Q1.

13 Fig. 13.1 shows the variation with time t of part of the signal voltage V produced by a microphone.

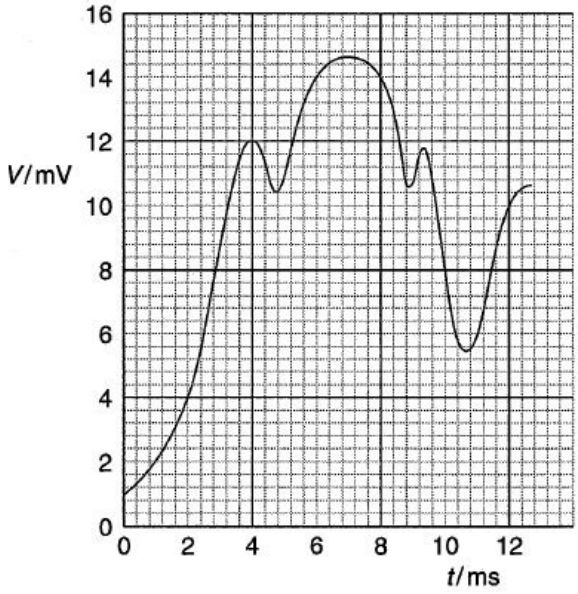


Fig. 13.1

The signal voltage is to be digitised using a 4-bit analogue-to-digital converter (ADC), sampling at 2.0 ms intervals.

(a) The first sample is taken at time $t = 0$. Complete Fig. 13.2 to show the signal voltage and the corresponding binary number at the sampling times shown. [4]

sampling time / ms	signal voltage / mV	binary number
0	1.0	0001
2	.....	.....
4	.....	.....
6	.....	.....
8	.....	.....
10	.....	.....
12	.....	.....

Fig. 13.2

(b) The digitised signal voltage is transmitted and then converted back to an analogue signal using a digital-to-analogue converter (DAC). On Fig. 13.3, draw the variation with time t of the received analogue signal V_r. [2]

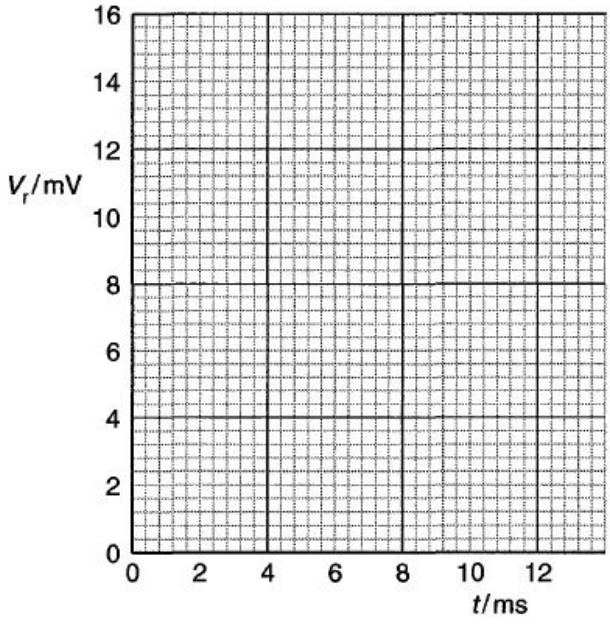


Fig. 13.3

(c) State **two** changes, giving a reason for each, that can be made so as to improve the quality of the received analogue signal.

1. .....

.....

.....

2. .....

.....

..... [4]

Q2.

14 (a) Draw a labelled diagram of a section through a coaxial cable. [2]

(b) State **three** advantages of a coaxial cable compared with a wire pair for the transmission of an electrical signal.

1. .....

2. .....

3. .....[3]

Q3.

15 A radio signal may be transmitted between a transmitter and a receiving aerial by means of sky waves, ground (surface) waves or space waves. Complete Fig. 15.1 by giving a typical wavelength and the maximum transmission range for each type of wave. [5]

type	wavelength / m	range
sky wave	.....	.....
ground (surface) wave	.....	.....
space wave	.....	.....

Fig. 15.1

Q4.

Use

10 An analogue signal is sampled at a frequency of 5.0 kHz. Each sample is converted into a four-bit number and transmitted as a digital signal.
Fig. 10.1 shows part of the digital signal.

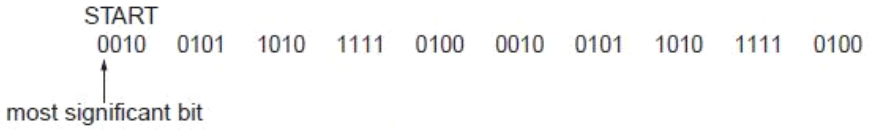
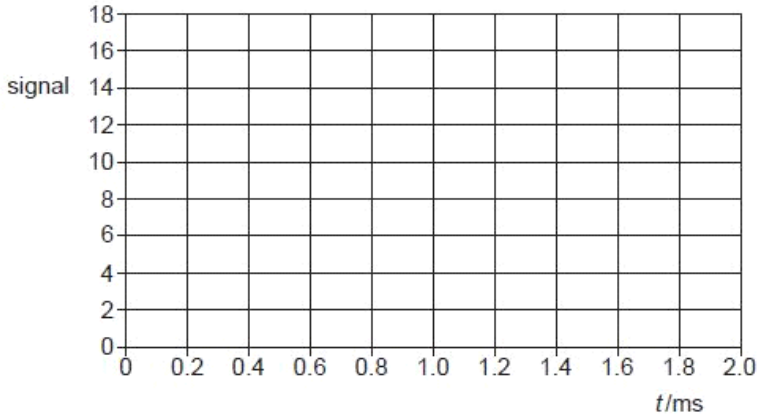


Fig. 10.1

The digital signal is transmitted and is finally converted into an analogue signal.

(a) On the axes of Fig. 10.2, sketch a graph to show the variation with time *t* of this final analogue signal.



[4]

Fig. 10.2

(b) Suggest two ways in which the reproduction of the original analogue signal could be improved.

1. .....

.....

2. .....

..... [2]

Q5.

11 (a) Fig. 11.1 is a block diagram showing part of a mobile phone handset used for sending a signal to a base station.

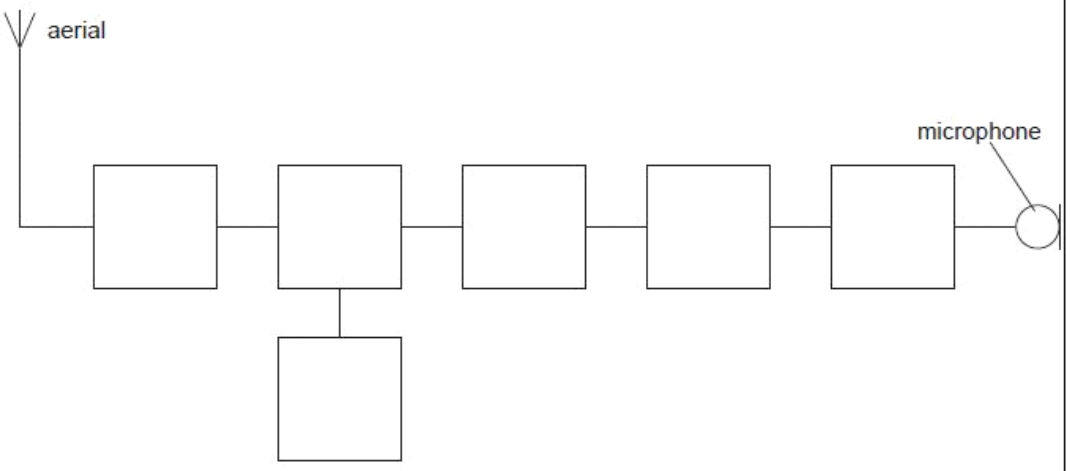


Fig. 11.1

Complete Fig. 11.1 by labelling each of the blocks. [3]

(b) Whilst making a call using a mobile phone fitted into a car, a motorist moves through several different cells. Explain how reception of signals to and from the mobile phone is maintained.

