A-LEVEL
Electronics

ELEC5 – Communications Systems
Mark scheme

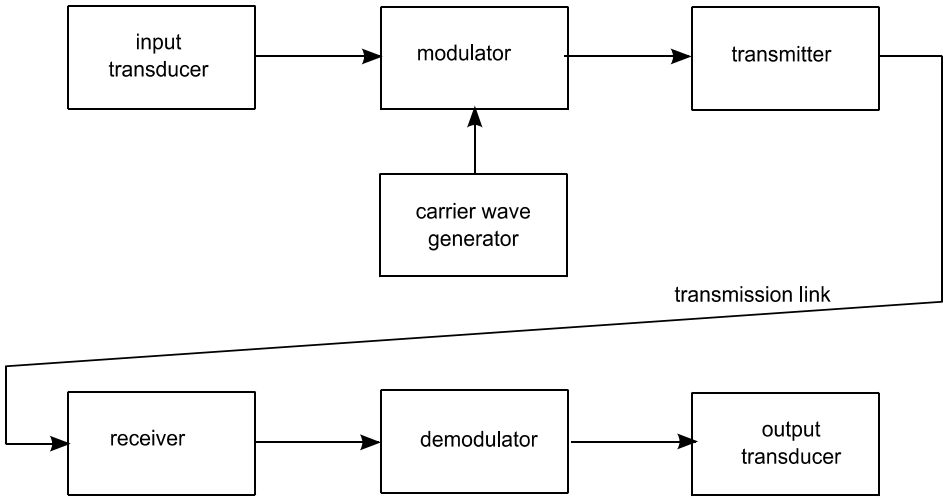
2430
June 2015

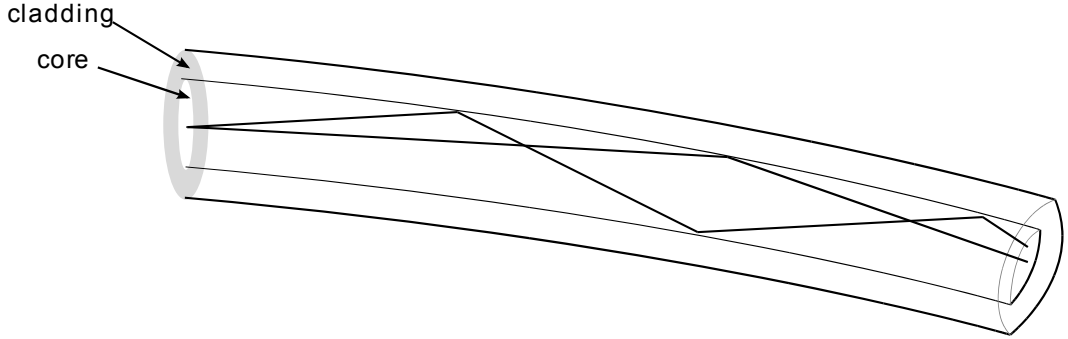
Version: Final Mark Scheme v1.0

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.

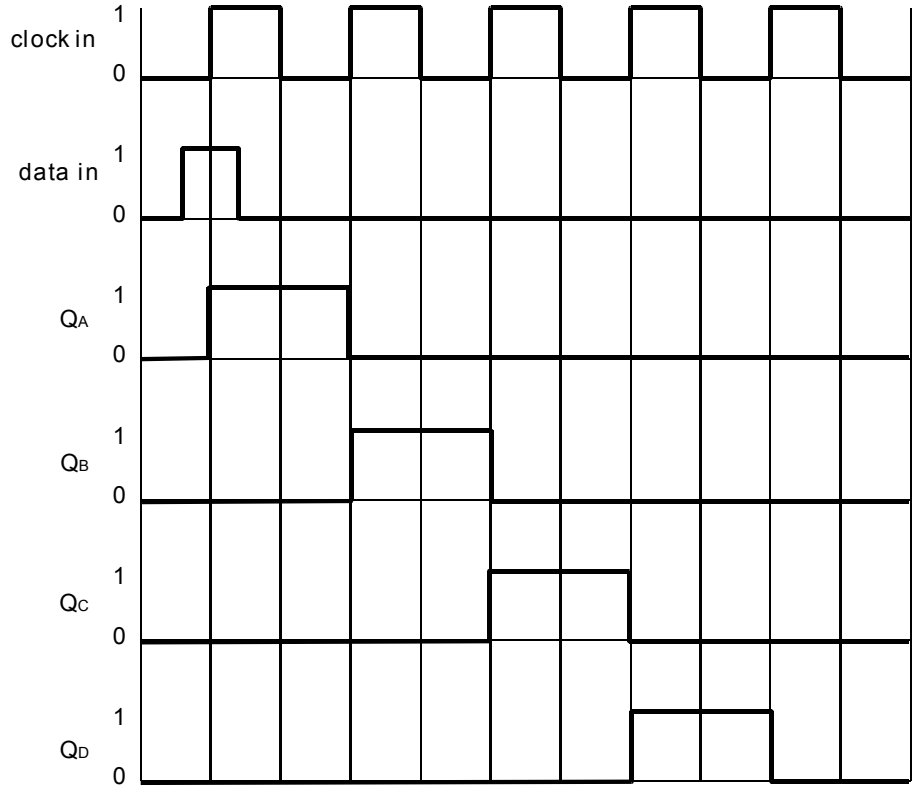
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

