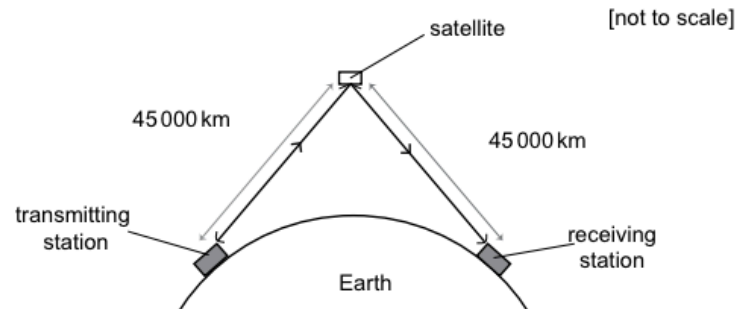


P4 – Waves

- 15 The diagram represents a satellite communication link between two points on Earth. The distances between the transmitting station, the satellite and the receiving station are shown.

The frequency of the waves used for the link can be taken as 1.5×10^{10} Hz, and the speed of light as 3.0×10^8 m/s.



What type of wave is used in such a link, and what is the time delay between a signal being transmitted and then being received at the receiving station?

	type of wave	time delay (s)
A	microwave	0.0015
B	microwave	0.0030
C	microwave	0.15
D	microwave	0.30
E	ultraviolet	0.0015
F	ultraviolet	0.0030
G	ultraviolet	0.15
H	ultraviolet	0.30



Waves

- 27 Light travels through glass at a speed which is $\frac{2}{3}$ of its speed through air.

Light travels through water at a speed which is $\frac{3}{4}$ of its speed through air.

A ray of light has a wavelength of 360 nm when travelling through water.

What is the wavelength of this ray of light when travelling through glass?

- A 180 nm
- B 240 nm
- C 320 nm
- D 330 nm
- E 390 nm
- F 540 nm
- G 720 nm

2016

- 3 The colour of the surface of an object has an effect on the rate of infrared radiation that it absorbs and emits. As a result of this, some clothes which are otherwise identical will keep a person warmer when outside in winter because of their differences in colour.

Which line in the table shows the correct comparison between black and white surfaces?

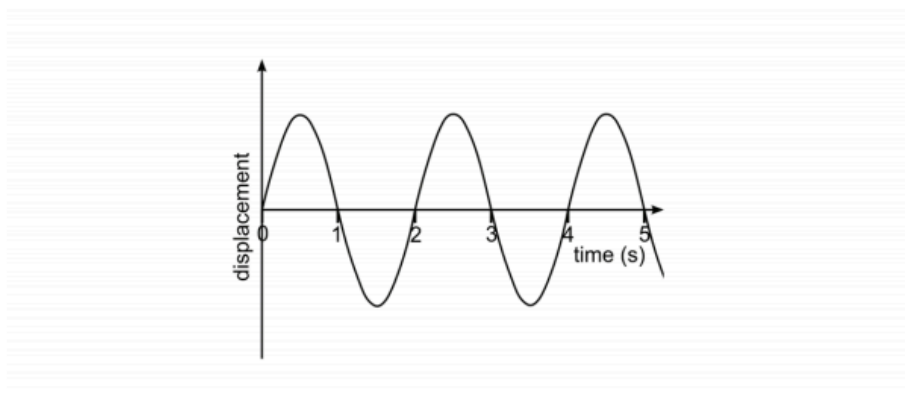
	<i>Better absorber of infrared</i>	<i>Better emitter of infrared</i>	<i>Better colour of clothes to keep a person warm in winter</i>
A	black	black	black
B	black	black	white
C	black	white	black
D	black	white	white
E	white	black	black
F	white	black	white
G	white	white	black
H	white	white	white

2015



Waves

- 19 The displacement/time graph shown represents a wave of wavelength 1.5 cm.



What is the speed of the wave?

- A 0.33 cm/s
- B 0.67 cm/s
- C 0.75 cm/s
- D 1.33 cm/s
- E 1.5 cm/s
- F 3.0 cm/s

2014

- 3 Below are four statements about electromagnetic radiation.

- 1 Microwaves have a shorter wavelength than all other electromagnetic waves.
- 2 For identical amplitudes, waves with the largest wavelength transfer the most energy.
- 3 The speed of electromagnetic waves is inversely proportional to their frequency.
- 4 Ultraviolet radiation can cause cataracts.