.....

.....

.....

.....

.....

.....

..... [4]

Q6.

11 (a) (i) Describe what is meant by *frequency modulation*.

.....

.....

.....[2]

(ii) A sinusoidal carrier wave has frequency 500 kHz and amplitude 6.0 V. It is to be frequency modulated by a sinusoidal wave of frequency 8 kHz and amplitude 1.5 V. The frequency deviation of the carrier wave is 20 kHz V^{-1}.
Describe, for the carrier wave, the variation (if any) of

1. the amplitude,

.....

.....[1]

2. the frequency.

.....

.....

.....

.....[3]

(b) State two reasons why the cost of FM broadcasting to a particular area is greater than that of AM broadcasting.

1 .....

.....

2 .....

.....[2]

Q7.

12 **(a)** Optic fibre transmission has, in some instances, replaced transmission using co-axial cables and wire pairs.
Optic fibres have negligible cross-talk and are less noisy than co-axial cables.
Explain what is meant by

(i) cross-talk,

.....

.....

.....[2]

(ii) noise.

.....

.....

.....[2]

(b) An optic fibre has a signal attenuation of $0.20\,\text{dB}\,\text{km}^{-1}$.
The input signal to the optic fibre has a power of 26 mW. The receiver at the output of the fibre has a noise power of 6.5 μW.
Calculate the maximum uninterrupted length of optic fibre given that the signal-to-noise ratio at the receiver must not be less than 30 dB.

length = ... km [5]

Q8.

12 A signal is to be transmitted along a cable system of total length 125 km.
The cable has an attenuation of 7 dB km^{-1}. Amplifiers, each having a gain of 43 dB, are placed at 6 km intervals along the cable, as illustrated in Fig. 12.1.

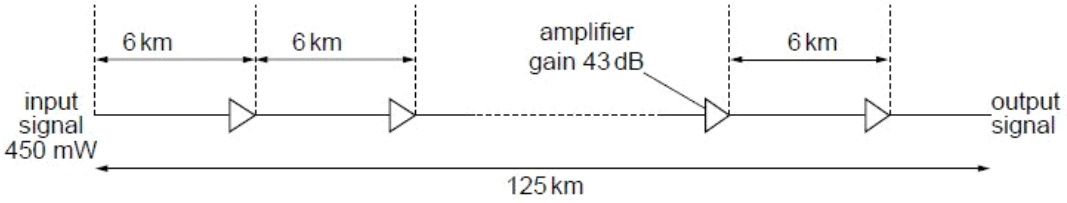


Fig. 12.1

(a) State what is meant by the *attenuation* of a signal.

.....

..... [1]

(b) Calculate

(i) the total attenuation caused by the transmission of the signal along the cable,

attenuation = ... dB [1]

(ii) the total signal gain as a result of amplification by all of the amplifiers along the cable.

gain = ... dB [1]

(c) The input signal has a power of 450 mW. Use your answers in **(b)** to calculate the output power of the signal as it leaves the cable system.

power = ... mW [3]

Q9.

13 **(a)** Fig. 13.1 is a block diagram illustrating part of a mobile phone handset used for receiving a signal from a base station.

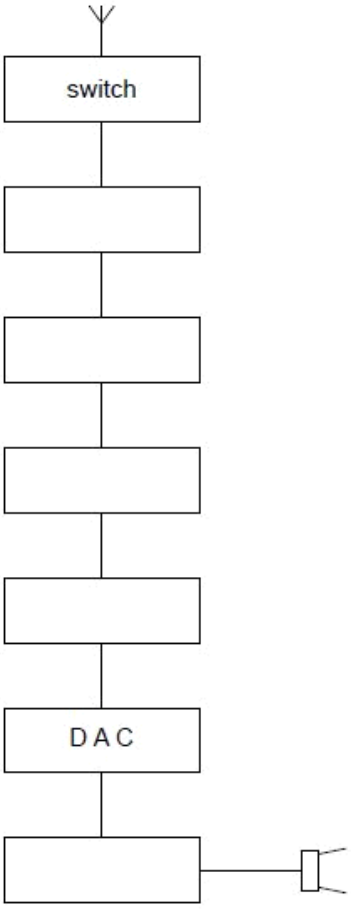


Fig. 13.1

Complete Fig. 13.1 by labelling each of the blocks. [4]

(b) Explain the role of the base station and the cellular exchange when a mobile phone is switched on and before a call is made or received.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Q10.

11 Many radio stations now broadcast on FM rather than on AM. In general, FM is broadcast at much higher frequencies than AM.

For Examiner's Use

(a) Explain what is meant by *FM* (*frequency modulation*).

.....

.....

.....

.....[2]

(b) State two advantages and two disadvantages of FM transmissions when compared with AM transmissions.

advantages of FM transmissions

1. .....

.....

2. .....

.....

disadvantages of FM transmissions

1. .....

.....

2. .....

.....

[4]

Q11.

12 A ground station on Earth transmits a signal of frequency 14 GHz and power 18 kW towards a communications satellite orbiting the Earth, as illustrated in Fig. 12.1.

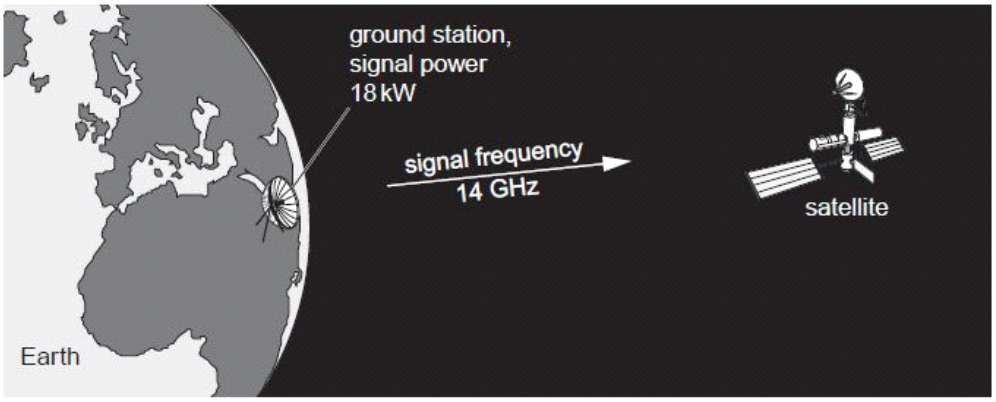


Fig. 12.1

The loss in signal power between the ground station and the satellite is 190 dB.