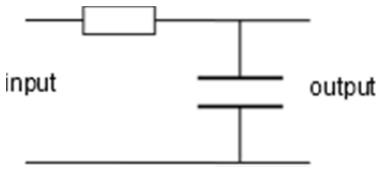
Question	Part	Subpart	Marking guidance	**Mark**	Comments
1	a		 transmitter & receiver, carrier wave gen ✓ demodulator & modulator✓	**2**	#
1	b		E.g. free space optical fibre twisted pair coax cable (any 3 ✓✓✓)	**3**	#
1	c	i	superimpose the information signal onto the carrier wave ✓	**1**	#

1	c	ii	AM – constant frequency sinusoidal wave matching carrier wave ✓, amplitude varies in phase with information signal ✓ FM – constant amplitude sinusoidal wave ✓, frequency varies in phase with information signal ✓	**4**	#
2	a	i#	 core ✓ cladding ✓	**2**	#
2	a	ii	different refractive index ✓ core > cladding ✓ to make total internal reflection (or equivalent description) ✓ possible.	**3**	
2	b	i	diagram showing two rays drawn correctly *or* pulses overlapping ✓ different path length *or* more reflections (label or explanation) ✓ different times *or* signals are spread out (diagram or explanation) ✓ data bits overlap affecting data rate (diagram or explanation) ✓	**4**	#
2	b	ii	only one path possible / acts as waveguide ✓	**1**	#

3	a		upper audio frequency maximum 15–20kHz ✓, sampling frequency must be higher ✓ than 2x ✓ highest audio frequency	**3**	#
3	b		65536 ✓	**1**	allow 65535
3	c		5/65535 ✓ = 76μV ✓	**2**	allow 65536 ecf from (b)
3	d		high & low frequencies are lost *or* reduced bandwidth ✓ reference to perceived quality, e.g. lack of bass/treble in the music,'tinny', or similar ✓	**2**	#
4	a		16 ✓	**1**	#
4	b		serial – bits transmitted one after the other (one signal wire) ✓ parallel – bits transmitted together *or* one signal wire for each bit ✓	**2**	#
4	c	i	data in ✓ Q to following D ✓ clock in✓ clocks connected together ✓ parallel data outputs ✓ reset to 0V ✓	**6**	#

4	c	ii		**4**	all changes on rising edge of clock ✓ single pulses on each output of same width ✓ correct width of pulse ✓ single pulse moves along ✓

5	a		analogue speech signal is sampled ✓at regular intervals ✓ converted to numbers ✓ #	**3**	#
5	b		E.g. pulse code modulation, pulse width modulation, pulse position modulation✓✓	**2 max**	
5	c	i	number of bits of data✓ (and routing information)	**1**	implies a part of a data stream
5	c	ii	e.g. source address, destination address, checksum, data, packet number/size, preamble, padding	**2 max**	#
5	c	iii	e.g. efficient use of bandwidth/infrastructure ✓ variety of routes for each packet (robustness) ✓ security (packets on different routes) ✓	**2 max**	#
5	d		E.g.: use control channel to communicate with base station ✓ log onto network / establish connection ✓ transmission from phone is via uplink ✓ reception on phone is via downlink ✓ these are two different frequencies✓ area is divided into cells ✓ when getting out of range of one base station, call is 'handed over' ✓	**5 max**	for 5 marks, must cover: connecting to network, two-way conversation, hand over to new base station

6	a		range of frequencies in signal ✓ reference to frequency at which signal drops by e.g. power 3dB (50%) / voltage 6dB (71%)✓	**2**	#
6	b		low pass / treble cut ✓	**1**	#
6	c	i#	RC filter circuit, with input & output labelled ✓ correct R & C positions ✓ 	**2**	#
6	c	ii	substitute values into f = 1/ 2πRC ✓ rearrange for C ✓ 40 (39.7) nF ✓	**3**	#
6	d	i	gain > 1 ✓	**1**	#
6	d	ii	100Hz ✓	**1**	#
6	d	iii	gain = 0.2 ✓ output = 0.4V ✓	**2**	#

7	a		aerial 1st & loudspeaker last ✓ tuned circuit follows aerial ✓ # af amplifier precedes loudspeaker ✓ #	**3**	#
7	b		substitution into correct formula ✓ rearrange for C ✓ correct answer ✓ (310pF)	**3**	#
7	c		interference from adjacent channels *or* inability to reject nearby/unwanted frequencies ✓	**1**	#
7	d	i	correct reading from graph (638kHz) ✓	**1**	636kHz to 640kHz#
7	d	ii	correct reading from graph (to 70%)✓ ✓ (620kHz–660kHz = 40kHz) *or* reading from graph (to 50%) ✓ (610–670kHz = 60kHz)	**2**	± 2kHz#
7	d	iii	use f/Δf ✓ correct calculation (16) ✓	**2**	ecf from (d)(ii)