

1. The table below shows some communication applications that transmit using different regions of the electromagnetic spectrum.

Application	Spectrum region	Typical transmission frequency / MHz
national radio station	longwave	0.198
amateur radio	shortwave	28.2
satellite TV link	microwave	10 700

Explain why each transmission takes the pathway it does from the transmitter to the receiver.

For each of the spectrum regions, you should:

- indicate a frequency range
- refer to the properties of the wave
- name the pathway and outline its properties.

You may use diagrams to help explain your answer.

Space for diagrams

(Total 6 marks)

2.

Discuss how longwave (LW), shortwave (SW) and microwave links can be used to communicate beyond the visible horizon.

For each link, you should give:

- a typical carrier frequency that is used
- an explanation of how the signals travel from the transmitter to the receiver
- a typical use.

You may use a diagram to help make clear aspects of your answer.

(Total 6 marks)

3.

Pulse code modulation (PCM) is used to encode live music as an uncompressed digital audio file.

Sampling of the analogue signal is carried out at 44.1 kHz.

A 16-bit system is used to encode each of the two channels that make up the stereo signal.

- (a) Explain why the sampling frequency used is suitable for this task.

(2)

- (b) Calculate the number of quantisation levels available on a 16-bit encoding system.

number of quantisation levels = _____

(1)

- (c) A recorded piece of stereo music lasts for 3.5 minutes.

Calculate the size, in megabytes, of the digital file needed to store this recording.

file size = _____ megabytes

(2)

- (d) The music file is used by a call centre to play as background music while a phone call is on hold. However, the telephone network is designed to use a bandwidth of 0.3 kHz – 3.4 kHz.

Compare the quality of the music heard by the telephone caller with that of the original file heard when played directly from a compact disc.

(2)

(Total 7 marks)

4.

A telephone company transmits 15 speech channels across a single transmission link. The analogue information is first subjected to pulse code modulation (PCM) before transmission using time division multiplexing (TDM). The transmission system incorporates regenerators which remove noise from the signal.

Explain the basic principles of:

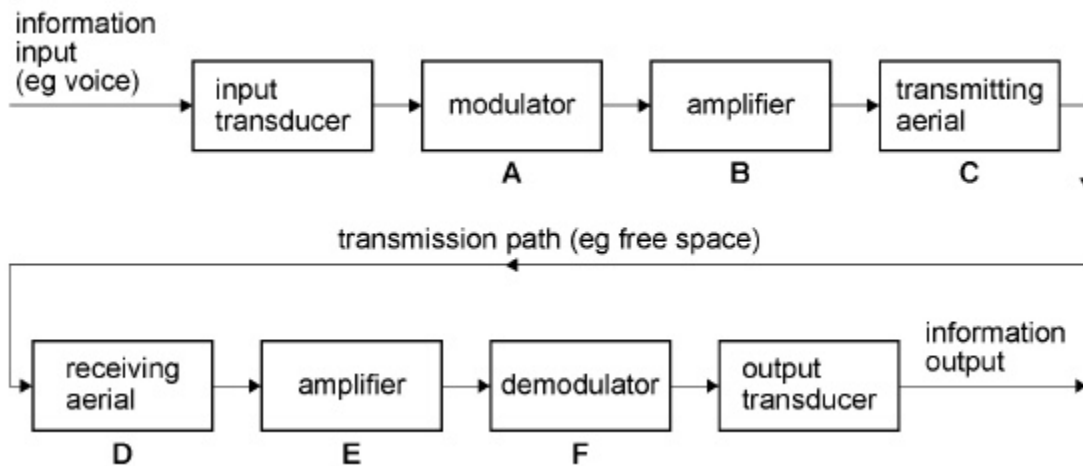
- pulse code modulation (PCM)
- time division multiplexing (TDM)
- a regenerator.

(Total 6 marks)

5.

Figure 1 shows a block (subsystem) diagram for a radio communication system.

Figure 1



- (a) State the letter representing the subsystem in which you might find an induced emf being generated.

(1)

- (b) State the letter representing the subsystem where the audio and radio waves are combined.