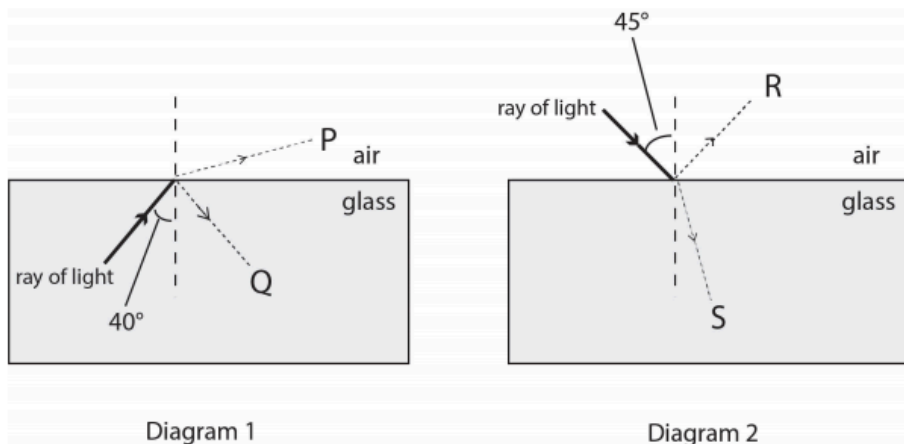
Which of these statements is/are correct?

- A 1 only
- B 2 only
- C 3 only
- D 4 only
- E 1 and 3 only
- F 1 and 4 only
- G 2 and 3 only
- H 2 and 4 only

2014

Waves

- 11 The diagrams show two glass blocks in air. For the rays of light shown, the critical angle for the glass/air boundary is 42° . A ray of light is shown approaching the boundary in each case, with the angle of incidence labelled. Two possible labelled directions in which each ray might travel after reaching the boundary are also shown.



Which line in the table correctly shows the direction taken by most or all of the light and also states whether total internal reflection (T.I.R.) will occur?

	Diagram 1		Diagram 2	
	Direction	T.I.R.?	Direction	T.I.R.?
A	P	No	R	No
B	P	No	R	Yes
C	P	No	S	No
D	Q	No	S	No
E	Q	Yes	R	Yes
F	Q	Yes	S	Yes

2013

- 3 Microwave, X-ray and infra-red radiation can all damage living tissues.

Which of the following statements correctly explain why this damage occurs?

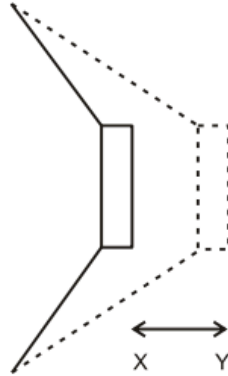
1. Microwaves cause damage because they are absorbed by water molecules.
2. X-rays cause damage because of their ionising ability.
3. Infra-red waves cause damage because of their ability to penetrate matter.

- A 1 only
- B 2 only
- C 3 only
- D 1 and 2 only
- E 1 and 3 only
- F 2 and 3 only
- G 1, 2 and 3

2013

Waves

- 27 A sound wave is produced by a loudspeaker cone, which creates pulses of pressure by moving back and forth between two points X and Y as shown in the diagram.



The distance between points X and Y is 5.0mm and the loudspeaker produces pulses of pressure every 0.2 milliseconds.

The following statements about the sound wave produced are made:

- P** It has a speed of 25m/s
- Q** It has an amplitude of 5.0mm
- R** It has a wavelength of 5.5mm
- S** It has a fundamental frequency of 5.0kHz

Which of these statements can be correctly deduced from the information given?

- A** P only
- B** P and Q only
- C** P and R only
- D** P, R and S only
- E** Q and S only
- F** R and S only
- G** S only

2012



Waves

- 15 The microwaves generated in a microwave oven travel through air at a speed of $3.0 \times 10^8 \text{ m/s}$, with a wavelength of 12cm. They pass through plastic food containers, but at a reduced speed of $2.0 \times 10^8 \text{ m/s}$.

What are the wavelength and frequency of these microwaves as they pass through a plastic food container?

	Wavelength (cm)	Frequency (Hz)
A	8	1.7×10^9
B	8	2.5×10^9
C	8	3.8×10^9
D	12	1.7×10^9
E	12	3.8×10^9
F	18	1.7×10^9
G	18	2.5×10^9
H	18	3.8×10^9

2012

- 23 A ray of orange light travelling through air has a speed of $3.0 \times 10^8 \text{ m/s}$ and a wavelength of 600nm. ($1 \text{ nm} = 10^{-9} \text{ m}$)

What could be the speed, frequency and wavelength of this orange light when travelling through glass?

