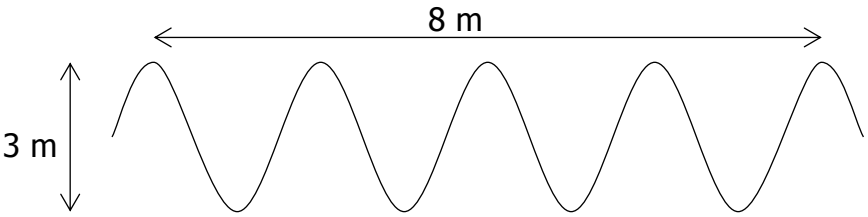
WAVES & ELECTROMAGNETIC RADIATION QUESTIONS

1. What do waves transmit?
2. What type of wave is shown below?

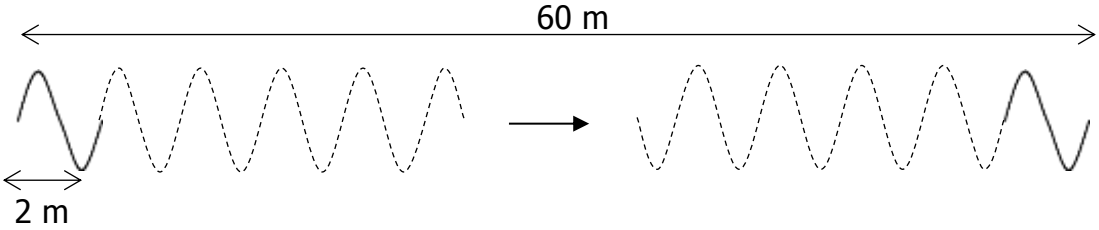
3. The questions below refer to this diagram.



(a) Calculate the wavelength of the waves shown.
(b) What is the amplitude of these waves?

4. 24 water waves pass a point in 6 seconds. What is the frequency of the waves?

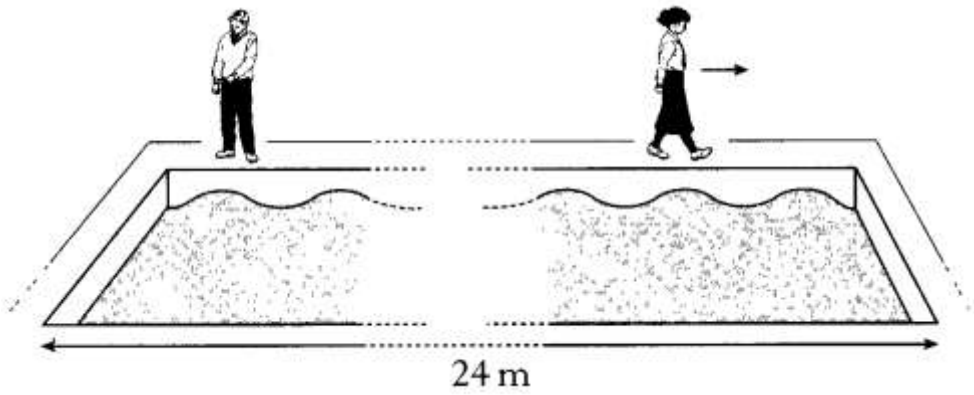
5. A wave of wavelength 2 m travels 60 m in 12 seconds.



(a) What is the speed of the wave?
(b) How many waves would be produced in 12 seconds?
(c) What is the frequency of the wave?

6. Two students watch the waves produced by a wave machine at a swimming pool.

One student walks beside a wave as it travels along the pool. The wave goes from one end of the pool to the other in 20 s. The length of the pool is 24 m.

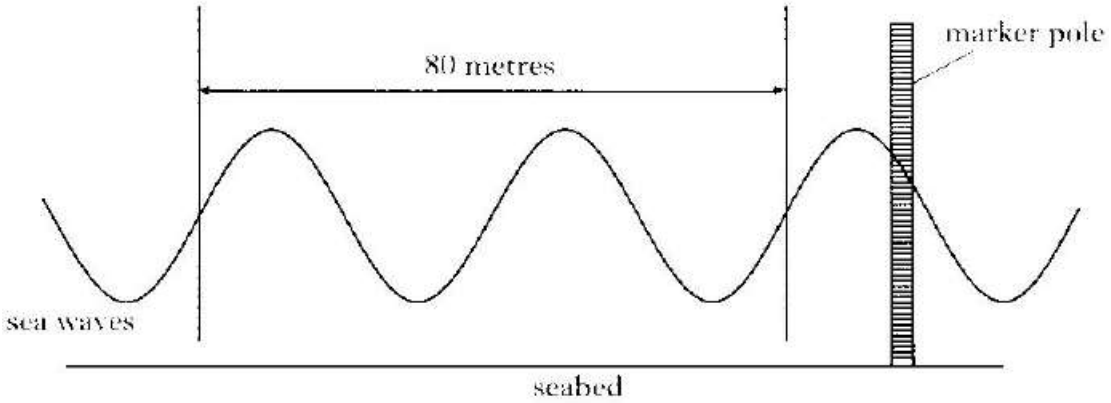


(a) Calculate the speed of the waves.

