

# 4.5 Standing Waves

## Question Paper

Course	DPIB Physics
Section	4. Waves
Topic	4.5 Standing Waves
Difficulty	Easy

**Time allowed:** 70  
**Score:** /53  
**Percentage:** /100

### Question 1a

Standing waves are sometimes referred to as stationary waves.

(a)

State three conditions which are required for the formation of a standing wave.

[3]

[3 marks]

### Question 1b

Standing waves can be thought of as the opposite of progressive waves.

(b)

Use the text in the box to complete the sentences below, comparing the two types of wave.

**constant  
store**

**transfer  
do**

**do not  
different at different points**

(i)

Standing waves \_\_\_\_\_ energy but progressive waves \_\_\_\_\_ energy.

[1]

(ii)

The amplitude of a standing wave is \_\_\_\_\_, whereas the amplitude of a progressive wave is \_\_\_\_\_.

[1]

(iii)

The crests of a standing wave \_\_\_\_\_ move along but simply oscillate up and down, while but the crests of a progressive wave \_\_\_\_\_ move along as the wave travels.

[1]

[3 marks]

### Question 1c

(c)

A stationary wave is made up of nodes and anti-nodes. State the definitions of

(i)

A node.

[1]

(ii)

An antinode.

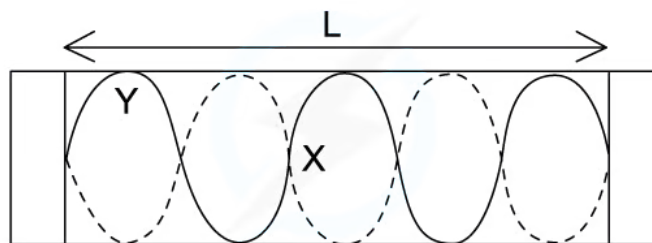
[1]

[2 marks]

### Question 1d

(d)

The length L shows 2.5 full wavelengths of a standing wave in a column of air.



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(i)

Identify the points marked X and Y.

[2]

(ii)

State the boundary conditions for the formation of this standing wave.

[2]

[4 marks]

**Question 2a**

Standing waves are formed when waves undergo superposition.

(a)

State the principle of superposition.

[3]

**[3 marks]**

**Question 2b**

(b)

Name two types of waves which can undergo superposition.

[2]

**[2 marks]**

**Question 2c**

(c)

Distinguish between constructive interference and destructive interference.

[2]

**[2 marks]**

### Question 2d

A standing wave representing the first harmonic is set up on a vibrating string.

(d)

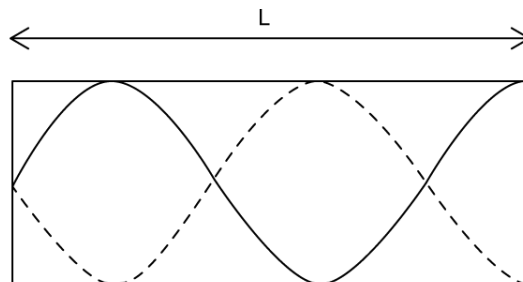
State the number of nodes and anti-nodes which would appear on this wave.

[2]

[2 marks]

### Question 3a

A standing wave is set up in a column of air within a pipe of length  $L$ , which is open at one end.



(a)

Giving your answer as a fraction of  $L$ , determine the wavelength,  $\lambda$ .

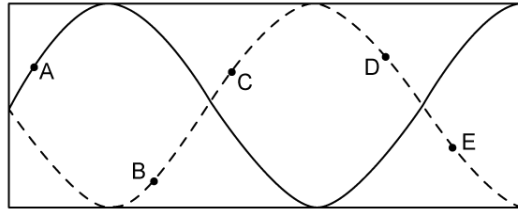
[2]

[2 marks]

### Question 3b

(b)

For the standing wave identify which points are in phase and which points are in anti-phase.



