Communication

Question paper 5

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Communication
Sub Topic	
Paper Type	Theory
Booklet	Question paper 5

Time Allowed: 60 minutes

Score: /50

Percentage: /100

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

1 **(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.

(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]

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

(i) *noise*,

....

....[1]

(ii) *attenuation.*

....

....[1]

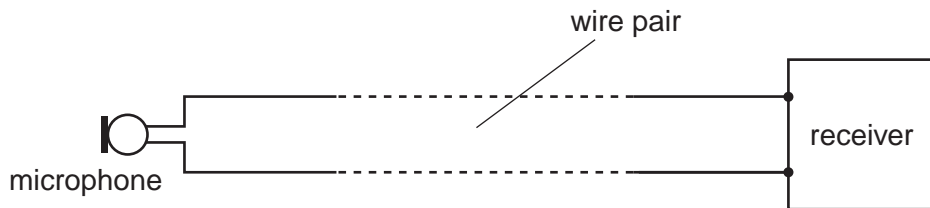**(b)** A microphone is connected to a receiver using a wire pair, as shown in Fig. 11.1.

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 $3.4 \times 10^{-9}\,W$.
The microphone produces a signal power of $2.9\,\mu W$.

(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.

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....

....[2]

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

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.... [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.

advantage: ....

....

....

....

disadvantage: ....

....

....

....

[4]

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

   (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

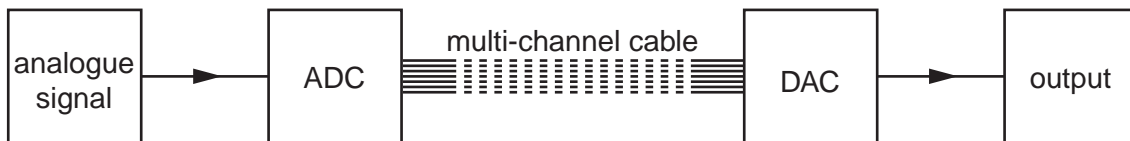   **(i)** Describe the function of the ADC (analogue-to-digital converter).

   ....

   ....

   ....[2]

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

   ....

   ....[1]

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

(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]

6 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.
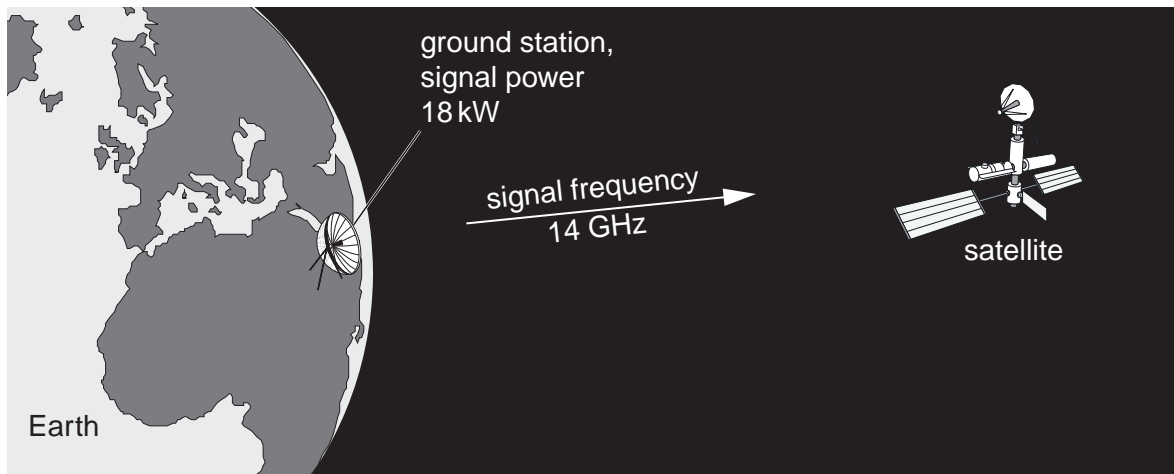

Fig. 12.1

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]

7 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 $6.1 \times 10^{-19} \, W$.

(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]