(a) Calculate the power of the signal received by the satellite.

power = ... W [3]

(b) The signal received by the satellite is amplified and transmitted back to Earth.

(i) Suggest a frequency for the signal that is sent back to Earth.

frequency = ... GHz [1]

(ii) Give a reason for your answer in **(i)**.

.....

.....[1]

Q12.

12 A telephone link between two towns is to be provided using an optic fibre. The length of the optic fibre between the two towns is 75 km.

(a) State two changes that occur in a signal as it is transmitted along an optic fibre.

1. .....

.....

2. .....

.....

[2]

(b) The optic fibre has an attenuation per unit length of 1.6 dB km^{-1}. The minimum permissible signal-to-noise power ratio in the fibre is 25 dB. The average noise power in the optic fibre is 6.1×10^{-19} W.

(i) Suggest one reason why power ratios are expressed in dB.

.....

..... [1]

(ii) The signal input power to the optic fibre is designed to be 6.5 mW.
Determine whether repeater amplifiers are necessary in the optic fibre between the two towns.

[5]

Q13.

11 **(a)** Describe what is meant by *frequency modulation* (*FM*).

For Examiner's Use

.....

.....

.....[2]

(b) A sinusoidal carrier wave has a frequency of 600 kHz and an amplitude of 5.0 V.
The carrier wave is frequency modulated by a sinusoidal wave of frequency 7.0 kHz and amplitude 2.0 V.
The frequency deviation of the carrier wave is 20 kHz V^{-1}.

Determine, for the modulated carrier wave,

(i) the amplitude,

amplitude = ... V [1]

(ii) the maximum frequency,

maximum frequency = ... Hz [1]

(iii) the minimum frequency,

minimum frequency = ... Hz [1]

(iv) the number of times per second that the frequency changes from maximum to minimum and then back to maximum.

number = ...[1]

Q14.

12 Many television receivers are connected to an aerial using a coaxial cable. Such a cable is illustrated in Fig. 12.1.

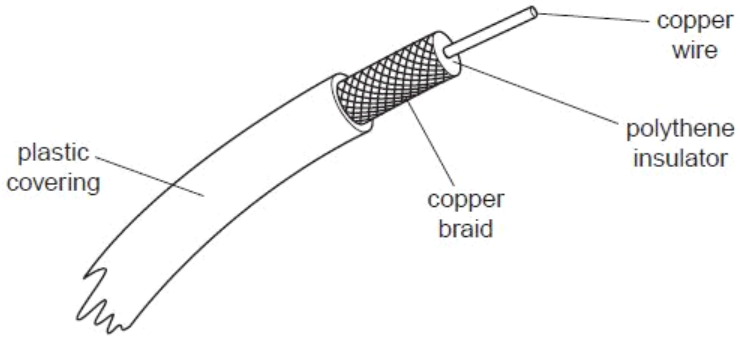


Fig. 12.1

(a) State two functions of the copper braid.

1. .....

.....

2. .....

.....

[2]

(b) Suggest two reasons why a coaxial cable is used, rather than a wire pair, to connect the aerial to the receiver.

1. .....

.....

2. .....

.....

[2]

(c) A coaxial cable has an attenuation per unit length of 200 dB km^{-1}.
The length of the co-axial cable between an aerial and the receiver is 12 m.
Calculate the ratio

$$\frac{\text{input signal power to coaxial cable}}{\text{output signal power from coaxial cable}}.$$

ratio = ...[3]

Q15.

11 The use of ionospheric reflection of radio waves for long-distance communication has, to a great extent, been replaced by satellite communication.

Fo
Exami
Us

(a) State and explain two reasons why this change has occurred.

1. .....

.....

.....

2. .....

.....

..... [4]

(b) The radio link between a geostationary satellite and Earth may be attenuated by as much as 190 dB.
Suggest why, as a result of this attenuation, the uplink and downlink frequencies must be different.

.....

.....

.....

..... [2]

Q16.

12 **(a)** The signal-to-noise ratio in an optic fibre must not fall below 24 dB. The average noise power in the fibre is 5.6×10^{-19} W.

F
Exam
U

(i) Calculate the minimum effective signal power in the optic fibre.

power = ... W [3]

(ii) The fibre has an attenuation per unit length of 1.9 dB km^{-1}.
Calculate the maximum uninterrupted length of fibre for an input signal of power 3.5 mW.

length = ... km [3]

(b) Suggest why infra-red radiation, rather than ultraviolet radiation, is used for long-distance communication using optic fibres.

.....

..... [1]

Q17.

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

For Examiner Use

(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]

Q18.

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

For Examiner Use

(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]

Q19.

12 An incomplete simplified block diagram of the circuitry for a mobile-phone handset is shown in Fig. 12.1.

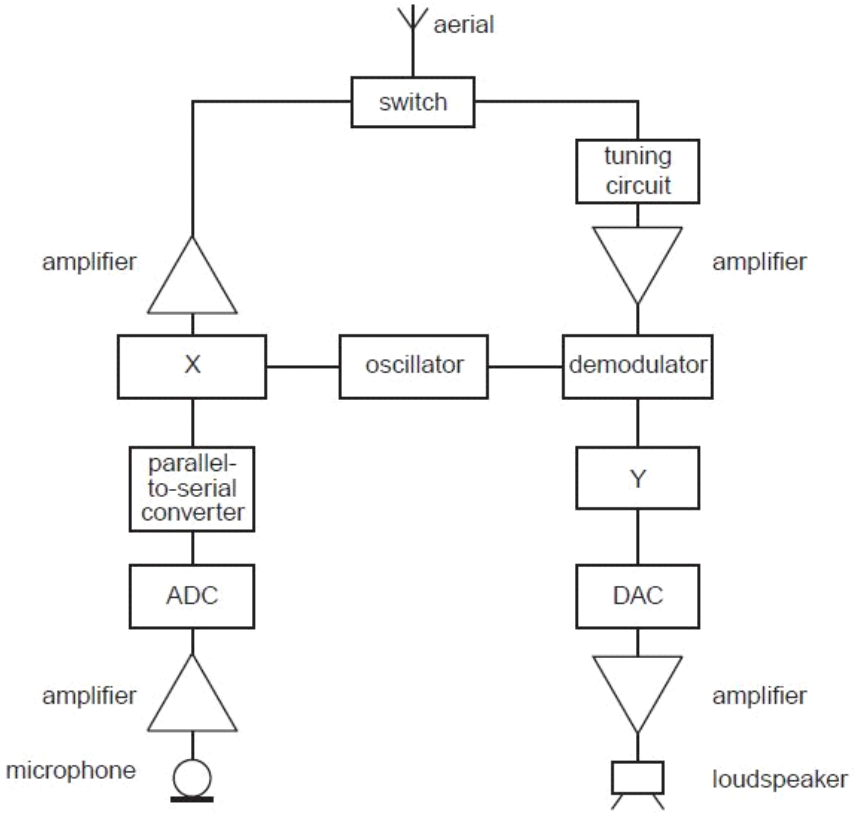


Fig. 12.1

(a) State the name of the block labelled

(i) X,

.....[1]

(ii) Y.

.....[1]

(b) Explain the purpose of

(i) the switch,

.....

.....[1]

(ii) the parallel-to-serial converter.

.....

.....

.....[2]

Q20.

11 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.

