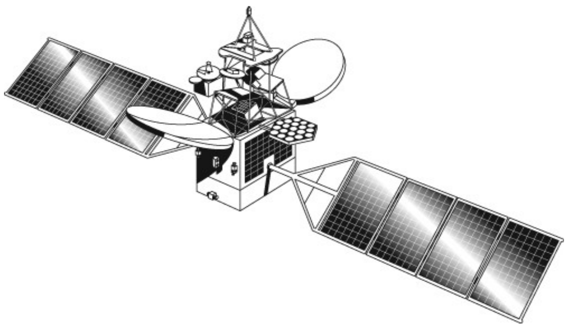
S2 Telecommunications

Homework



Homework 1
Communication Using Waves

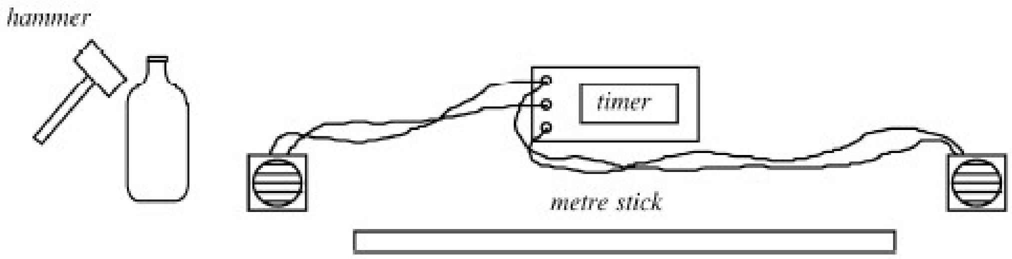
1. A person walking through a golf course sees a golfer in the distance striking a golf ball. The sound of the club hitting the ball is heard by the person 2 seconds later.

   (a) Explain why there is a delay between seeing the ball being struck and hearing the sound.

   (b) Calculate the distance between the person and the golfer. (*speed of sound in air = 340 metres per second*)

2. A boy sees a firework explode in the night sky and starts a stopwatch. He stops the watch 1.5 s later when he hears the sound. Estimate the distance between the firework and the boy.

3.



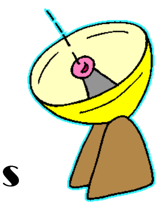
A pupil uses the apparatus above to measure the speed of sound. Sound waves are produced when the hammer is struck against the bottle. When the sound waves reach the first sound sensor, a timer is triggered. When the sound reaches the second sensor, placed 5 m away, the timer stops. The final display on the timer shows 0.015 s.

(a) Calculate the speed of sound.

(b) The experiment is repeated five times to obtain an average time. The times in seconds are shown below :

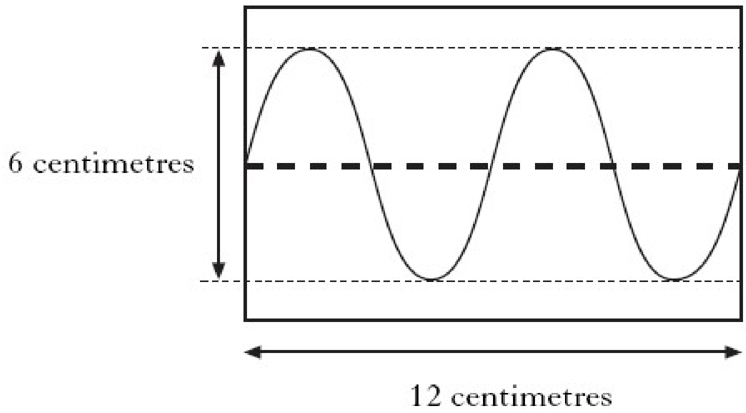
0.017, 0.016, 0.014, 0.017, 0.019

Calculate the average speed of sound.



Homework 1 cont.
Communication Using Waves

4. Electrical signals are displayed as waves on an oscilloscope.



(a) What is the wavelength of the waves ?

(b) What is the amplitude of the waves ?

5. The diagram shows part of a water tank used to test a model wave power generator.

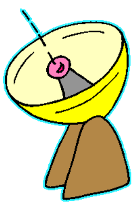
A wave power generator uses waves to generate electricity.

(*a*) A machine in the tank produces 20 waves in 10 seconds.
Calculate the frequency of the waves.

(b) The wavelength of the waves in the tank is 1·2 metres.
Calculate the speed of the waves in the tank.

(c) The amplitude of the waves in the tank is 0·15 metres. Calculate the maximum vertical distance the wave power generator moves through.

