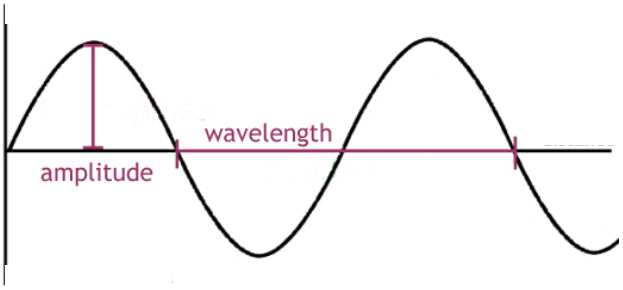


S2 Telecommunications

Self Checks

Self check 1

1. Give three examples which illustrate the speed of sound in air is less than the speed of light in air.

2. A pupil at a football match sees opposing fans clap and then hears the sound 0.2 s later. If the opposing fans are 68 m away, calculate the speed of sound in air.

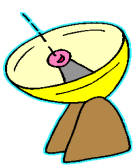
3. At a school summer fete, the announcer uses a loud-hailer so that the pupils can hear about all the available activities.

A pupil stands 30m away from the loudspeaker.

(a) Find the speed of sound in air if it takes the pupil 0.09s to hear the announcer.

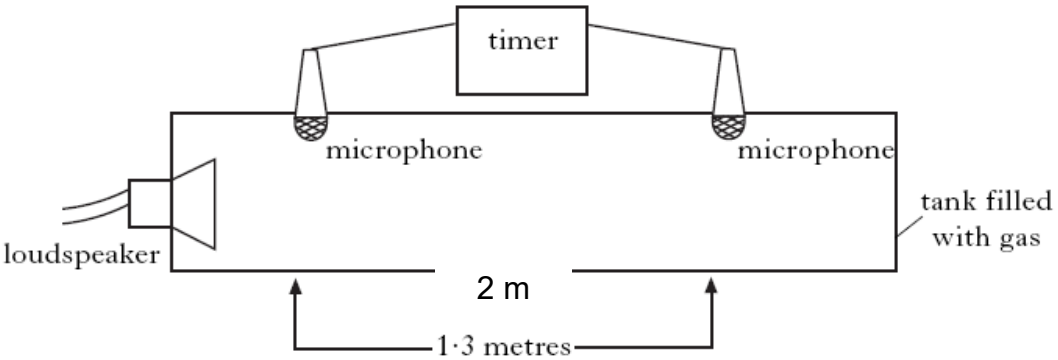
(b) How far away would a pupil be if it took 0.18 s to hear the announcer.

4. In a thunderstorm, the thunder is heard 5 s after the lightning.
Calculate the distance to the storm. (speed of sound = 340 m/s)



Self check 1 continued

5. A pupil investigates the speed of sound in different gases. She designs an experiment as shown below. A short note is produced by the loudspeaker and the sound travels though the tank from one microphone to another.



The tank is filled with carbon dioxide. The sound takes 0.005 s to travel 2 metres.

(a) Calculate the speed of sound in carbon dioxide.

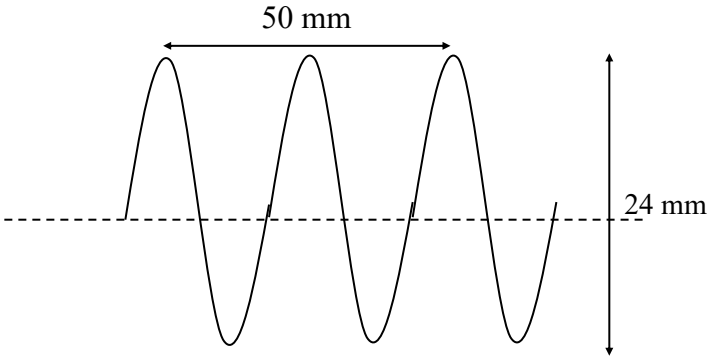
(b) The tank is now filled with a different gas. It takes the sound 0.5 s to travel 2 m. Explain if the speed of sound in the gas is less than, equal to or greater than the speed of sound in carbon dioxide.