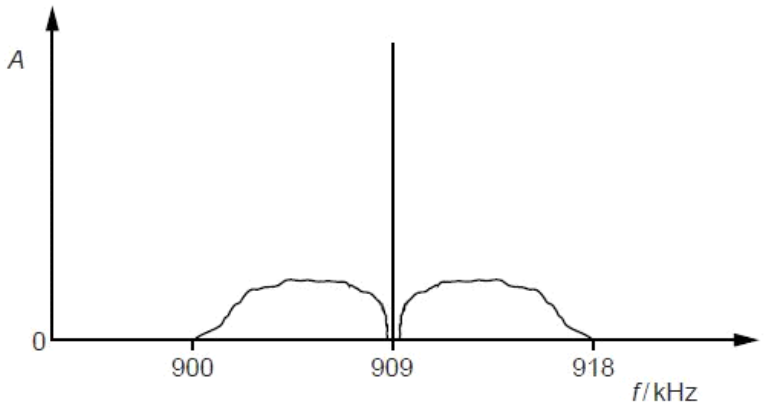


Fig. 11.1

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]

Q21.

12 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.

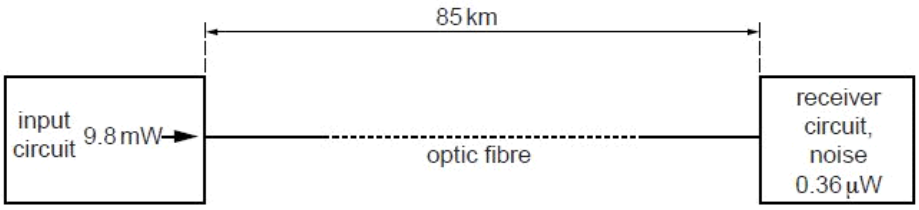


Fig. 12.1

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]

Q22.

12 The digital transmission of speech may be represented by the block diagram of Fig. 12.1.

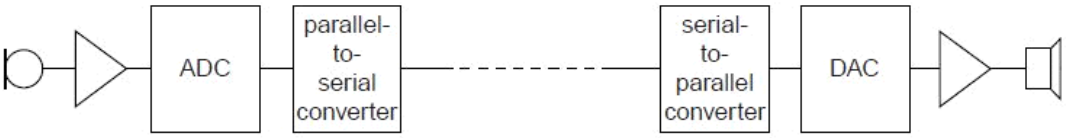


Fig. 12.1

(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.

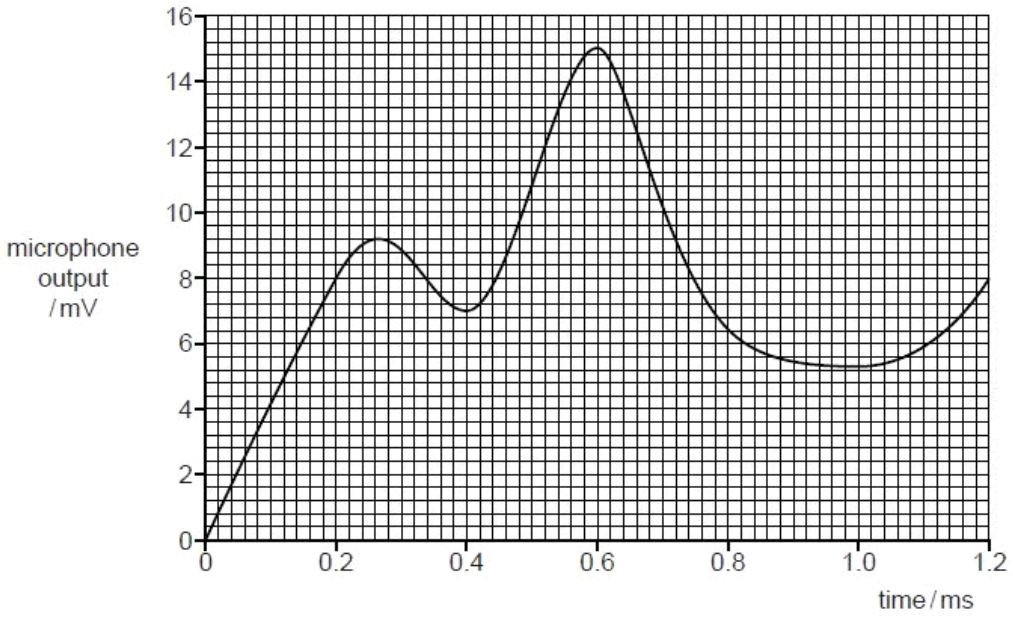


Fig. 12.2

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.

For Examiner's Use

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

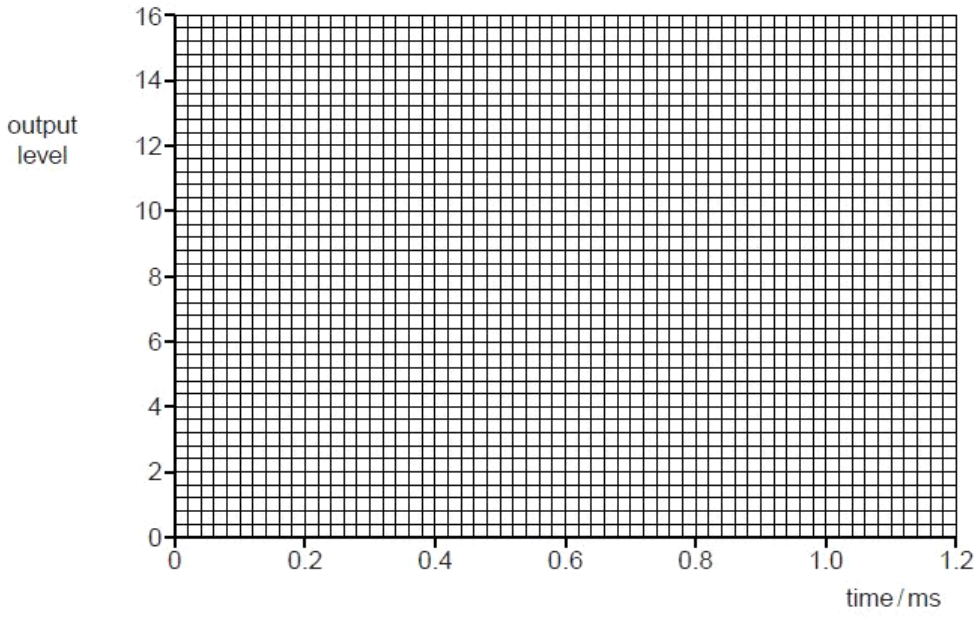
(i) 0.4 ms,

..... [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]

Q23.

