Communication

Mark Scheme 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Communication
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 2

Time Allowed: **64 minutes**

Score: **/53**

Percentage: **/100**

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

1 **(a)** reduction in power (*allow intensity/amplitude*) B [1]

(b) attenuation = 2.4 × 30
= 72 dB A1 [1]

(ii) gain/attenuation/dB = 10 lg(P_2/P_1) C
72 = 10 lg(P_{IN}/P_{OUT}) *or* –72 = 10 lg(P_{OUT}/P_{IN}) C
ratio = 1.6×10^7 A1 [3]

(c) e.g. enables smaller/more manageable numbers to be used
e.g. gains in dB for series amplifiers are added, not multipli B1 [1]

2 **(a)** **(i)** satellite is in equatorial orbit B1
travelling from west to east B1
period of 24 hours / 1 day B1 [3]

(ii) *either* uplink signal is highly attenuated
or signal is highly amplified (before transmission) as downlink signal B1
prevents downlink signal swamping the uplink signal B1 [2]

(b) speed of signal is same order of magnitude in both systems B1
optic fibre link (much) shorter than via satellite M1
time delay using optic fibre is less A1 [3]

3 **(a)** left-hand bit underlined — B1 [1]

(b) 1010, 1110, 1111, 1010, 1001
(*5 correct scores 2, 4 correct scores 1*) — A [2]

(c) significant changes in detail of *V* between samplings — M1
so frequency too low — A1 [2]

4 **(a)** e.g. logarithm provides a smaller number
gain of amplifiers is series found by addition, (not multiplication)
(*any sensible suggestion*) — B [1]

(b) **(** optic fibre — B1 [1]

(ii) attenuation/dB = 10 lg(P_2/P_1) — C
= 10 lg({6.5×10^{-3}}/{1.5×10^{-15}})
= 126
length = 126 / 1.8
= 70 km — A1 [3]

5 **(a)** **(i)** *either* series of 'highs' and 'lows' *or* two discrete values with no intermediate values — M1 A1 [2]

(ii) e.g. noise can be eliminated (NOT 'no noise')
signal can be regenerated
addition of extra data to check for errors
larger data carrying capacity
cheaper circuits
more reliable circuits (*any three, 1 each*) — B [3]

(b) **(i)** **1.** amplifier [1]

2. digital-to-analogue converter *allow DAC*) — B [1]

(ii) output of ADC is number of digits all at one time — B1
parallel-to-serial sends digits one after another — B1 [2]

6 **(a)** e.g. no / little ionospheric reflection
large information carrying capacity
(*any two sensible suggestions, 1 each*) — B2 [2]

(b) prevents (very) low power signal received at satellite being swamped by high-power transmitted signal — M1 A1 [2]

(c) attenuation / dB = 10 lg(P_2/P_1) — C
185 = 10 lg({3.1×10^3}/P) — C1
$P = 9.8 \times 10^{-16}$ W — A1 [3]

7 **(a)** **(i)** amplitude of the carrier wave varies M1
(in synchrony) with the displacement of the information signal A1 [2]

(ii) e.g. more than one radio station can operate in same region/less interference
enables shorter aerial
increased range/less power required/less attenuation
less distortion
(any two sensible answers, 1 each) B2 [2]

(b) **(** frequency = 909 kHz
wavelength = $(3.0 \times 10^8) / (909 \times 10^3)$
= 330 m A1 [2]

(ii) bandwidth = 18 kHz [1]

(iii) frequency = 9000 Hz [1]

8 **(a)** for received signal, $28 = 10 \lg(P / \{0.36 \times 10^{-6}\})$ C1
$P = 2.3 \times 10^{-4}$ W A1 [2]

(b) loss in fibre $= 10 \lg(\{9.8 \times 10^{-3}\} / \{2.27 \times 10^{-4}\})$
= 16 dB [2]

(c) attenuation per unit length = 16 / 85
= 0.19 dB km^{-1} A1 [1]