Self check 2

1. Copy and complete the following passage:

   Sound energy travels from the source to the receiver in the form of a _ _ _ _.
   The greater the energy the larger the _ _ _ _ _ _ _ _ _.
   The _ _ _ _ _ _ _ _ _ of a wave is the number of waves per second and is measured in _ _ _ _ _. The _ _ _ _ _ _ _ _ _ _ is the distance from one crest to the next crest.

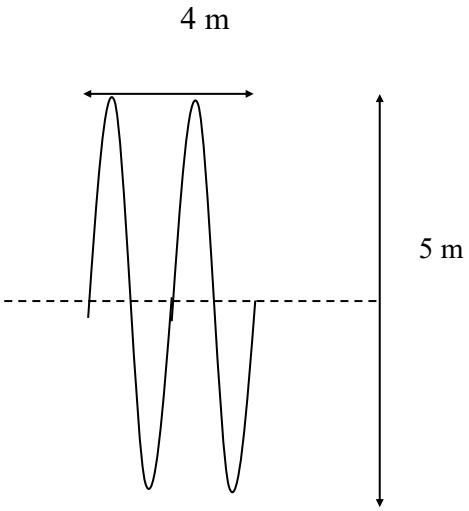
2. A wave is shown below:



   (a) What is the amplitude of the wave?

   (b) What is the wavelength of the wave?

3. For the wave below, the amplitude of the wave is:



   A. 4 m
   B. 2 m
   C. 5 m
   D. 2.5 m
   E. 1 m

Self check 2 continued

4. A wave generator at swimming pool sends out 10 waves in 20 s. The waves cross the 25 m pool in 10 s. Calculate:

   (a) The frequency of the waves.

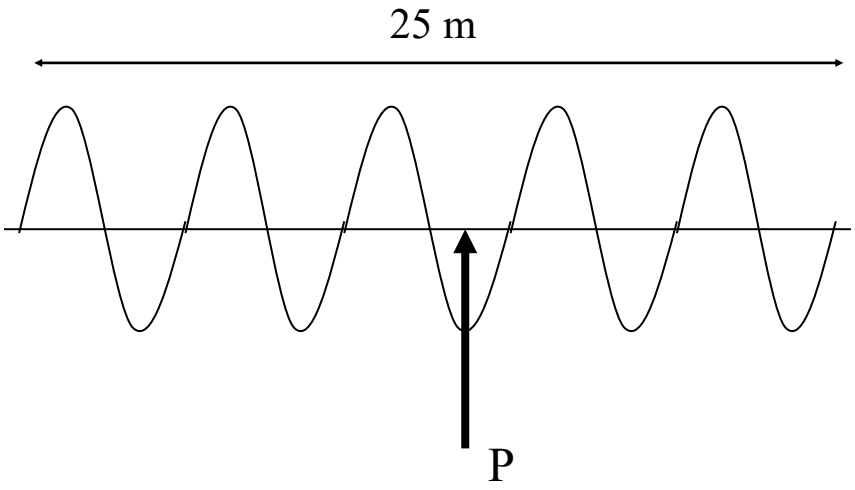
   (b) The speed of the waves.

5. A pupil sends 16 waves along a rope in 2 seconds. The waves have a wavelength of 0.5 m.

   (a) Find the frequency of the waves.

   (b) Calculate the speed of the waves.

6. A wave is shown below:



   In one second, 2.5 waves pass point P.

   (a) What is the frequency of the wave?

   (b) Calculate the speed at which the wave is travelling.

Self check 3

1. Describe how Morse code signals were sent.

2. For a Morse code telegraph, state which part of the system is the transmitter and which part is the receiver.

3. What form of energy is used to transmit messages through a telephone line ?

4. A telephone is able to transmit messages over a large distance using cables.

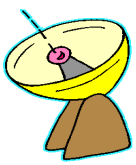
(a) What is the transmitter in a telephone?

(b) What is the energy change that takes place in the transmitter of a telephone?

(c) What is the receiver in a telephone?

(d) What is the energy change that takes place in the receiver of a telephone?

(e) What speed are telephone signals sent along the cable at?

