Communication

Question paper 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Communication
Sub Topic	
Paper Type	Theory
Booklet	Question paper 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 The digital transmission of speech may be represented by the block diagram of Fig. 12.1.

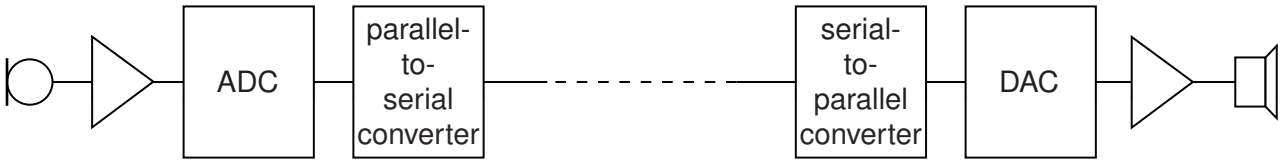


Fig. 12.1

(a) State the purpose of the parallel-to-serial converter.

.....

.....

..... [2]

(b) Part of the signal from the microphone is shown in Fig. 12.2.

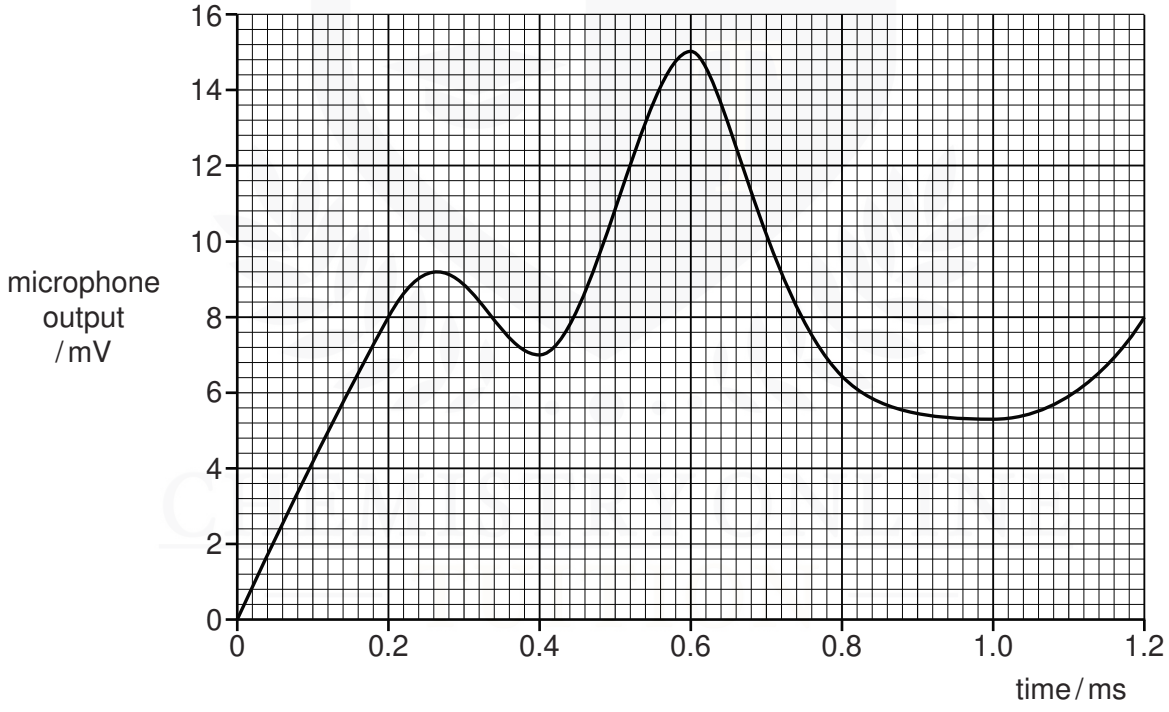


Fig. 12.2

The ADC (analogue-to-digital converter) samples the analogue signal at a frequency of 5.0 kHz.
Each sample from the ADC is a four-bit digital number where the smallest bit represents 1.0 mV.
The first sample is taken at time zero.

