Communication

Question paper 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Communication
Sub Topic	
Paper Type	Theory
Booklet	Question paper 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)** State what is meant by the *attenuation* of a signal.

.....

..... [1]

(b) A transmission cable has a length of 30 km. The attenuation per unit length of the cable is 2.4 dB km^{-1}.

Calculate, for a signal being transmitted along the cable,

(i) the total attenuation, in dB,

attenuation = ... dB [1]

(ii) the ratio

$$\frac{\text{input power of signal}}{\text{output power of signal}}.$$

ratio = ... [3]

(c) By reference to your answers in **(b)**, suggest why the attenuation of transmitted signals is usually expressed in dB.

.....

..... [1]

2 Two people, living in different regions of the Earth, communicate either using a link provided by a geostationary satellite or using optic fibres.

(a) **(i)** Explain what is meant by a *geostationary* satellite.

.....

.....

.....

.....

..... [3]

(ii) The uplink frequency for communication with the satellite is 6 GHz and the downlink has a frequency of 4 GHz.

Explain why the frequencies are different.

.....

.....

.....

..... [2]

(b) Comment on the time delays experienced by the two people when communicating either using geostationary satellites or using optic fibres. Explain your answer.

.....

.....

.....

.....

..... [3]

3 The variation with time *t* of the output *V* produced by a microphone is shown in Fig. 11.1.

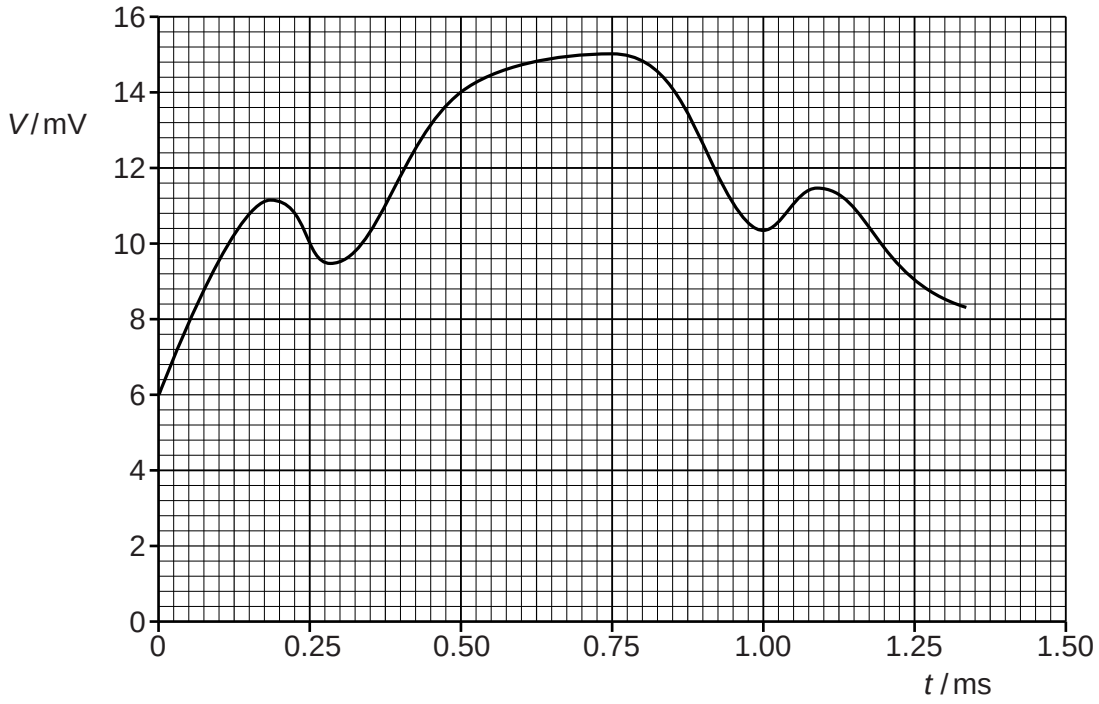

Fig. 11.1

The output is processed by a four-bit analogue-to-digital converter (ADC) that samples the output every 0.25 ms.
The first sample is taken at time $t = 0$ and is shown in Fig. 11.2.

0110					

Fig. 11.2

(a) On Fig. 11.2, underline the most significant bit (MSB) of the sample shown. [1]

(b) Complete Fig. 11.2 for the next five samples. [2]

(c) Explain whether the sampling frequency is adequate to enable detail of the output *V* to be reproduced.

.....

.....

.....[2]

4 **(a)** Suggest why attenuation of a signal in channels of communication is usually measured on a logarithmic rather than a linear scale.

.....

..... [1]

(b) For a particular channel of communication having low attenuation, the input power is 6.5 mW and the attenuation per unit length is 1.8 dB km^{-1}.

(i) Suggest the name of this channel of communication.

..... [1]

(ii) Calculate the distance over which the power of the signal is reduced to 1.5×10^{-15} W.

distance = ... km [3]

5 Data may be transmitted in either analogue or digital form.

(a) State

(i) what is meant by a *digital* signal,

.....

.....

.....[2]

(ii) three advantages of the digital transmission of data when compared to analogue transmission.

1. .....

2. .....

3. .....

[3]

(b) The block diagram of Fig. 11.1 represents the digital transmission of music.