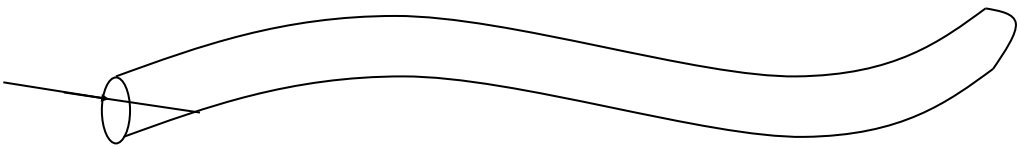


Self check 4

1. Describe what is meant by an optical fibre.

2. Describe one advantage of an optical fibre for carrying television signals into the home rather than using an aerial on the roof.

3. Light is passed along an optical fibre without any of the light escaping. Copy and complete the following diagram of an optical fibre to show how this is achieved:

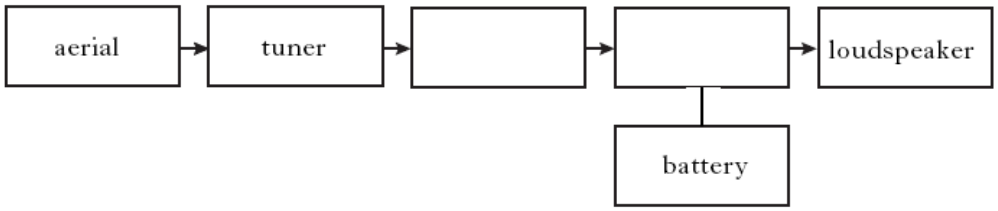


4. At what speed does light travel through optical fibres?

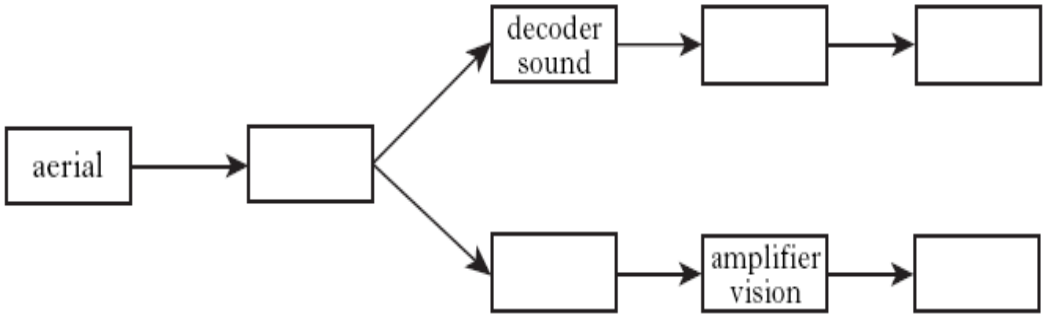
5. One telephone signal is sent from Scotland to America through an electrical cable and another through an optical fibre. Which one will reach America first?
Explain your answer.

Self check 5

1. The block diagram shows the main parts of a radio receiver:

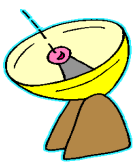


(a) Copy and complete the block diagram.
(b) State the function of each part of the radio receiver.



2. The block diagram for a television is shown below:

Device	Function
	Changes electrical energy into sound energy
Aerial	
	Selects the tv signal required
Tv screen	
Sound Amplifer	



Self check 5 continued

3. Copy and Complete:

(a) Red + Green =

(b) Red + Blue =

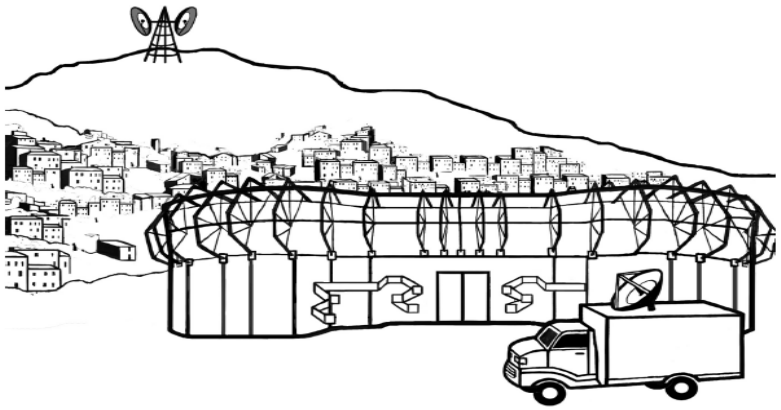
(c) Blue + _____ = Cyan

(d) Red + Blue + Green =

4. Copy and complete the following:

The picture tube/ LCD or plasma screen changes _____ energy to _____ energy.