Use Fig. 12.2 to determine the four-bit digital number produced by the ADC at times

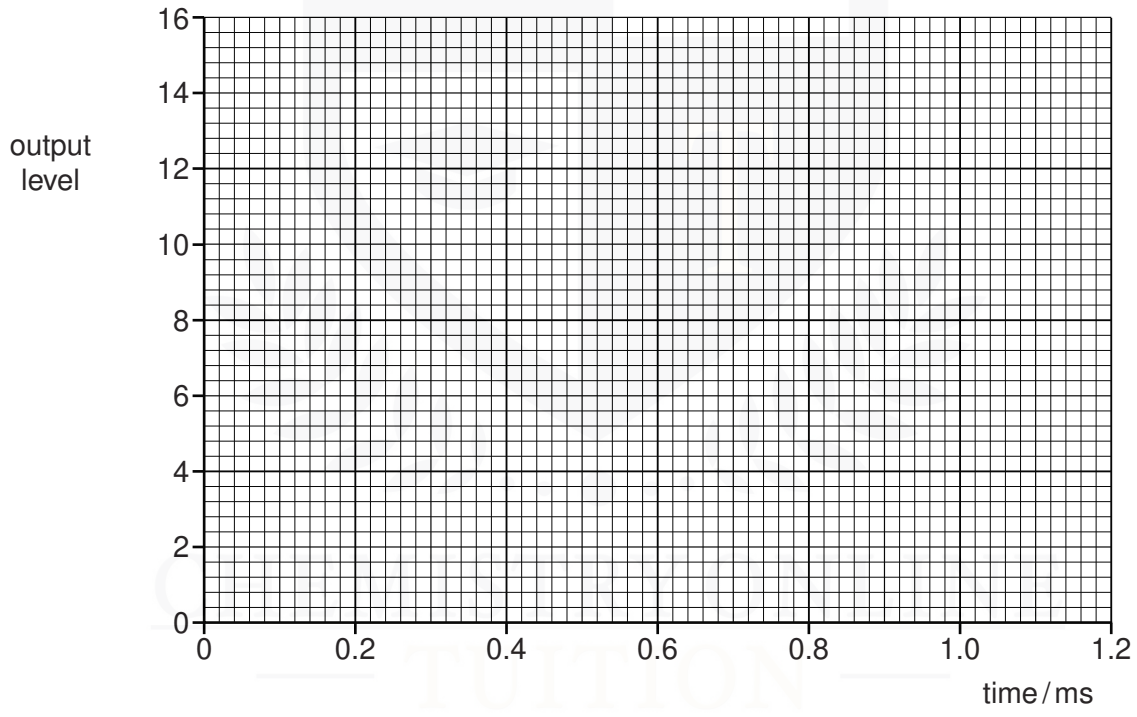
(i) 0.4 ms,

..... [1]

(ii) 0.8 ms.

..... [1]

(c) The digital signal is transmitted and then converted to an analogue form by the DAC (digital-to-analogue converter).
Using data from Fig. 12.2, draw, on the axes of Fig. 12.3, the output level of the transmitted analogue signal for time zero to time 1.2 ms.



[4]

Fig. 12.3

(d) State and explain the effect on the transmitted analogue waveform of increasing, for the ADC and the DAC, both the sampling frequency and the number of bits in each sample.

.....

.....

.....

..... [3]

2 **(a)** In modern communications systems, the majority of data is transmitted in digital form rather than analogue form.
Suggest three advantages of the transmission of data in digital form.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

(b) A recording is made of some music. For this recording, the music is sampled at a rate of 44.1 kHz and each sample consists of a 16-bit word.

(i) Suggest the effect on the quality of the recording of

1. sampling at a high frequency rather than a lower frequency,

.....

.....[1]

2. using a long word length rather than a shorter word length.