(b) In the same time interval, the other student counts 5 waves going past the point where he is standing.
Calculate the frequency of the waves.

(c) The students note that there are 5 complete waves in the pool at anytime. Calculate the wavelength of the waves.

7. A surfer rides the waves near a beach
(a) The diagram below shows a wave some distance from the beach.



(i) Using information from the diagram, calculate the wavelength of the wave.
(ii) The time between one crest and the next crest passing the marker pole in 5 seconds. Calculate the speed of the wave
(iii) Calculate the frequency of the wave.

ELECTROMAGNETIC SPECTRUM

1. The parts of the electromagnetic spectrum are shown below.

Visible Light	Infrared Radiation	Gamma Rays	Ultraviolet Radiation
X-Rays	Radio Waves	Microwaves	

Rearrange these electromagnetic waves so that they are in order of increasing frequency.

2. What is the speed of an electromagnetic wave in a vacuum?

3. What happens to the wavelength of electromagnetic waves as frequency increases?

4. What happens to the energy of an electromagnetic wave as frequency increases?

5. Describe an application of each of these types of electromagnetic radiation in medicine:
(a) X-Rays.

(b) Gamma Rays.

(c) Infrared Radiation.

(d) Ultraviolet Radiation.

6. Describe an application of each of these types of electromagnetic radiation in telecommunication:
   (a) Radio waves.
   (b) Microwaves.

7. Describe an application of each of these types of electromagnetic radiation in the home:
   (a) Infrared Radiation.
   (b) Microwaves.

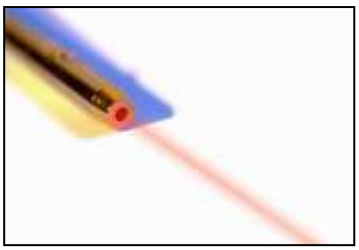
8. Why are gamma rays unsuitable for using in mobile phone communication? Give two reasons for your answer.

9. How long will it take visible light to travel through 250 km of water?

10. A radio carrier wave is sent out from BBC Radio 1 in London with a frequency of 97.5 MHz. A student in Edinburgh (which is 670 km away) is listening to the broadcast.
    (a) What is the wavelength of this radio wave?
    (b) How long will it take the wave to travel from London to Edinburgh?

11. Ultraviolet radiation is one of many types of radiation given off by the Sun. The ultraviolet radiation from the Sun takes 8 minutes to reach the Earth. How far away is the Earth from the Sun?

12. What type of electromagnetic radiation is given off by a laser?



WAVE EQUATION

1. A wave of frequency 8 Hz has a wave speed of 24 m/s. What is its wavelength?
2. Find the velocity of a wave in a ripple tank if its frequency is 12 Hz and its wavelength 3 cm.

3. The speed of a wave is 1.5 m/s and its wavelength is 0.25m.
What is its frequency?

4. A pupil is sent exam results by a text message on a mobile phone. The frequenct of the signal received by the phone is 1900 MHz

The mobile phone receives radio waves (signals).

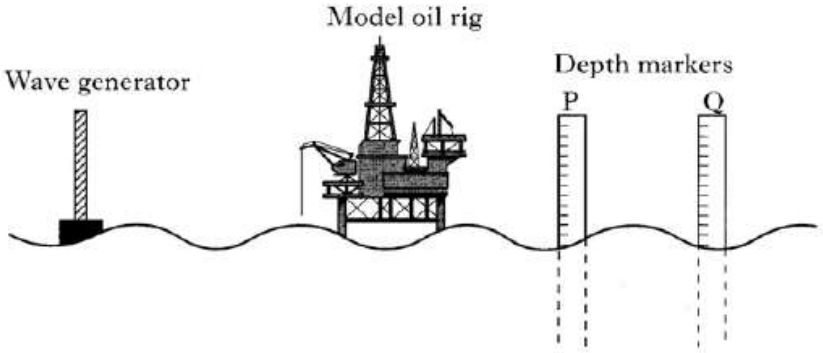
(a) What is the speed of the radio waves?

(b) Calculate the wavelength of the signal

(c) The pupil sends a video message from the mobile phone. The message is transmitted by microwaves. The message travels a total distance of 72 000 km. Calculate the time between the message being transmitted and received

5. A source produces 400 waves every minute. If the speed of the waves is 8 mm/s, calculate the distance between adjacent troughs.

6. The diagram shows part of an experimental wave tank used to test model oil rigs.



There is a wave generator at one end of the tank. Two depth markers, P and Q, are fixed to the bottom of the tank.