5. A rugby match is being broadcast live from Edinburgh. Signals from the stadium are transmitted to a station at the top of a nearby hill.



It takes the signals 0.000005 s to reach the station.

(a) Calculate the distance from the stadium to the station.
(the speed of light = 300 000 000 m/s)

(b) People living close to the stadium watch the game on their television. Explain why there is delay between hearing the crowd through their window and hearing it through their television.

Self check 6

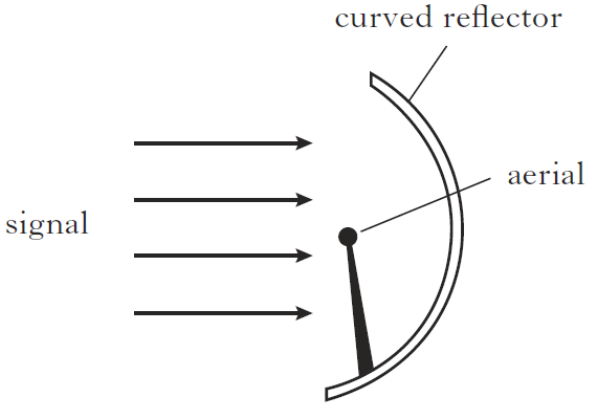
1. Television pictures are transmitted from London to Washington by a satellite, which is in a geostationary orbit.

   The diagram below shows the signals being transmitted from London to the satellite. This satellite transmits these signals to a ground station in Washington.

   (a) State what is meant by a geostationary orbit.

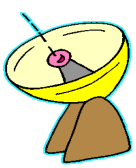
   (b) These television signals are transmitted by microwaves.
   At what speed do microwaves travel?

   (c) The television signals are received in Washington by a dish aerial with a curved reflector.
   Copy and complete the diagram below to show how the curved reflector affects the signals.



   (d) Explain why a curved reflector on a receiving aerial makes the received signal stronger.

2. Television signals are sent from a satellite 50 000 000 m in space back to Earth.
   How long does this take? (the speed of light = 300 000 000 m/s)



Extra Work Self Check 1

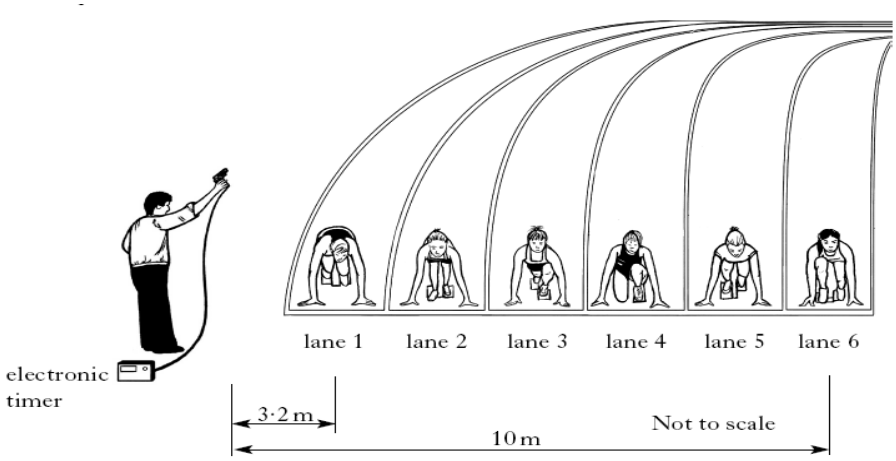
1. A pupil attends a fireworks display with her little brother. When the pupil sees the explosion before she hears the bang her little brother says this must be because the explosion happens before the bang.

(a) Explain why the little brother is wrong.

(b) If the time lapse between seeing the explosion and hearing the bang is 0.26 s. How far away is the rocket? (speed of sound = 340 m/s)

(c) A second firework is now fired, it travels at a speed of 12 m/s. How long will it take to reach a height of 110 m?

2. In a sprint race at a school sports day, the runners start when they hear the sound of the starting pistol. An electronic timer is also started when the pistol is fired into the air.



The runner in lane 1 is 3.2 m from the starting pistol. The runner in lane 6 is 10 m from the starting pistol.

If the speed of sound in air is 340 m/s, calculate how much later the runner in lane 6 will hear this sound after the runner in lane 1.