10 Fig. 10.1 shows the variation with frequency f of the power P of a radio signal.

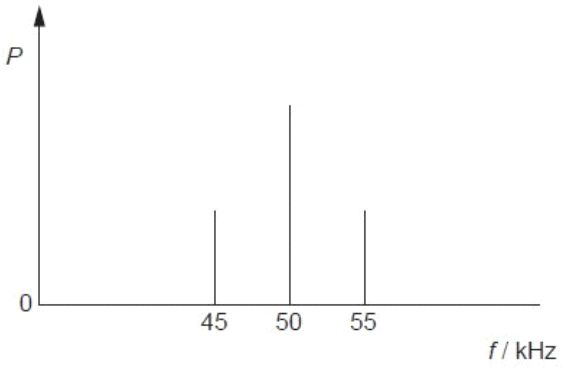


Fig. 10.1

(a) State the name of

(i) the type of modulation of this radio signal,

.....[1]

(ii) the component of frequency 50 kHz,

.....[1]

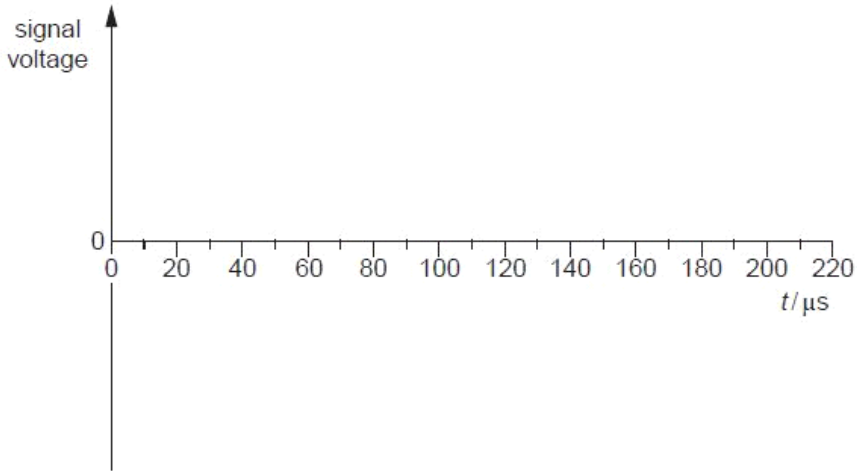
(iii) the components of frequencies 45 kHz and 55 kHz.

.....[1]

(b) State the bandwidth of the radio signal.

bandwidth = ...kHz [1]

(c) On the axes of Fig. 10.2, sketch a graph to show the variation with time t of the signal voltage of Fig. 10.1.



[3]

Q24.

11 In a cellular phone network, a country is divided into a number of cells, each with its own base station.
Fig. 11.1 shows a number of these base stations and their connection to a cellular exchange.

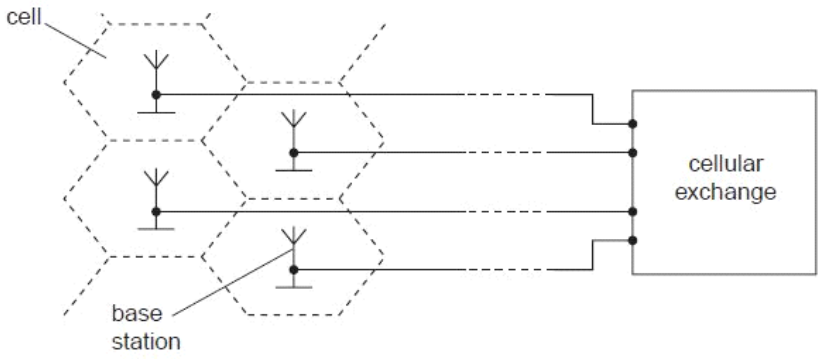


Fig. 11.1

(a) Suggest and explain why the country is divided into a number of cells.

.....

.....

.....

.....[2]

(b) Outline what happens at the base station and the cellular exchange when a mobile phone handset is switched on, before a call is made.

.....

.....

.....

.....

.....

.....

.....[4]

Q25.

9 Different frequencies and wavelengths are used in different channels of communication. Suggest why

(a) infra-red radiation rather than visible light is usually used with optic fibres,

.....

.....

.....[2]

(b) the base stations in mobile phone networks operate on UHF,

.....

.....

.....[2]

(c) for satellite communication, frequencies of the order of GHz are used, with the uplink having a different frequency to the downlink.

.....

.....

.....[2]

Q26.

12 **(a)** State and explain two advantages of the transmission of information in digital, rather than analogue, form.

For Examiner Use

1. .....

.....

.....

2. .....

.....

.....

[4]

(b) Convert

(i) the decimal number 13 to a four-bit digital number,

..... [1]

(ii) the digital number 0101 to a decimal number.

..... [1]

(c) An analogue signal is to be transmitted digitally. A block diagram for part of the transmission system is shown in Fig. 12.1.

Fig. 12.1

(i) Complete Fig. 12.1 by labelling block X and block Y. [2]

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

.....

.....

..... [2]

(d) The original analogue signal is shown in Fig. 12.2. The recovered signal after transmission is shown in Fig. 12.3.

For Examiner's Use

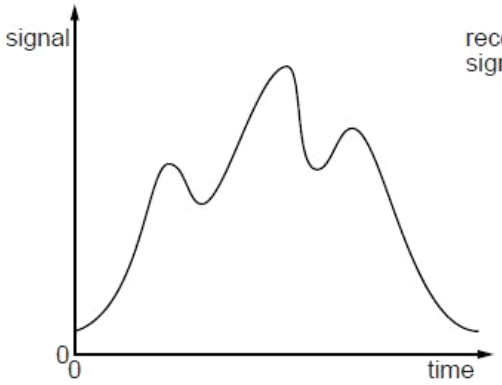


Fig. 12.2

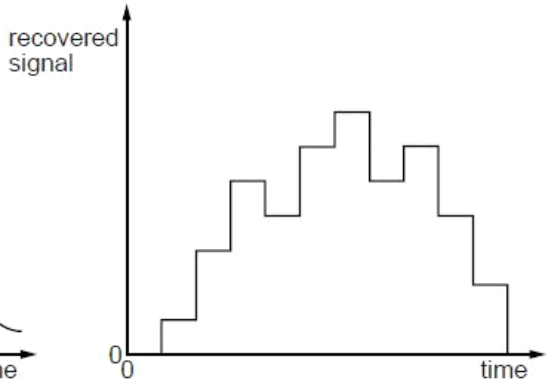


Fig. 12.3

Suggest and explain two ways in which the reproduction of the input signal may be improved.

1. .....

.....

.....

2. .....

.....

.....

[4]

Q27.