(a)

(i) Ten waves are made in 5 seconds. Calculate the frequency of the waves.

(ii) The distance from the wave generator o the other end of the tank is 12 metres. Eight complete waves are made in this distance. Calculate the wavelength of the waves.

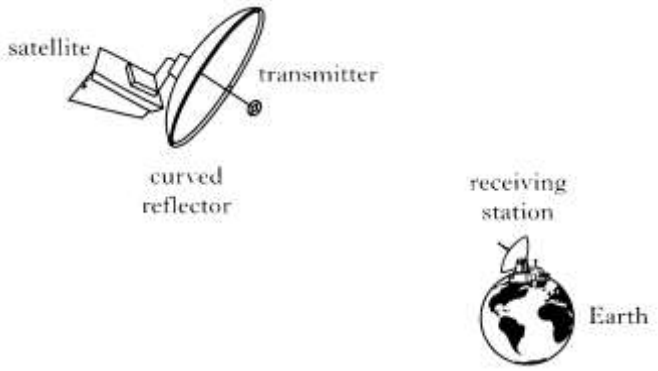
(ii) Calculate the speed of the waves.

(b)

(i) As the waves travel along the tank, the length of the depth marker P seen above the water changes from 15 centimetres to 13 centimetres. Calculate the amplitude of the waves at depth marker P.

(ii) Why is the amplitude of the waves at depth marker Q smaller than at P?

1. (a) All radiations in the electromagnetic spectrum travel at a speed of $3x10^8$ m/s in space.

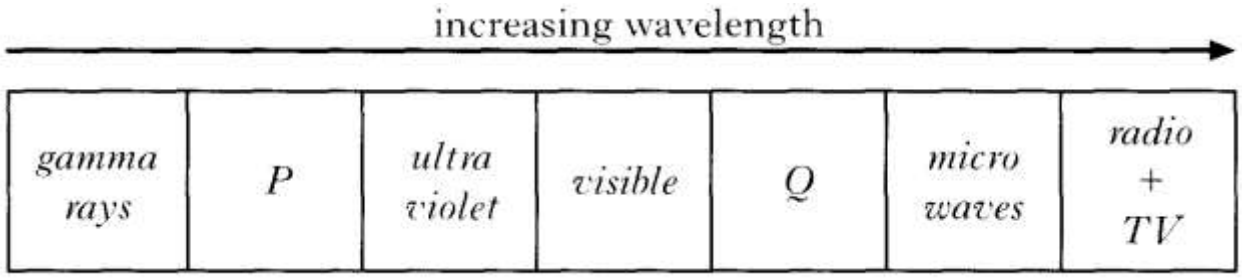


A satellite transmits microwaves on the following three frequencies.

1.0×10^{10} Hz,
9.0×10^{9} Hz,
8.0×10^{9} Hz

Calculate the wavelength of the microwaves with the **longest** wavelength.

(b) Microwaves are part of the electromagnetic spectrum.
The diagram below shows the electromagnetic spectrum arranged been omitted. Name the radiations P and Q.



(c) In which part of the spectrum do the waves have the highest energy?

(d) Name the colours of visible light from lowest to highest wavelength

2. An **optical fibre** is used to carry a telephone message to the USA from Scotland. It travels 5000 km. The light signals travel at a speed of 2×10^8 m/s. How long will this take?

3. X-rays travel at the speed of light. They have a range of frequencies from 5×10^{14} Hz to 5×10^{16} Hz.

   Calculate the range of wavelengths that correspond to X-rays

4. A section of an optical fibre used in an endoscope is shown below.

Complete the diagram to show how the laser light is transmitted along the optical fibre

5. Different types of radiation are used to detect and treat illnesses and injuries. Four of these radiations are

infrared laser light ultraviolet X-rays

(a) What type of radiation is used to treat skin conditions such as acne?

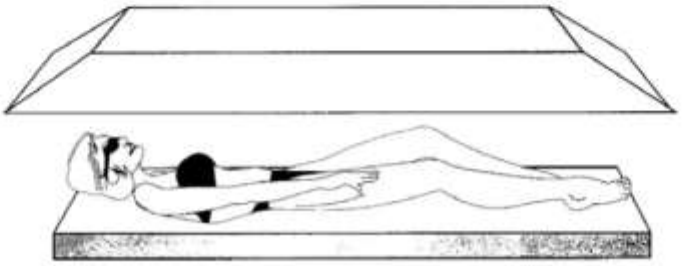
(b)

(i) State one medical use of X-rays

(ii) What can be used to detect X-rays.

(c)

Colour photographs called thermograms are used to find the temperature variation in a patient's body. Name the radiation used to make thermograms.



(d) Explain why people need to be protected from overexposure to ultraviolet radiation.