(1)

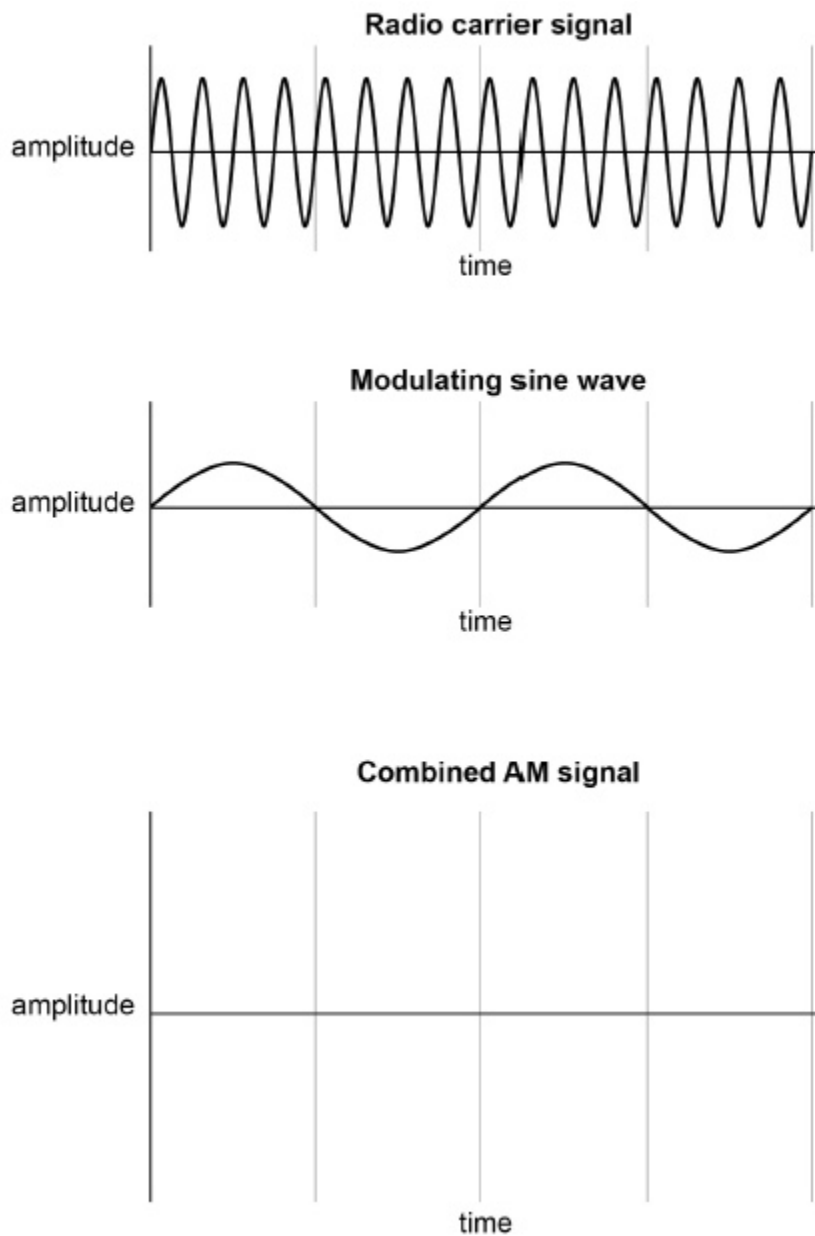
- (c) The signal strength at stage **D** must be amplified.

Explain why the signal strength at stage **D** is weak.

(1)

(d) **Figure 2** shows graphs of a radio carrier signal and a modulating sine wave.

Figure 2



Complete the graph in **Figure 2** to represent the combined amplitude modulated (AM) signal.

(1)

- (e) Approximately 20 radio stations use amplitude modulation (AM) to broadcast to people living in the London area. Another 35 AM stations broadcast to people outside the London area. However, these broadcasts can still be received in London.

The allocated frequency spectrum for all these broadcasts is in the range 540 kHz to 1600 kHz

Suggest whether all these stations can broadcast hi-fi music using the full audio frequency of 20 kHz

(3)
(Total 7 marks)

6. British embassies in Europe are to be connected to a new long-distance communication link. The link, in the form of a land-based cable, will support multiple simultaneous video conferencing as well as the transmission of sensitive government data.

The company installing the link has to consider the choice between using optic fibre or copper wire in the cables.

Compare the advantages and disadvantages of the two options for use in these cables. State which option you would advise the company to use.

For both types of cable refer to their:

- physical properties
- ability to reject external interference
- signal-carrying properties.

(Total 6 marks)