11 The variation with time of the signal transmitted from an aerial is shown in Fig. 11.1.

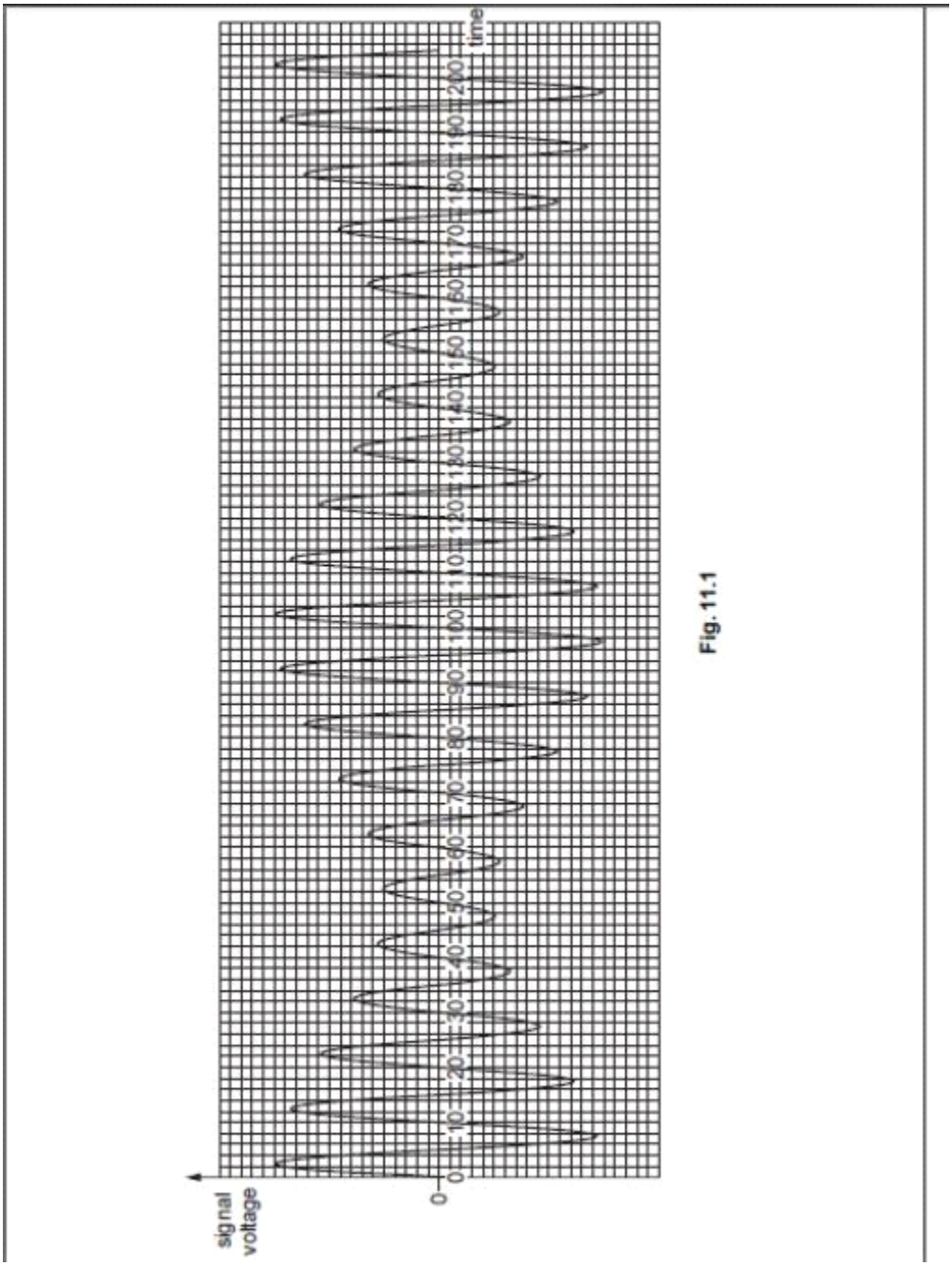

time
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
0
signal voltage

Fig. 11.1

(a) State the name of this type of modulated transmission.

..... [1]

(b) Use Fig. 11.1 to determine the frequency of

(i) the carrier wave,

frequency = ... Hz [2]

(ii) the information signal.

frequency = ... Hz [1]

(c) **(i)** On the axes of Fig. 11.2, draw the frequency spectrum (the variation with frequency of the signal voltage) of the signal from the aerial. Mark relevant values on the frequency axis.

Fig. 11.2

[3]

(ii) Determine the bandwidth of the signal.

bandwidth = ... Hz [1]

Q28.

12 A block diagram representing part of a mobile phone network is shown in Fig. 12.1.

For Examiner Use

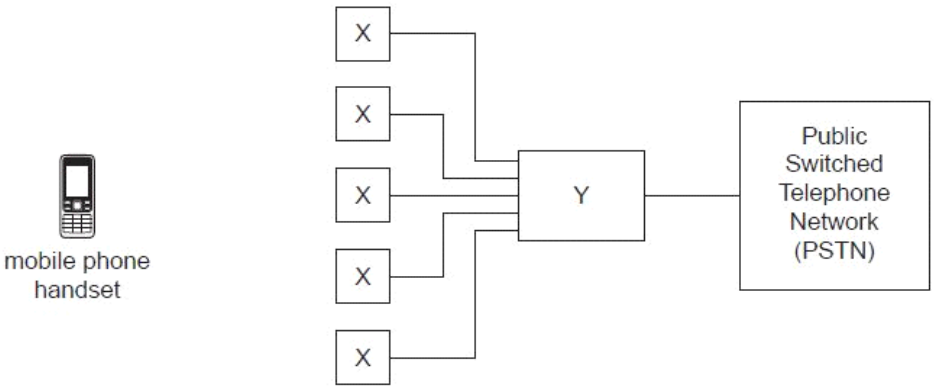


Fig. 12.1

(a) State what is represented by

(i) the blocks labelled X,

..... [1]

(ii) the block labelled Y.

..... [1]

(b) A user of a mobile phone is making a call.

Explain the role of the components in the boxes labelled X and Y during the call.

.....

.....

.....

.....

.....

.....

.....

..... [5]

Q29.

11 **(a)** Wire pairs provide one means of communication but they are subject to high levels of noise and attenuation.
Explain what is meant by

For Examiner's Use

(i) *noise*,

.....

.....[1]

(ii) *attenuation*.

.....

.....[1]

(b) A microphone is connected to a receiver using a wire pair, as shown in Fig. 11.1.

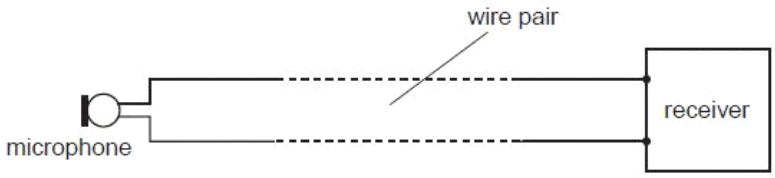


Fig. 11.1

The wire pair has an attenuation per unit length of 12 dB km^{-1}. The noise power in the wire pair is 3.4×10^{-9} W.
The microphone produces a signal power of 2.9 μW.

(i) Calculate the maximum length of the wire pair so that the minimum signal-to-noise ratio is 24 dB.

length = ... m [4]

(ii) Communication over distances greater than that calculated in **(i)** is required.
Suggest how the circuit of Fig. 11.1 may be modified so that the minimum signal-to-noise ratio at the receiver is not reduced.

.....

.....

.....[2]

Q30.

12 **(a)** Outline the principles of the use of a geostationary satellite for communication on Earth.

For Examin Use

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) Polar-orbiting satellites are also used for communication on Earth.
State and explain one advantage and one disadvantage of polar-orbiting satellites as compared with geostationary satellites.

For Examiner's Use

advantage: .....

.....

.....

.....

disadvantage: .....

.....

.....

.....

[4]

Q31.

12 **(a)** Data may be transmitted as an analogue signal or as a digital signal.

For Examiner Use

(i) Explain what is meant by

1. an *analogue* signal,

.....

.....

.....

2. a *digital* signal.

.....

.....

.....

[3]

(ii) State two advantages of the transmission of data in digital form.

1. .....

.....

2. .....

.....

[2]

(b) The block diagram of Fig. 12.1 represents a system for the digital transmission of analogue data.