[3]

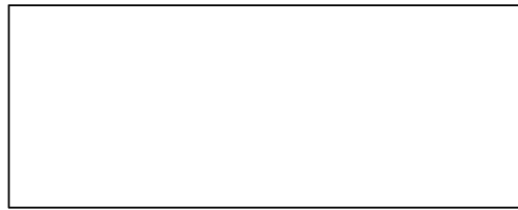
[3 marks]

### Question 3c

The column of air is vibrated so that it oscillates at the third harmonic.

(c)

Sketch a diagram to show the shape of the wave produced in the pipe.



[3]

[3 marks]

### Question 3d

The column of air oscillating at the seventh harmonic has length  $L$  and velocity,  $v$ .

(d)

In terms of  $L$  and  $v$ , determine the

(i)

Wavelength.

[1]

(ii)

Frequency.

[1]

[2 marks]

### Question 4a

(a)

Describe three methods that can be used to identify that two points on a standing wave are in phase.

[3]

[3 marks]

### Question 4b

(b)

Describe the boundary conditions for a standing wave in a pipe of air which is open at one end and closed at the other.

[2]

[2 marks]

### Question 4c

(c)

For a pipe that is open at both ends

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(i)

Sketch the first harmonic.

[2]

(ii)

Write an expression for wavelength in terms of the length of the pipe,  $L$ .

[1]

**[3 marks]**

### Question 4d

(d)

For a string which is fixed at both ends, sketch the third harmonic.

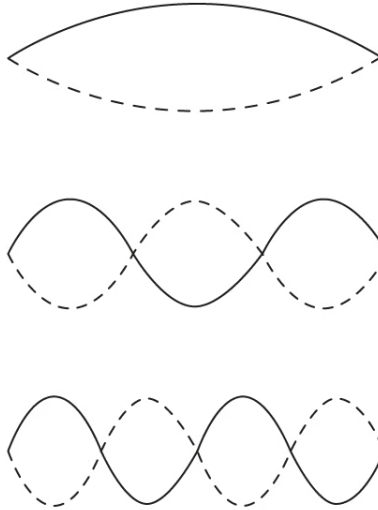
[3]

**[3 marks]**



### Question 5a

The diagram shows three possible harmonics on a string fixed at each end.



- (a)  
Identify the three harmonics.

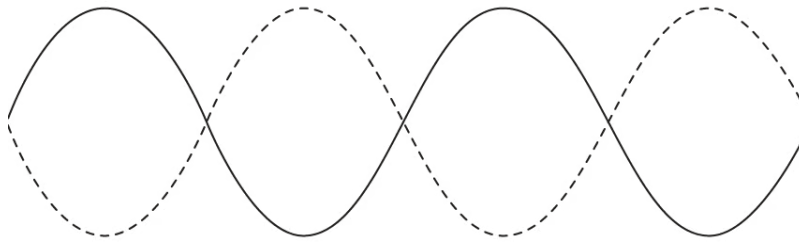
[3]

[3 marks]

### Question 5b

(b)

For the harmonic shown, identify an expression for the wavelength.

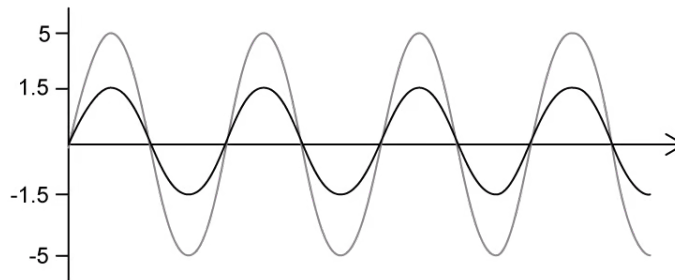


[3]

[3 marks]

### Question 5c

The diagram shows two waves which are travelling in phase.



(c)

Sketch the resultant wave, including labelling the axes with relevant quantities.

[3]

[3 marks]

**Question 5d**

Stationary waves are formed when two waves travelling on the same line superpose.

(d)

Identify two conditions which must be true for superposition to occur.

[2]

[2 marks]