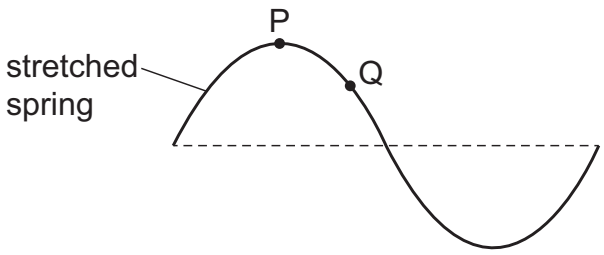
29 The diagram shows a stationary wave on a stretched spring at an instant in time.



Two particles on the spring, P and Q, are shown.

Which statement about the vibrations of P and Q is correct?

A They have different frequencies.

B They have the same amplitudes.

C They have different periods.

D They are always in phase.

30 Two progressive sound waves move in opposite directions and superpose to form a stationary wave.

Which statement describes an antinode of this stationary wave?

A a position where the phase difference between the two waves is always 0°

B a position where the phase difference between the two waves is always 180°

C a position where the stationary wave has maximum amplitude

D a position where the stationary wave has minimum amplitude

29 A wire is fixed at both ends and is vibrated by a source of frequency *f*. A stationary wave is formed on the wire with a total of two antinodes.

The frequency of the source is increased to 3*f* and a new stationary wave is formed.

What is the total number of antinodes on the new wave?

A 4 **B** 5 **C** 6 **D** 9

4 **(a)** State the principle of superposition.

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.....

..... [2]

(b) An electromagnetic wave of wavelength 0.026 m in free space is incident normally on an aluminium sheet, as shown in Fig. 4.1.

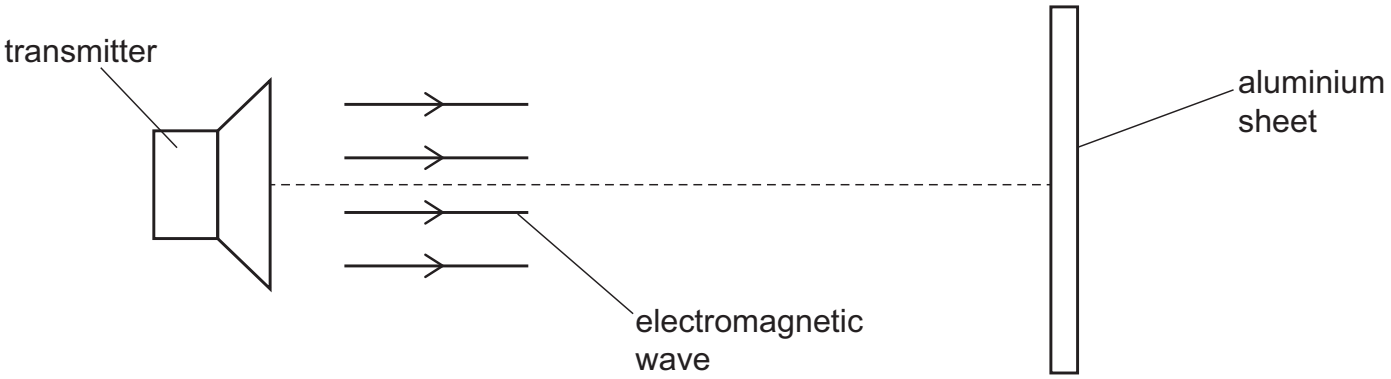

Fig. 4.1

The wave reflects at the aluminium sheet and a stationary wave is formed in the region between the transmitter and the sheet.

(i) Explain how the stationary wave, including its nodes and antinodes, is formed.

.....

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..... [3]

(ii) Calculate the frequency of the electromagnetic wave.

frequency = ... Hz [2]

(iii) State the principal region of the electromagnetic spectrum to which the wave belongs.

..... [1]

(iv) Determine the distance between a node and an adjacent antinode.

distance = ... m [1]

[Total: 9]

29 One wave has an amplitude of $2A$. A second wave has an amplitude of $\frac{A}{2}$. The waves are otherwise identical.

The two waves travel in opposite directions and overlap.

What is the ratio $\frac{\text{maximum amplitude of combined wave}}{\text{minimum amplitude of combined wave}}$?

A $\frac{3}{2}$ **B** $\frac{5}{3}$ **C** $\frac{5}{2}$ **D** 4

31 A hollow tube is closed at one end and open at the other.

A stationary sound wave of the lowest possible frequency, 820 Hz, is produced in the tube.

The speed of sound in air is $330\,\text{m}\,\text{s}^{-1}$.