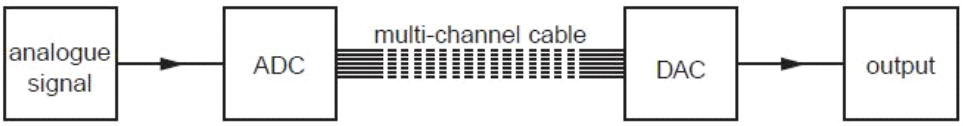


Fig. 12.1

(i) Describe the function of the ADC (analogue-to-digital converter).

.....

.....

.....[2]

(ii) Suggest why the transmission cable has a number of channels.

.....

..... [1]

Q32.

10 **(a)** Cable television uses optic fibres for the transmission of signals.
Suggest four advantages of optic fibres over coaxial cables for the transmission of data.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(b) Electromagnetic radiation of wavelength 1310 nm is frequently used for optic fibre communication, rather than visible light.

(i) State the region of the electromagnetic spectrum in which radiation of wavelength 1310 nm is found.

.....[1]

(ii) Suggest why this radiation is used, rather than visible light.

.....

.....[1]

(c) An optic fibre has an attenuation per unit length of $0.2\,\text{dB km}^{-1}$.
A signal is transmitted along the optic fibre of length 30 km to a receiver. The noise power at the receiver is $9.3\,\mu\text{W}$.
The minimum acceptable signal-to-noise ratio at the receiver is 26 dB.

Calculate

(i) the minimum signal power at the receiver,

power = ... W [2]

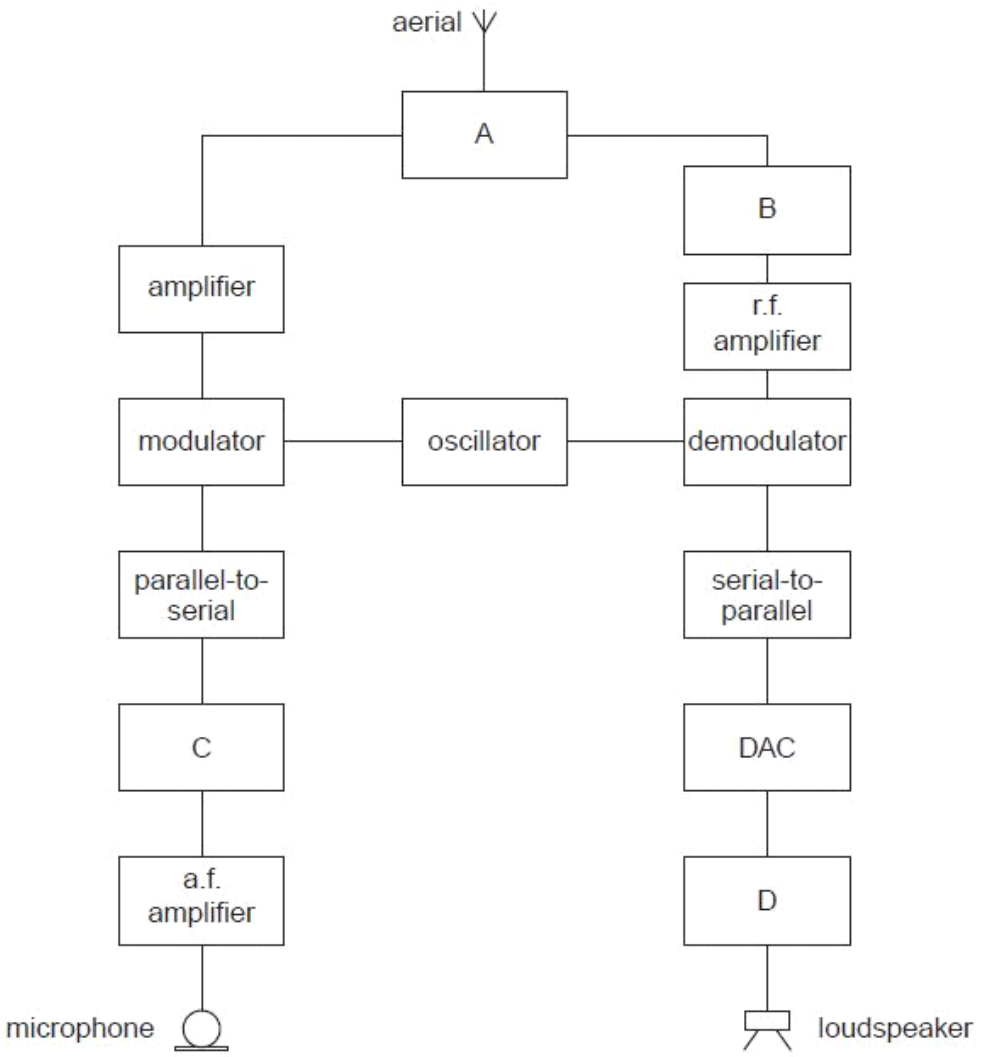
For Examin Use

(ii) the minimum input signal power to the optic fibre.

power = ...W [2]

Q33.

11 A simplified block diagram of a mobile phone handset is shown in Fig. 11.1.



(a) Name and state the function of

(i) block A,

.....

.....

.....[2]

(ii) block B,

.....

.....

.....[2]

(iii) block C,

.....

.....

.....[2]

(iv) block D.

.....

.....

.....[2]

(b) Give two reasons why communication between a mobile phone handset and the base station is conducted using UHF.

1. .....

.....

2. .....

.....

[2]

For Examiner's Use

Q34.

12 In a cellular phone network, a region is divided into a number of cells, each with its own base station.

For Examin Use

(a) Suggest and explain two reasons why a region is divided into a number of cells.

1. .....

.....

.....

2. .....

.....

.....

[4]

(b) A passenger in a car is using a mobile phone as the car moves across several cells. Outline how it is ensured that the phone call is continuous.

.....

.....

.....

.....

..... [4]

Q35.

11 **(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]

Q36.

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

For Examiner's Use

(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.

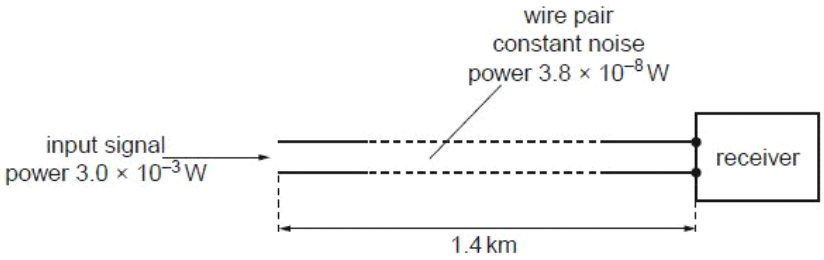


Fig. 12.1

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]

Q37.

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

For Examiner's Use

(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]

Q38.

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

For Examiner's Use

(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]

Q39.

