Cambridge Assessment International Education

Cambridge International AS & A Level

4: Waves – Topic questions

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
4	2017	June	21
5	2017	June	21
4	2017	March	22

The mark scheme for each question is provided at the end of the document.

4 **(a)** State the conditions required for the formation of stationary waves.

.....

.....

.....[2]

(b) One end of a string is attached to a vibrator. The string is stretched by passing the other end over a pulley and attaching a load, as illustrated in Fig. 4.1.

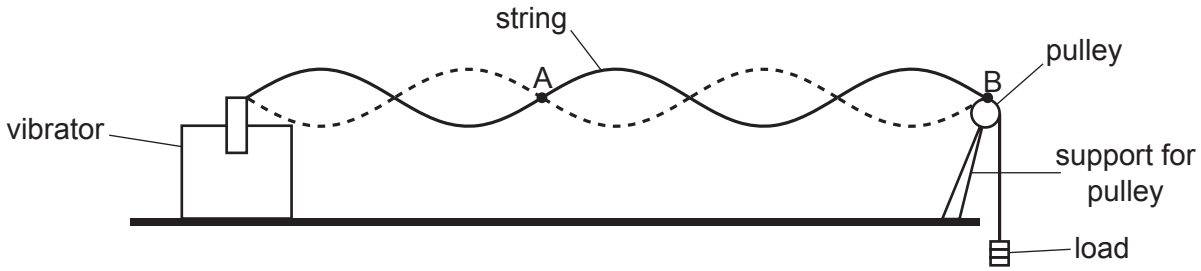

Fig. 4.1

The frequency of vibration of the vibrator is adjusted to 250 Hz and a transverse wave travels along the string with a speed of 12 m s^{-1}. The wave is reflected at the pulley and a stationary wave forms on the string.

Fig. 4.2 shows the string between points A and B at time $t = t_1$.

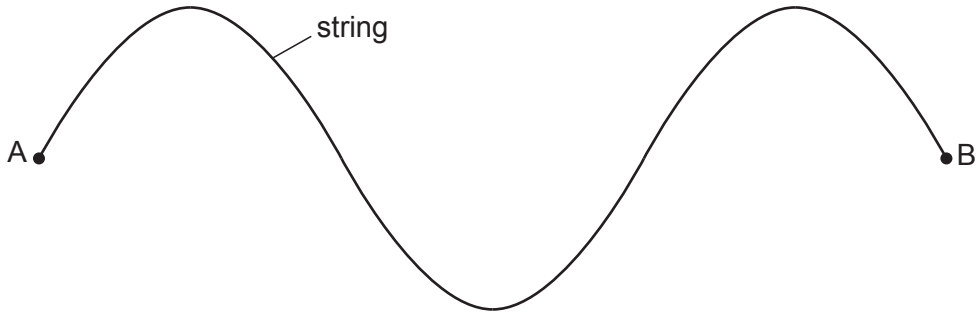

Fig. 4.2

At time $t = t_1$ the string has maximum displacement.

(i) Calculate the distance AB.

distance = ...m [2]

(ii) On Fig. 4.2, sketch the position of the string between A and B at times

1. $t = t_1 + 2.0\,\text{ms}$ (label this line P),

2. $t = t_1 + 5.0\,\text{ms}$ (label this line Q).

[3]

[Total: 7]

5 **(a)** Describe the Doppler effect.

.....

.....

.....[1]

(b) A car travels with a constant velocity along a straight road. The car horn with a frequency of 400 Hz is sounded continuously. A stationary observer on the roadside hears the sound from the horn at a frequency of 360 Hz.
The speed of sound is 340 m s^{-1}.

Determine the magnitude v, and the direction, of the velocity of the car relative to the observer.

v = ...m s^{-1}

direction .....

[3]

[Total: 4]

4 **(a)** State what is meant by the *Doppler effect*.

.....

.....

.....[2]

(b) A child sits on a rotating horizontal platform in a playground. The child moves with a constant speed along a circular path, as illustrated in Fig. 4.1.

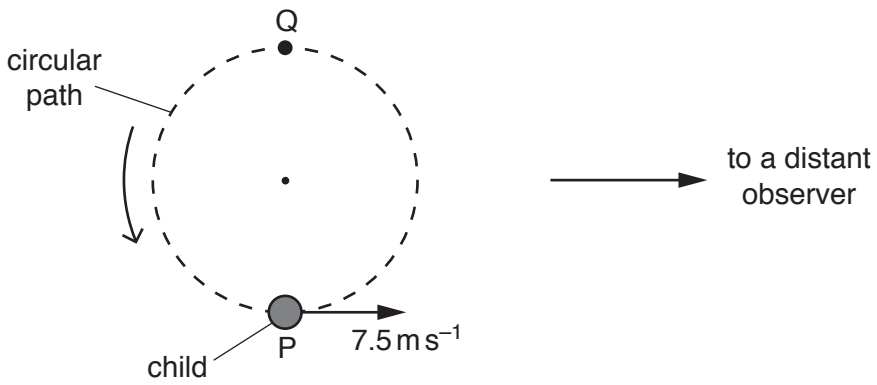

Fig. 4.1

An observer is standing a long distance away from the child. During one particular revolution, the child, moving at a speed of $7.5\,m\,s^{-1}$, starts blowing a whistle at point P and stops blowing it at point Q on the circular path.

The whistle emits sound of frequency 950 Hz. The speed of sound in air is $330\,m\,s^{-1}$.

(i) Determine the maximum frequency of the sound heard by the distant observer.

maximum frequency = ... Hz [2]

(ii) Describe the variation in the frequency of the sound heard by the distant observer.

.....

.....

.....

.....[2]

[Total: 6]

Question	Answer	Marks
4 (a)	(two) waves travelling (at same speed) in opposite directions overlap	**1**
	waves (are same type and) have same frequency/wavelength	**1**
4 (b) (i)	λ = 12 / 250 (= 0.048 m)	**1**
	distance = 1.5 × 0.048 = 0.072 m	**1**
4 (b) (ii)	*T* = 1 / 250 = 0.004 (s) or 4 (ms)	**1**
	1. curve drawn is mirror image of that in Fig. 4.2 and labelled P	**1**
	2. horizontal line drawn between A and B and labelled Q	**1**
		Total: 7
5 (a)	observed frequency is different to source frequency when source moves relative to observer	**1**
5 (b)	360 = (400 × 340) / (340 ± *v*)	**1**
	v = 38 (37.8) m s^{-1}	**1**
	away (from the observer)	**1**
		Total: 5
4 (a)	change in frequency when source moves relative to observer	**1**
	refers to 'change in observed / apparent frequency'	**1**
4 (b) (i)	*f* = (950 × 330) / (330 – 7.5)	**1**
	= 970 (972) Hz	**1**
4 (b) (ii)	frequency decreases	**1**
	from greater than 950 Hz / from 970 (972) Hz / to less than 950 Hz / to 930 (929) Hz / by 40 (43) Hz	**1**
		Total: 6

Notes about the mark scheme are available separately.