Extra Work Self Check 2

1. A loudspeaker sends out a wave with a wavelength of 80 cm.

(a) What is the speed at which the wave travels?

(b) Find the frequency of the sound wave.

2. During a discussion in Physics three pupils state the following.

Pupil A: Television waves have a higher frequency than radio waves.

Pupil B: A higher frequency means that the wavelength is larger.

Pupil C: Frequency is measured in Hertz.

(a) What pupil(s) is/are correct?

(b) Is/Are any pupil(s) incorrect? Explain why.

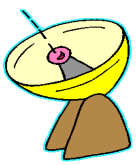
(c) What is it that determines how much energy a wave has?

(d) What does 50 Hz mean?

3. Tuning forks are set to a particular frequency. The one shown produces sound with a frequency of 256 Hz.

(a) Calculate the wavelength of these waves.

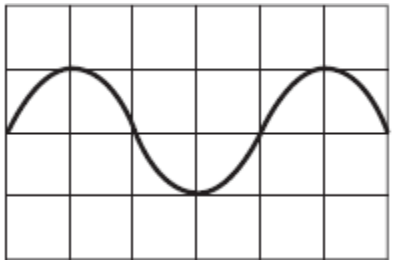
(b) A different tuning fork is now used. The wavelength of the waves sent now have a wavelength of 2 m. Show by calculation if this tuning fork is set to a higher frequency.



Extra Work Self Check 3

1. A student investigates sound waves.

   She connects a microphone to an oscilloscope. The microphone detects a sound and the following trace is seen on the oscilloscope screen.



   (a) The student then uses a signal double the frequency. The oscilloscope setting remain constant. Draw the trace that would be seen on the oscilloscope screen.

   (b) Using the original sound source the loudness of signal is increased but frequency kept constant. Draw the trace that would be seen on the oscilloscope screen.

2. What are the advantages of communication through wires?

3. An orchestra uses many different musical instruments.

Musical Instrument	Lowest Frequency (hertz)	Highest Frequency (hertz)
Acoustic Guitar	73	1174
Piano	28	4186
Flute	261	2637
Trumpet	165	1046
Violin	196	3520
Cello	65	660
Piccolo	523	4000

   (a) Which instrument will have the longest wavelength?

   (b) Calculate the wavelength of the trumpet when played at the lowest frequency.

Extra Work Self Check 4

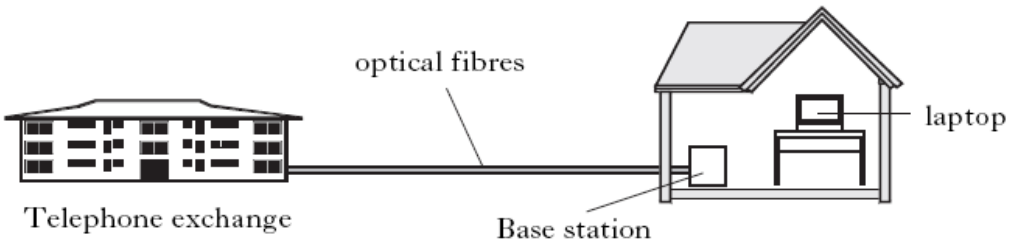
1. Cables laid on the seabed link between Scotland and America provide internet and telephone links. The table below shows information about the two different cables.

   (a) Copy and complete the table.

Subsea Cable Name	*Cable Material*	*Type of Signal carried*	*Speed of Signal in Cable* (metres per second)
Atlantic Crossing–1	*Optical Fibre*		
TAT–7		*Electrical*	

   (b) State one advantage that Atlantic Crossing-1 has over TAT-7 cable.

2. A laptop computer uses a radio signal to transfer information to a base station. The base station is connected by optical fibres to a telephone exchange.



   (a) At what speed do radio waves travel ?

   (b) The base station is 40 km away from the telephone exchange. How long would it take the signal to travel along the optical fibre.
   (speed of light in glass = 200,000,000 m/s)

Extra Work Self Check 5

1. A student has a high definition television like the one shown below:

(a) The student notices that the picture is a bit orange, what colour should be adjusted to minimise this ?

(b) At what speed are the signals sent to the television ?

