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General Certificate of Education (A-level)
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Electronics ELEC5

(Specification 2430)

Unit 5: Communications Systems

Final

Mark Scheme

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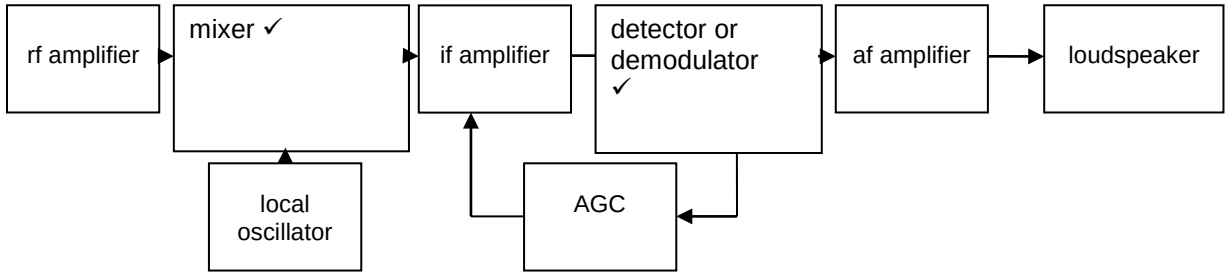
Question	Part	Subpart	Marking guidance		Mark
1	(a)	(i)	unmodulated carrier wave/ sine wave/ blank carrier etc✓		**1**
1	(a)	(ii)	electromagnetic signal/ modulated radio wave/ ray in fibre etc✓		**1**
1	(a)	(iii)	modulated carrier wave✓		**1**
1	(a)	(iv)	information signal/ recovered information signal/ baseband signal etc✓		**1**
1	(b)	(i)	demodulator (could also be modulator)✓		**1**
1	(b)	(ii)	carrier generator(may also be demodulator)✓		**1**
1	(b)	(iii)	output transducer✓		**1**
1	(b)	(iv)	carrier generator/transmitter/receiver✓		**1**
2	(a)				**2**
2	(b)	(i)	automatic gain control✓		**1**
2	(b)	(ii)	Purpose: to make all signals, weak or strong produce the same audio output power✓ Action: uses detected signal to control the gain of the if amplifier ✓, small signals result in higher gain, large signals cause a reduction in if amplifier gain ✓		**3**
2	(c)		1215 + 455 = 1670 kHz ✓		**1**

2	(d)	(i)	The receiver has a response, generated by the mixing process, to a second channel or image frequency ✓, it is as far above the local oscillator frequency as the wanted response is below ✓		**2**
2	(d)	(ii)	1670 (or ecf) + 455 ✓ = 2125kHz ✓		**2**
3	(a)		use of $f = 1/2\pi\sqrt{LC}$, change subject to $L = 1/4\pi^2f^2C$ substitute values, calculation , leading to 6.9μH ✓✓✓✓		**4**
3	(b)		use of λ = c/f, substitute values leading to 22.1m ✓ dipole = 11.05m ✓ too large for desk operation ✓		**3**
3	(c)		13.56/0.1 = 136✓ (could be rounded down to 135)		**1**
3	(d)		1KB = 8192 bits (allow 8000)✓ 8192/100000 = 0.082s (or allow values based on 8000, 0.08s) regardless of these variations, time to download centres on 80ms✓		**2**
4	(a)		1.1MHz – 138kHz = 962kHz✓		**1**
4	(b)		962/4.31 = 223.2, so 223 sub-channels✓		**1**
4	(c)		223 x 56kbps ✓ = 12.488Mbps (not just 12, to show calc has been done ✓		**2**
4	(d)		$3GBytes = 3 \times 1024^3 \times 8$ bits = 3221225472 bits x 8 = 25,769,803,776 bits✓ to every 8 bits, 3 are added = 35, 433, 480, 192 bits ✓ divided by 8Mbps (8388608 bps) gives 4224 sec ✓		**3**
4	(e)		bandwidth of 138 – 26 = 112kHz ✓ smaller than download ✓		**2**
4	(f)		frequency of use/ download more (music and video) info than upload ✓		**1**
5	(a)		connected in non-inverting configuration ✓ pin 1 is used as input ✓		**2**

5	(b)	(i)	high pass/ bass cut✓		**1**
5	(b)	(ii)	use of $f_0 = 1/2\pi RC$✓ 1/ 2x3.14159x1x10^{-6}x22x10^{3}✓ 7(.25) Hz✓		**3**
5	(c)		reduce high frequency response/provide a load at hf/shunt high frequencies to 0V/ stability/ stop oscillation etc✓		**1**
5	(d)		R_2✓, R_4 (allow C_2) in feedback circuit ✓ (or ratio between✓ R_2 and R_4✓)		**2**
5	(e)		Load/loudspeaker impedance (allow resistance) ✓ size of power supply voltage (allow heatsink considerations)✓		**2**
6	(a)		correct use of terms uplink✓ downlink✓ analogue✓ and digital✓ frequency separation✓		**5**
6	(b)	(i)	time division multiplex ✓		**1**
6	(b)	(ii)	16 – 1 =15 x 8✓ = 120 users✓		**2**
6	(b)	(iii)	16 x 200 kHz = 3.2 MHz✓		**1**
6	(b)	(iv)	adjacent cells using different frequencies✓		**1**
6	(b)	(v)	frequency re-use by cells ✓ at larger distances apart than signals will propagate✓		**2**
6	(c)		Large number of users at events✓ would overload existing base stations in the area ✓		**2**
7	(a)	(i)	reverse✓		**1**
7	(a)	(ii)	use of V = IR✓ 5x10^{-9} x 10^{6} = 5x10^{-3}V or 5mV✓		**2**
7	(a)	(iii)	use of current = sens x power✓ 6 x 10^{-7}A or 0.6 µA✓ voltage = 6 x 10^{-7}A x 10^{6} = 0.6V✓		**3**

7	(a)	(iv)	T = RC 10^6 x 10x10^{-12} ✓= 10^{-5}s or 10μs✓		**2**
7	(a)	(v)	capacitance given at zero bias, reverse bias decreases diode capacitance / use of smaller resistance than stated in question ✓		**1**
7	(a)	(vi)	Increase R ✓ use op-amp✓		**2**
7	(b)		Attenuation✓ due to absorption✓ and/or scattering of signal in fibre✓Radiation✓ due to signal loss from tight bends or fibre misalignment ✓		**5**