.....

.....[1]

(ii) The recording lasts for a total time of 5 minutes 40 seconds.
Calculate the number of bits generated during the recording.

number = ...[2]

3 (a) Wire pairs used for the transmission of telephone signals are subject to cross-linking.

(i) Explain what is meant by *cross-linking*.

.....

.....[1]

(ii) Suggest why cross-linking in coaxial cables is much less than in wire pairs.

.....

.....

.....[2]

(b) A wire pair has a length of 1.4 km and is connected to a receiver, as illustrated in Fig. 12.1.

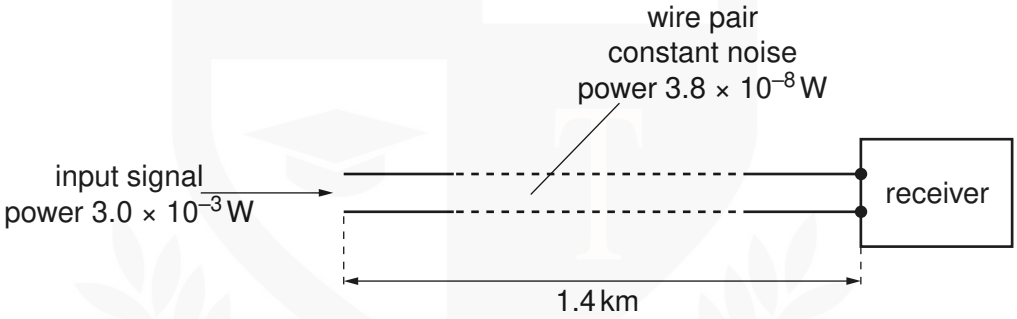


Fig. 12.1

The constant noise power in the wire pair is 3.8×10^{-8} W.
For an input signal to the wire pair of 3.0×10^{-3} W, the signal-to-noise ratio at the receiver is 25 dB.

Calculate the attenuation per unit length for the wire pair.

attenuation per unit length = ... dB km^{-1} [4]

4 In commercial radio, transmissions are made by means of carrier waves that are modulated by the audio signals.

(a) State what is meant by a *modulated carrier* wave.

.....

.....

.....

.....[3]

(b) State three reasons why modulated carrier waves are used, rather than the direct transmission of electromagnetic waves having audio frequencies.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

5 **(a)** Suggest applications, one in each case, for the transmission of signals using

(i) a wire pair,

.....[1]

(ii) a coaxial cable,

.....[1]

(iii) a microwave link.

.....[1]

(b) A cable used for the transmission of a signal has an attenuation per unit length of 2.1 dB km^{-1}. There are no amplifiers along the cable.
The input power of the signal is 450 mW.

(i) Calculate the output power of the signal for the cable of length 40 km.

output power = ... W [3]

(ii) The minimum acceptable signal power in the cable is 7.2×10^{-11} W.
Calculate the maximum uninterrupted length of the cable.

length = ... km [2]

6 **(a)** In a mobile phone system, the area covered by the system is divided into a number of cells.
For this system, explain why

(i) neighbouring cells use different carrier frequencies,

.....

..... [1]

(ii) each cell has a limited area, even in sparsely populated regions.

.....

..... [1]

(b) A mobile phone handset is left switched on.
Explain why, although a call is not being made, the computer at the cellular exchange is still operating for this phone.

.....

.....

.....

..... [3]

7 A signal that is transmitted over a long distance will be attenuated and it will pick up noise.

(a) State what is meant by

(i) *attenuation*,

.....

..... [1]

(ii) *noise*.

.....

.....

..... [2]

(b) Explain why regenerator amplifiers do not amplify the noise that has been picked up on digital signals.

.....

.....

..... [2]

(c) A transmitter on Earth produces a signal of power 2.4 kW. This signal, when received by a satellite, is attenuated by 195 dB.

Calculate the signal power received by the satellite.

power = ... W [3]