2. (a) A pupil receives a text message on a mobile telephone. The frequency of the waves sent to the phone are 1900 kHz.

(i) What type of waves are sent to the mobile phone?

(ii) Calculate the wavelength of the signal.

(b) The pupil now sends a video message from her mobile telephone. The message is transmitted by microwaves. The message travels a total distance of 72,000 km.

Calculate the time taken between the message being transmitted and received.

Extra Work Self Check 6

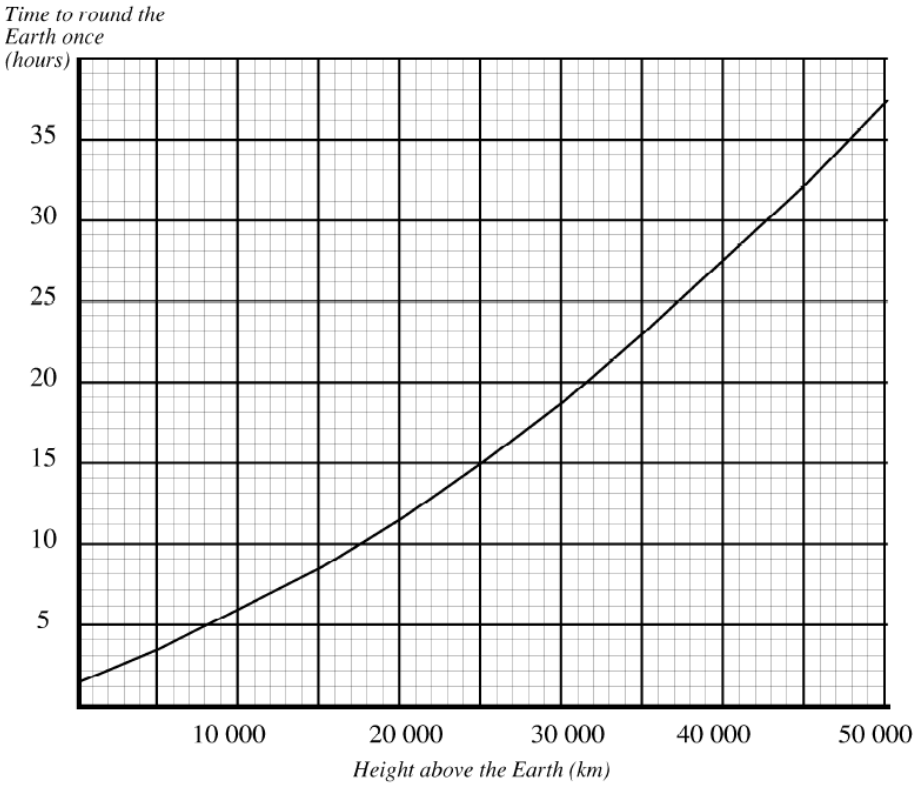
1 Satellite navigation systems use satellites orbiting above the Earth to identify their location. They transmit and receive radio waves.

It takes the radio waves 0.12 s to travel 36 million metres from the satellite to the navigation system.

(a) Show that the waves travel at 300 000 000 metres per second.

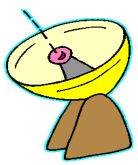
(b) What time will it take a signal to travel from a different satellite, which is 18 million metres above the earth ?

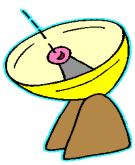
2. The graph below shows how the time it takes a satellite to go round the Earth changes with its height above the Equator.



(a) Use the graph to find the height of a geostationary satellite.

(b) A spy satellite has to orbit the Earth twice each day.
Use the graph to find the height of this spy satellite





Self Check 1 Answers

1. Any suitable examples

2. 340 m/s

3.(a) 333 m/s
(b) 60 m

4. 1700 m

5.(a) 400 m/s
(b) Speed of sound is less than in carbon dioxide as the time taken to travel 2m is longer.

Self Check 2 Answers

1. wave, amplitude, frequency, hertz, wavelength

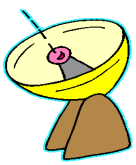
2.(a) 12 mm
(b) 25 mm

3. D

4.(a) 0.5 Hz
(b) 2.5 m/s

5. 8 Hz

6.(a) 2.5 Hz
(b) 12.5 m/s



Self Check 3 Answers

1. Coded messages were sent along wires as electrical pulses. Pulses are created by opening and closing a switch. The pulses were changed into sound by a buzzer to be decoded.