What is the length of the tube?

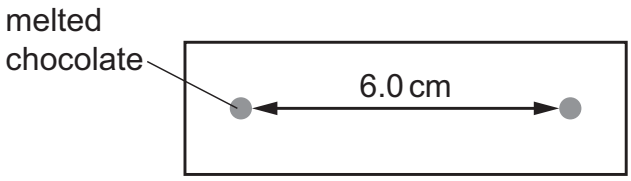
A 10 cm **B** 20 cm **C** 40 cm **D** 160 cm

24 A teacher removes the turntable from a microwave oven and places a bar of chocolate in the oven. She then switches the oven on for a short time.

A stationary wave is formed in the oven.

When the chocolate is removed, the teacher observes that there are two small sections of melted chocolate 6.0 cm apart with unmelted chocolate in between.

Each section of melted chocolate is located at an antinode.



Assume that the speed of the microwaves is $3.0 \times 10^8\,\text{m s}^{-1}$.

What is the frequency of the microwaves emitted by the oven?

A 25 MHz **B** 50 MHz **C** 2.5 GHz **D** 5.0 GHz

30 Two waves meet.

What is **not** a necessary condition for the waves to produce a stationary wave?

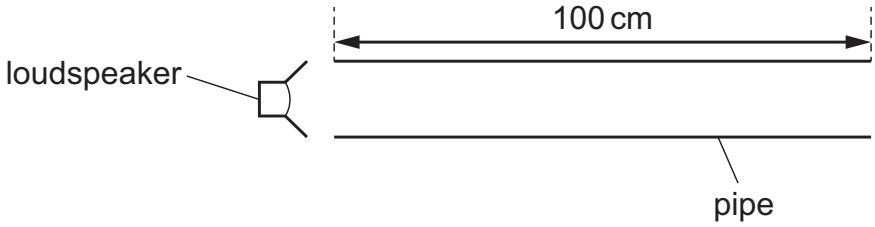
A They must be of the same type.

B They must have the same period.

C They must have the same wavelength.

D They must travel in the same direction.

25 A pipe of length 100 cm is open at both ends. A loudspeaker situated at one end of the pipe can emit sound of different wavelengths.



Which wavelength can produce a stationary wave in the pipe?

A 50 cm **B** 75 cm **C** 150 cm **D** 300 cm

4 A device containing a microwave emitter and receiver is placed in front of a large metal sheet in a vacuum as shown in Fig. 4.1.

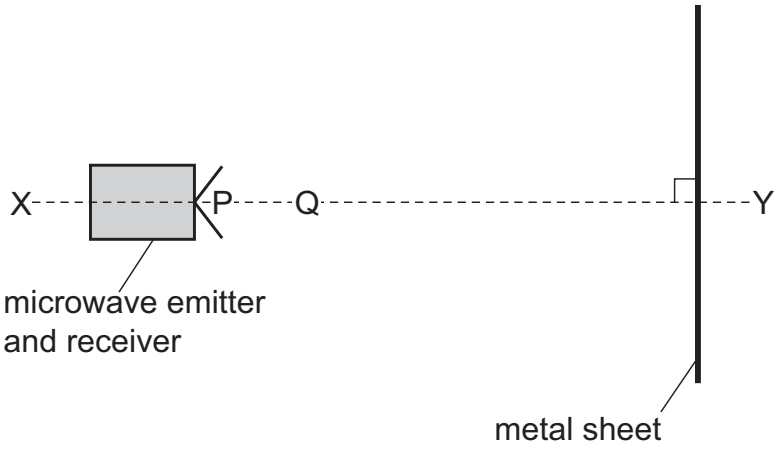


Fig. 4.1 (not to scale)

The line XY is perpendicular to the metal sheet. The device emits microwaves of frequency 6.3 GHz.

(a) When the device is at position P, a stationary wave is formed between the device and the sheet.

Explain how the stationary wave, including the nodes and the antinodes, is formed.

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..... [4]

(b) (i) Calculate the wavelength of the microwaves.

wavelength = ... m [2]

(ii) At point P the receiver detects a maximum amplitude of the stationary wave.

The device is moved slowly from point P along the line XY and the receiver detects a series of minimum and maximum amplitudes. The first time a minimum amplitude is detected by the receiver is when the device is at point Q.

Determine the distance between P and Q.

distance = ... m [1]

(iii) The intensity of the microwaves emitted by the device is increased. The frequency of the microwaves is unchanged. The device is moved slowly along the line XY from point Q until the next maximum amplitude is detected at point R.

State and explain whether the distance QR is greater than, less than or the same as distance PQ.

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..... [1]

[Total: 8]