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

For Examiner's Use

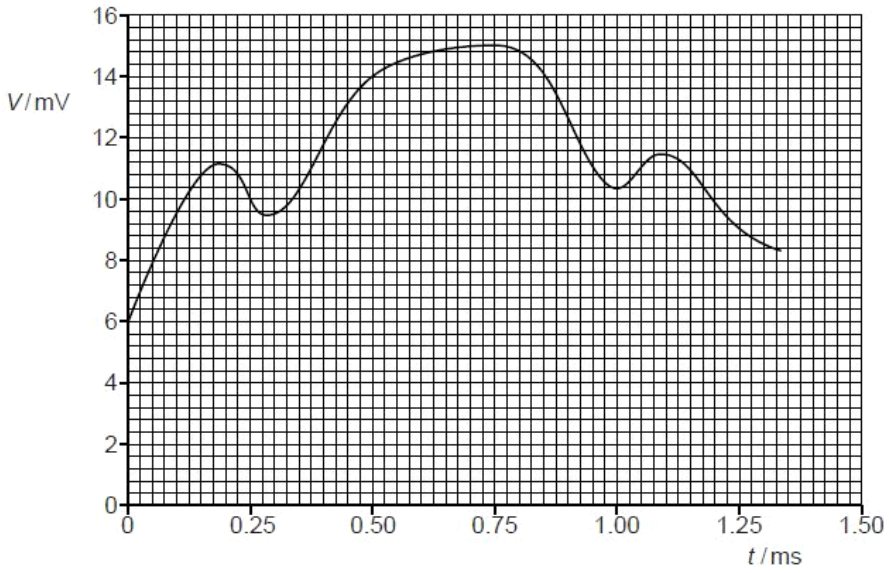


Fig. 11.1

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]

Q40.

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

For Examiner's Use

.....

.....[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]

Q41.

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

For Examiner's Use

(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.

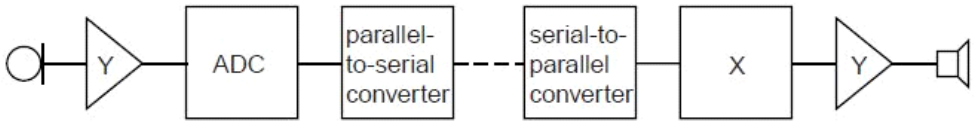


Fig. 11.1

(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]

Q42.

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

For Examiner's Use

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]

Q43.

13 The signal from a microphone is to be transmitted in digital form. A block diagram of part of the transmission system is shown in Fig. 13.1.

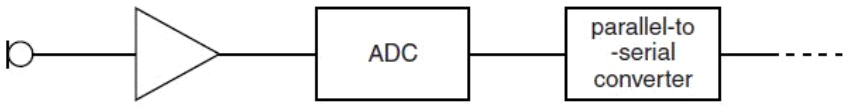


Fig. 13.1

(a) Suggest two advantages of the transmission of a signal in digital form rather than in analogue form.

1. .....

.....

2. .....

.....
[2]

(b) State the function of the parallel-to-serial converter.

.....

.....

..... [2]

(c) In a particular telephone system, the sampling frequency is 8 kHz. In the manufacture of a compact disc, the sampling frequency is approximately 44 kHz.

Suggest and explain why the sampling frequency is much higher for the compact disc.

.....

.....

.....

.....

..... [3]

Q44.

14 **(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]

Q45.

12 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]

Q46.

12 **(a)** Information may be carried by different channels of communication.

State one application, in each case, where information is carried using

(i) microwaves,

.....

..... [1]

(ii) coaxial cables,

.....

..... [1]

(iii) wire pairs.

.....

..... [1]

(b) A station on Earth transmits a signal of initial power 3.1 kW to a geostationary satellite. The attenuation of the signal received by the satellite is 190 dB.

(i) Calculate the power of the signal received by the satellite.

power = ... kW [2]

(ii) By reference to your answer in **(i)**, state and explain the changes made to the signal before transmission back to Earth.

.....

.....

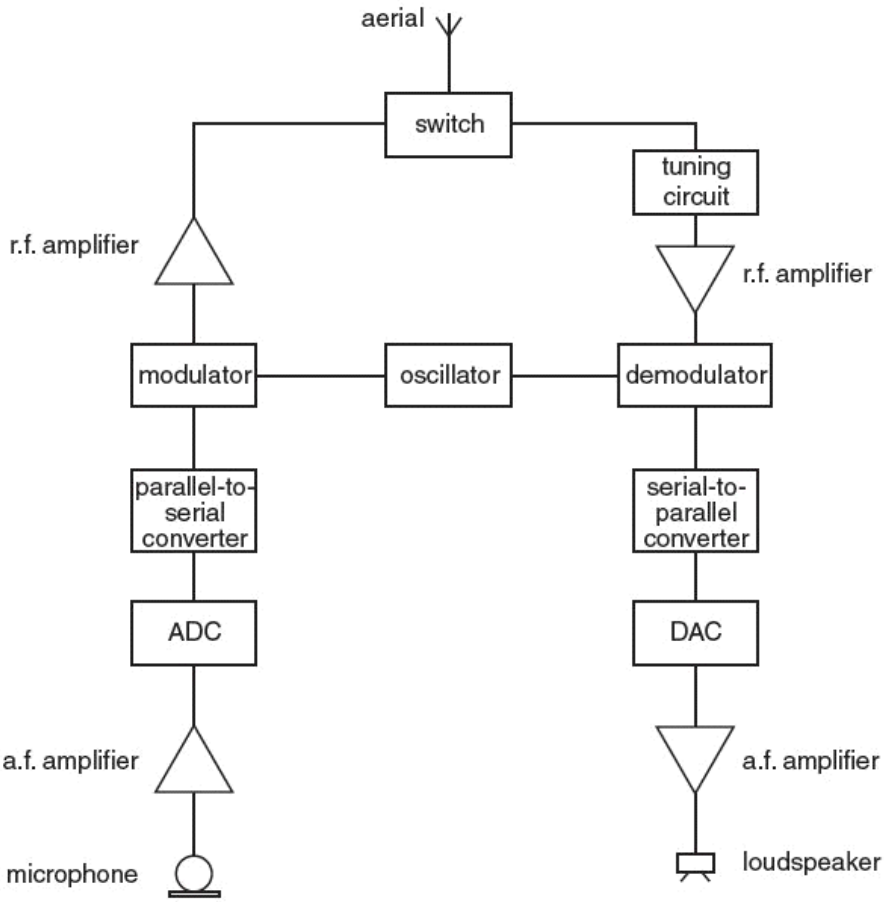
.....

.....

..... [3]

Q47.

13 A simplified block diagram of a mobile phone handset is shown in Fig. 13.1.



State the purpose of

(a) the switch,

.....

.....

.....

..... [2]

(b) the tuning circuit.

.....

.....

.....

..... [2]

Q48.

12 **(a)** Distinguish between an *analogue* signal and a *digital* signal.

analogue signal: .....

.....

digital signal: .....

.....

[2]

(b) An analogue-to-digital converter (ADC) converts whole decimal numbers between 0 and 23 into digital numbers.

State

(i) the minimum number of bits in each digital number,

number of bits = ... [1]

(ii) the digital number representing decimal 13.

..... [1]

(c) An analogue signal is digitised before transmission. It is then converted back to an analogue signal after reception.

State and explain the effect on the reproduction of the signal when the number of bits in the analogue-to-digital converter (ADC) and the digital-to-analogue converter (DAC) is increased.

.....

.....

.....

..... [3]

Q49.

13 In a mobile phone system, the country is divided into a number of cells, each with its own base station.

State and explain

(a) why the country is divided into cells,

.....

.....

..... [2]

(b) two reasons why the base stations operate on UHF frequencies.

1. .....

.....

.....

2. .....

.....

.....

[4]