6. A tuning fork produces a note of 262 Hertz. Calculate the wavelength of the waves produced when the wave speed is 340 metres per second.



Homework 2
Communication Using Cables

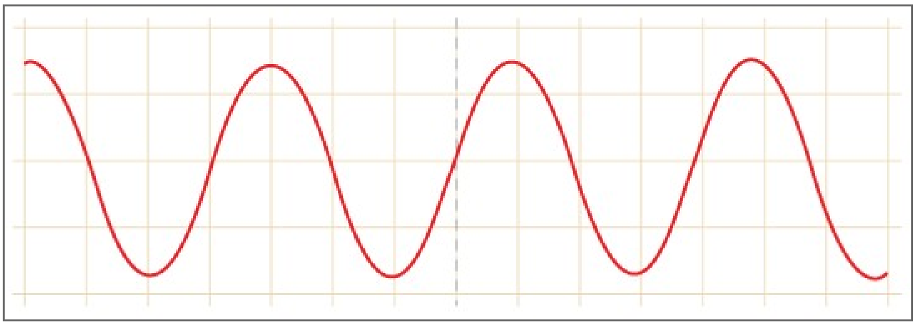
1. A telephone is connected to a telephone exchange by copper wiring.

(a) (i) What input device is in the mouthpiece of the telephone ?

(ii) What is the energy change in this device ?

(iii) What kind of signal travels through the copper wiring ?

(b) An oscilloscope is used to monitor the signal travelling through the copper wiring and the following trace is produced.

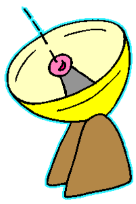


Carefully copy the trace above and **on the same diagram** draw a wave of greater amplitude and lower frequency.

(c) If the traces represent sound signals. How is the new sound different from the original ?

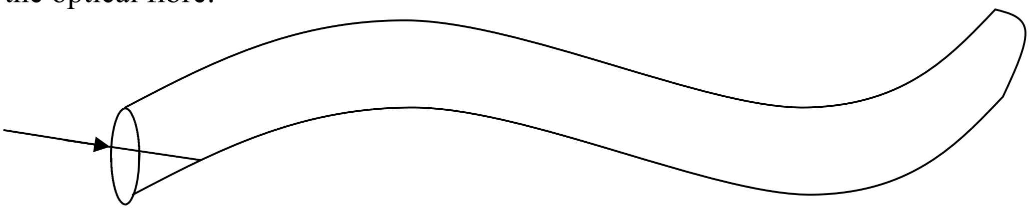
(d) A telephone signal travels to an exchange that is 12 kilometres away. How long will it take the signal to reach the end of the cable if the signal travels at a speed of 300 000 000 metres per second ?

2. How long does it take for a telephone signal to travel a distance of 50. 5 kilometres ?



Homework 3
Optical Fibre Communication

1. Copy and complete the diagram below showing the path of the light beam through the optical fibre:



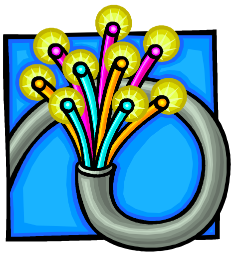
2. Name the effect when the light hits the inside surface of the fibre.

3. Telephone signals are sent along optical fibres and electrical cables.

   (a) State two advantages of using optical fibres in the transmission of telephone signals.

   (b) What is the advantage of electrical cables in the transmission of telephone signals ?

4. Signals travel at 200 000 000 metres per second in optical fibres.



   (a) How far will a signal travel along an optical fibre in 0.5 seconds ?

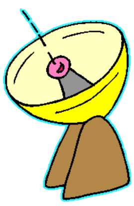
   (b) How long will it take to travel from Glasgow to London which are approximately 600 kilometres apart ?

5. A student makes the following statements about optical fibres.

   I Light travels in an optical fibre at a speed of nearly 300 000 000 metres per second.
   II Optical fibres can be made from long, thin pieces of glass.
   III Optical fibres carry electrical signals.

   Which of these statements is/are true?

   A I only
   B II only
   C I and II only
   D II and III only
   E I, II and III



Homework 4
Radio and Television

1. A student listens to his radio using headphones.

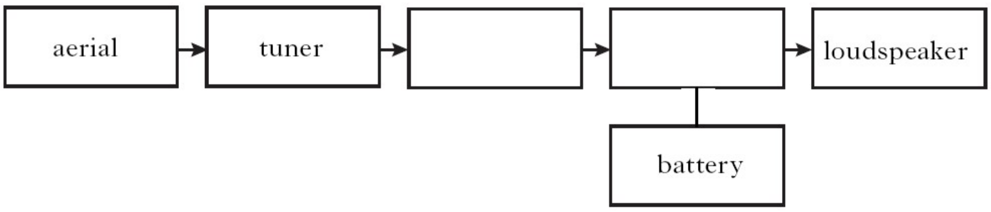
(a) State the main energy transformation that takes place in the headphones.

