Communication

Mark Scheme 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Communication
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 3

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** takes all the simultaneous digits for one number B1
and 'sends' them one after another (along the transmission line) B1 [2]

(b) 0111 A1 [1]

(ii) 0110 A1 [1]

(c) levels shown

t	0	0.2			0.8	1	
	0	8	7	1		5	8

(–1 for each error or omission) A2
correct basic shape of graph i.e. series of steps M1
with levels staying constant during correct time intervals A1 [4]
(vertical lines in steps do not need to be shown)

(d) increasing number of bits reduces step height M1
increasing sampling frequency reduces step depth / width M1
reproduction of signal is more exact A1 [3]

2 **(a)** e.g. noise can be eliminated / filtered / signal can be regenerated
extra bits can be added to check for errors
multiplexing possible
digital circuits are more reliable / cheaper
data can be encrypted for security
any sensible advantages, 1 each, max. 3 B3 [3]

(b) (i) **1.** higher frequencies can be reproduced B1 [1]

2. smaller changes in loudness / amplitude can be detected B1 [1]

(ii) bit rate $= 44.1 \times 10^3 \times 16$ C1
$= 7.06 \times 10^5\ s^{-1}$
number $= 7.06 \times 10^6 \times 340$
$= 2.4 \times 10^8$ A1 [2]

3 **(a) (i)** signal in one wire (pair) is picked up by a neighbouring wire (pair) B1 [1]

(ii) outer of coaxial cable is earthed B1
outer shields the core from noise / external signals B1 [2]

(b) attenuation per unit length = $1/L \times 10 \lg(P_2/P_1)$ C1
signal power at receiver = $10^{2.5} \times 3.8 \times 10^{-8}$
= 1.2×10^{-5} W C1
attenuation in wire pair = $10 \lg(\{3.0 \times 10^{-3}\} / \{1.2 \times 10^{-5}\})$
= 24 dB C1
attenuation per unit length = 24 / 1.4
= 17 dB km^{-1} A1 [4]
(*other correct methods of calculation are possible)*

4 **(a)** high frequency wave B1
the amplitude or the frequency is varied M1
the variation represents the information signal /
in synchrony with (the displacement of) the information signal. A1 [3]

(b) e.g. shorter aerial required
longer transmission range / lower transmitter power / less attenuation
allows more than one station in a region
less distortion
(*allow any three sensible suggestions, 1 mark each*) B3 [3]

5 **(a) (i)** e.g. linking a (land) telephone to the (local) exchange B1 [1]

(ii) e.g. connecting an aerial to a television B1 [1]

(iii) e.g. linking a ground station to a satellite B1 [1]

(b) attenuation = $10 \lg (P_2 / P_1)$ C
total attenuation = 2.1 × 40 (= 84 dB) C1
$84 = 10 \lg (\{450 \times 10^{-3}\} / P)$
$P = 1.8 \times 10^{-9}$ W A [3]
(*answer 1.1 ×10^8 W scores 1 mark only*)

(ii) maximum attenuation = $10 \lg (\{450 \times 10^{-3}\} / \{7.2 \times 10^{-11}\})$
= 98 dB C1
maximum length = 98/2.1
= 47 km A1 [2]

6 **(a) (i)** no interference (between signals) near boundaries (of cells) B1 [1]

(ii) for large area, signal strength would have to be greater and this could be hazardous to health B1 [1]

(b) mobile phone is sending out an (identifying) signal M1
computer/cellular exchange continuously selects cell/base station with strongest signal A1
computer/cellular exchange allocates (carrier) frequency (and slot) A1 [3]

7 **(a) (i)** loss of (signal) power B1 [1]

(ii) unwanted power (on signal) M1
that is random A1 [2]

(b) for digital, only the 'high' and the 'low' / 1 and 0 are necessary M1
variation between 'highs' and 'lows' caused by noise not required A1 [2]

(c) attenuation = $10\,\text{lg}(P_2 / P_1)$ C1
either $195 = 10\,\text{lg}(\{2.4 \times 10^3\} / P)$
or $-195 = 10\,\text{lg}(P / 2.4 \times 10^3)$ C1
$P = 7.6 \times 10^{-17}$ W A1 [3]