓	3	

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
6	(a)		uplink: from mobile to base station ✓ downlink: from base station to mobile ✓	2	
6	(b)		call setup ✓ channel changing ✓ base station handover ✓	max 2	
6	(c)		915MHZ – 890MHz = 25MHz ✓ 25MHz/0.2MHz less 1 for guard channel = 124	2	allow 125
6	(d)		cannot reuse in adjacent cells (e.g. 4, 5, 7, 9, 11, 12) ✓ relevant reference to interference of signals ✓ can reuse in more distant cells (e.g. 1, 2, 3, 6, 10, 13, 14) ✓ reference to relevant cell numbers ✓	max 3	

Question	Part	Sub-part	Marking Guidance	Mark	Comments/ Guidance
7	(a)		more than one set of data / multiple wires would be needed	1	
7	(b)		two wires twisted together screen (labelled) e.g.  	2	
7	(c)	(i)	to identify beginning/end of data bits OR to allow synchronisation of each set of data	1	
7	(c)	(ii)	clock period = 4µs x11 bits	2	**or 11/(250x10^3)**
7	(d)		512 x 44 ✓ = 22528µs + 160 µs ✓ = 22688µs 44 per second ✓	3	**or alternative, valid method**
7	(e)	(i)	voltages induced/dropped (noise) equally in the two wires ✓ allows interference to be cancelled out ✓ OR magnetic fields produced in opposite directions / cancel ✓ reduces crosstalk ✓	2	
7	(e)	(ii)	wire 1 to +input, wire 2 to –input Zener and resistor from output to 0V Zener correct way round and correct symbol	3	