2. Transmitter - switch
Receiver - buzzer.

3. Electrical energy.

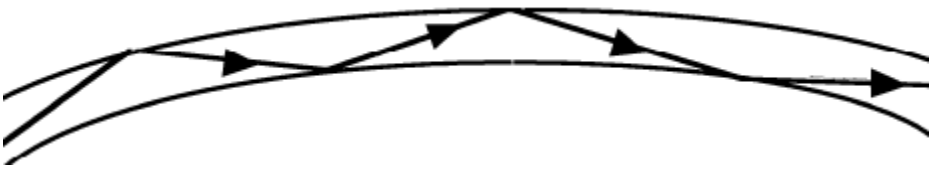
4.(a) Mouthpiece (Microphone)
(b) Sound → Electrical
(c) Earpiece (Loudspeaker)
(d) Electrical → Sound
(e) 300 000 000 m/s

Self Check 4 Answers

1. An optical fibre is a long thin piece of glass that allows light to travel through it.

2. Signals sent to an aerial on a roof can be affected by the weather (interference). Optical fibres are under ground and are unaffected by the weather (interference).

3.



4. 200 000 000 m/s

5. Signals travel faster through electrical cable.

Self Check 5 Answers

1.(a) Decoder, amplifier

(b) Aerial - Picks up all the radio signals.
Tuner - Selects one radio station
Decoder - Sorts out the electrical information
Amplifier - Increases the size of the electrical signal.
Loudspeaker - Changes the electrical signal into sound.

2.(a) Tuner, decoder visual, amplifier sound, loudspeaker, TV. Tube.

(b)

Device	Function
loudspeaker	Changes electrical energy into sound energy
Aerial	**Collects all signals**
Tuner	Selects the tv signal required
Tv screen	**Changes electrical energy into light energy**
Sound Amplifer	**Increases the size of electrical signal**

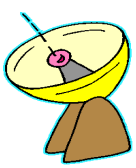
3. (a) Yellow

(b) Magenta

(c) Green

(d) White

4. Electrical, light



Self Check 6 Answers

1. Any suitable example (e.g. mobile telephone)

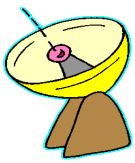
2. 0.12 s

3.(a) 1500m
(b) The TV signals are sent from the stadium to a satellite in space and then to the television. This is a much larger distance so it will take longer.

Extra Work Self Check 1 Answers

1.(a) Both the bang and the explosion occur at same time. The explosion is seen before the bang is heard because the speed of light is greater than the speed of sound.
(b) 88.4 m
(c) 9.17 s

2. Runner 1 hears pistol after 0.01 s
Runner 2 hears pistol after 0.03 s
Difference is 0.03-0.01 = 0.02s
Runner 1 hears pistol 0.02s before runner 2.



Extra Work Self Check 2 Answers

1.(a) 340 m/s
(b) 425 Hz

2.(a) Pupils A and C are correct.
(b) Pupil B is incorrect. If a wave has a higher frequency, the wavelength will be shorter.
(c) Amplitude.
(d) 50 Hz means 50 waves per second.

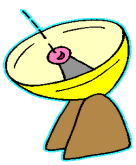
3.(a) 1.3 m
(b) 180 Hz, lower frequency.

Extra Work Self Check 3 Answers

1.(a) New trace will have double number of waves but the amplitude will be the same.
(b) New trace will have a larger amplitude but the frequency will be the same.

2. Messages can be sent over long distances.
Messages can be sent very quickly.
There is a degree of privacy.

3.(a) Piano
(b) 2.1 m



Extra Work Self Check 4 Answers

1.(a) Any 3 suitable advantages from page 6 of Telecommunications notes.
(b) Messages sent very fast. Speed of light in glass is 200 000 000 m/s

2.(a) 300 000 000 m/s
(b) 0.0002s

Extra Work Self Check 5 Answers

1.(a) The red colour has to be reduced.
(b) 300 000 000 m/s

Extra Work Self Check 6 Answers

1.(a)
(i) Microwaves
(ii) 300 000 000 m/s
(iii) 158m
(b) 0.00024s

2.(a) 300 000 000m/s as required
(b) 0.06s