(b) The table below shows the frequencies for different radio stations.

Radio Station	*Frequency* (mega hertz)
Forth 1	97·3
Real Radio	101·0
Radio Borders	103·1
Isles	103·0
Central Scotland FM	103·1
Radio Scotland	95·0

Explain why the radio stations Radio Borders and Central Scotland FM are allowed to transmit at the same frequency.

(c) The block diagram shows some of the main parts of a radio receiver.

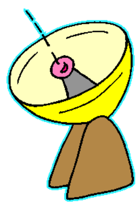


(i) Copy and complete the diagram.

(ii) What is the purpose of the aerial ?

2. (a) State the speed of the radio waves in air.

(b) How far will a radio wave travel in a time of 7 seconds ?



Homework 4 cont.
Radio and Television

4. The table below lists information about the frequency and wavelength of radio stations which can be selected on a radio receiver.

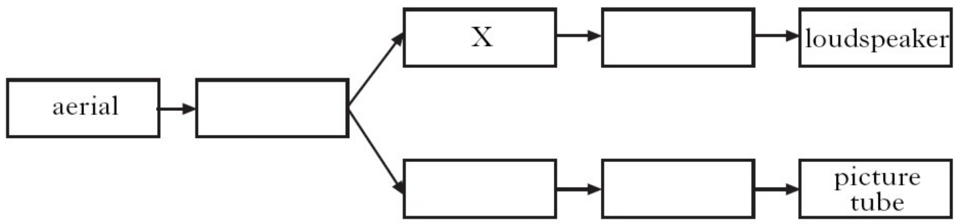
Radio Station	Signal Information
Radio 4	198 kilohertz, 1515 metres
Radio Scotland	810 kilohertz, 370 metres
Radio 5	639 kilohertz, 470 metres
Classic FM	102 000 kilohertz, 3 metres

(a) Which radio station has the highest frequency ?

(b) Which part of the radio receiver would be used to change from one station to another ?

(c) Which radio station has a wavelength longer than Radio 5 ?

5. The block diagram for a television is shown below.



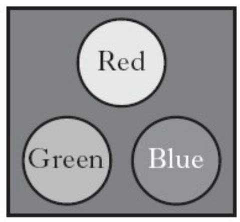
(a) Name the part labelled X.

(b) What is the energy change in the picture tube ?

6. Spectators viewing rugby in a stadium are able to view close-up images and replays of incidents in the match on giant screens.

Each screen is composed of millions of clusters of LEDs. The diagram shows one of these clusters.

A cluster of LEDs

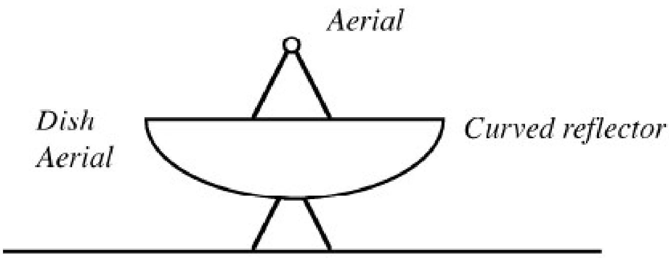


(a) In one cluster all LEDs are switched on. What colour is observed ?

(b) The green LED in this cluster is now switched off. What colour is observed ?

Homework 5
Satellites

1. An army unit on military exercise at the Earths equator have a positioned a satellite dish as shown.



During their stay they find there is no need to change the position of the dish, which is pointing vertically upward. Communications are good and are never interrupted.

(a) Why is there is no need to continually alter the position of the satellite dish?

(b) What name is given to the type of satellite being used?

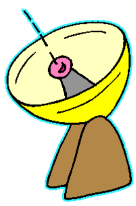
(c) What is the purpose of the curved reflector behind the aerial?
Explain your answer.

2. High frequency radio signals are sent from the USA to Britain. The signals are received by a ground station in Cornwall.

Describe what happens to the signal after it leaves the American ground station.

3. Microwave signals travel 90 000 kilometres when travelling from a ground station in Edinburgh to a ground station in New York via a satellite.

Calculate the time taken for the signal to travel from Edinburgh to New York.



S2 Telecommunications