	Speed/ ms^{-1}	Frequency/Hz	Wavelength/nm
A	2.0×10^8	3.3×10^{14}	400
B	2.0×10^8	3.3×10^{14}	600
C	2.0×10^8	5.0×10^{14}	400
D	2.0×10^8	5.0×10^{14}	600
E	3.0×10^8	3.3×10^{14}	400
F	3.0×10^8	3.3×10^{14}	600
G	3.0×10^8	5.0×10^{14}	400
H	3.0×10^8	5.0×10^{14}	600

2011



Waves

- 27 At the front of a long column of soldiers is a man regularly hitting a drum 50 times a minute. The soldiers are told to place their left foot down on the ground when they hear the drum beat. The column is so long that the soldiers at the back put down their left feet at the same time as the soldiers in the front put down their left feet.

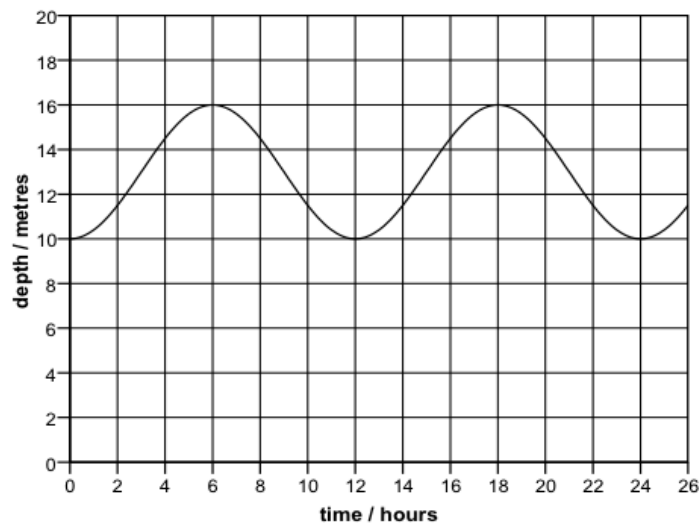
What is the minimum length of the column of soldiers?

[Speed of sound in air is 330m/s]

- A 165m
- B 198m
- C 330m
- D 396m
- E 660m
- F 792m

2011

- 7 The depth of water in a particular tidal harbour varies with time as shown in the graph:



If the variation in depth caused by the effect of the tide is considered as a wave, what are the amplitude and frequency of this wave?

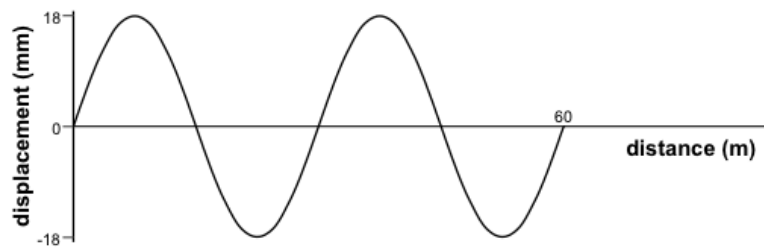
	amplitude / metres	frequency / hertz
A	3	$1/(12 \times 3600)$
B	3	$3600/12$
C	6	$1/(24 \times 3600)$
D	6	$3600/24$
E	8	$1/(12 \times 3600)$
F	8	$3600/12$
G	16	$1/(24 \times 3600)$
H	16	$3600/24$

2010

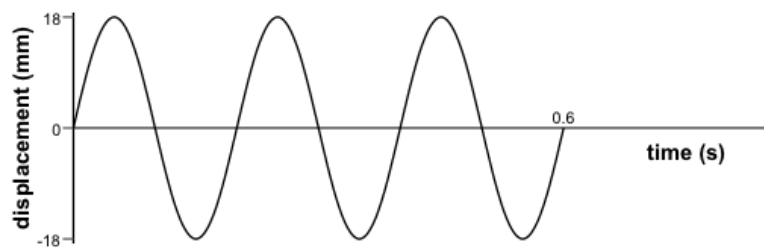


Waves

- 27 The first graph shows the variation of the displacement of particles with distance along a wave at a particular instant in time:



The second graph shows the variation with time of the displacement of a particular particle in this wave:



What is the speed of this wave?

- A 30m/s
- B 50m/s
- C 90m/s
- D 100m/s
- E 150m/s
- F 300m/s

2009