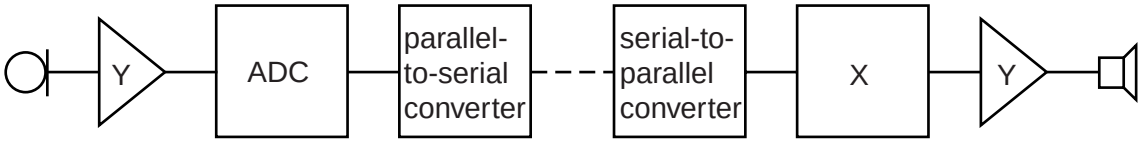

Fig. 11.1

(i) State the name of

1. the blocks labelled Y,

.....[1]

2. the block labelled X.

.....[1]

(ii) Describe the function of the parallel-to-serial converter.

.....

.....

.....[2]

6 **(a)** State two reasons why frequencies in the gigahertz (GHz) range are used in satellite communication.

1. .....

.....

2. .....

.....

[2]

(b) In one particular satellite communication system, the frequency of the signal transmitted from Earth to the satellite (the up-link) is 6 GHz. The frequency of the signal transmitted back to Earth from the satellite (the down-link) is 4 GHz.

Explain why the two signals are transmitted at different frequencies.

.....

.....

.....[2]

(c) A signal transmitted from Earth has a power of 3.1 kW.
This signal, received by a satellite, has been attenuated by 185 dB.

Calculate the power of the signal received by the satellite.

power = ... W [3]

7 A radio station emits an amplitude-modulated wave for the transmission of music.

(a) **(i)** State what is meant by an *amplitude-modulated* (AM) wave.

.....

.....

..... [2]

(ii) Give two reasons why the transmitted wave is modulated, rather than transmitting the information signal directly as a radio wave.

1. .....

.....

2. .....

.....

[2]

(b) The variation with frequency *f* of the amplitude *A* of the transmitted wave is shown in Fig. 11.1.

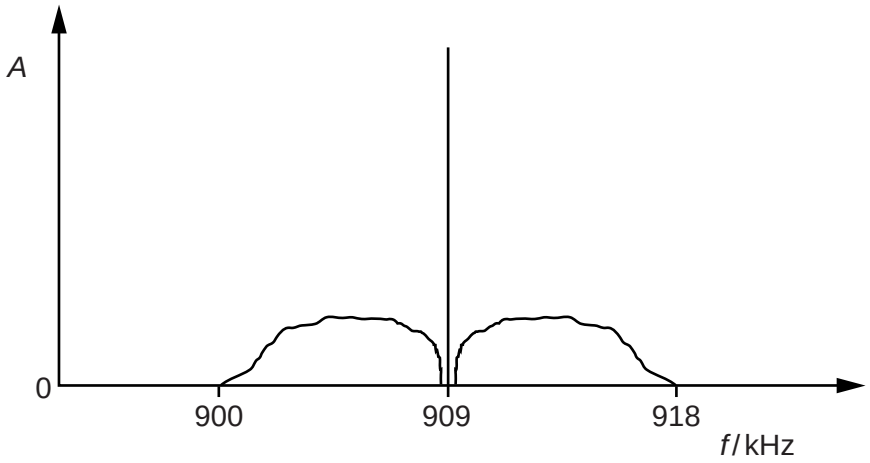

Fig. 11.1

For this transmission, determine

(i) the wavelength of the carrier wave,

wavelength = ... m [2]

(ii) the bandwidth,

bandwidth = ... kHz [1]

(iii) the maximum frequency, in Hz, of the transmitted audio signal.

frequency = ... Hz [1]

8 An optic fibre is used for the transmission of digital telephone signals. The power input to the optic fibre is 9.8 mW. The effective noise level in the receiver circuit is 0.36 μW, as illustrated in Fig. 12.1.

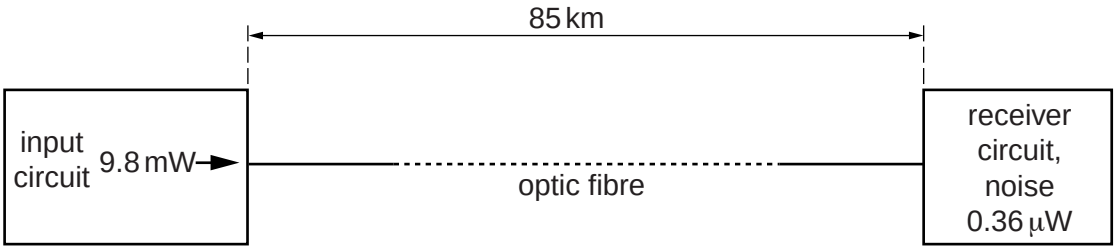

Fig. 12.1

The signal-to-noise ratio at the receiver must not fall below 28 dB.
For this transmission without any repeater amplifiers, the maximum length of the optic fibre is 85 km.

(a) Calculate the minimum input signal power to the receiver.

power = ... W [2]

(b) Use your answer in **(a)** to calculate the attenuation in the fibre.

attenuation = ... dB [2]

(c) Determine the attenuation per unit length of the fibre.

attenuation per unit length = ... dB km^{-1} [1]