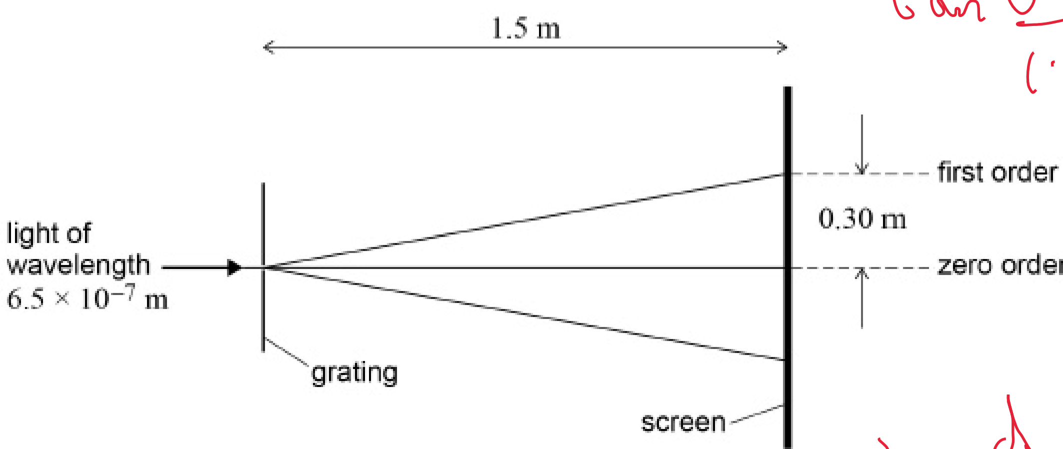
1 A diffraction grating is illuminated normally with light of wavelength 6.5×10^{-7} m
When a screen is 1.5 m from the grating, the distance between the zero and first-order maxima on the screen is 0.30 m



What is the number of lines per mm of the diffraction grating?

A 3.3×10^{-6}

B 3.3×10^{-3}

C 3.0×10^{2}

D 3.0×10^{5}

(Total 1 mark)

2 In a diffraction-grating experiment the maxima are produced on a screen.

What causes the separation of the maxima of the diffraction pattern to decrease?

A using light with a longer wavelength

B increasing the distance between the screen and grating

C increasing the distance between the source and grating

D using a grating with a greater slit separation

(Total 1 mark)

3 (a) Explain what is meant by a progressive wave.

medium isn't transfered but energy is

(2)

(b) **Figure 1** shows the variation with time of the displacement of one point in a progressive wave.

Figure 1

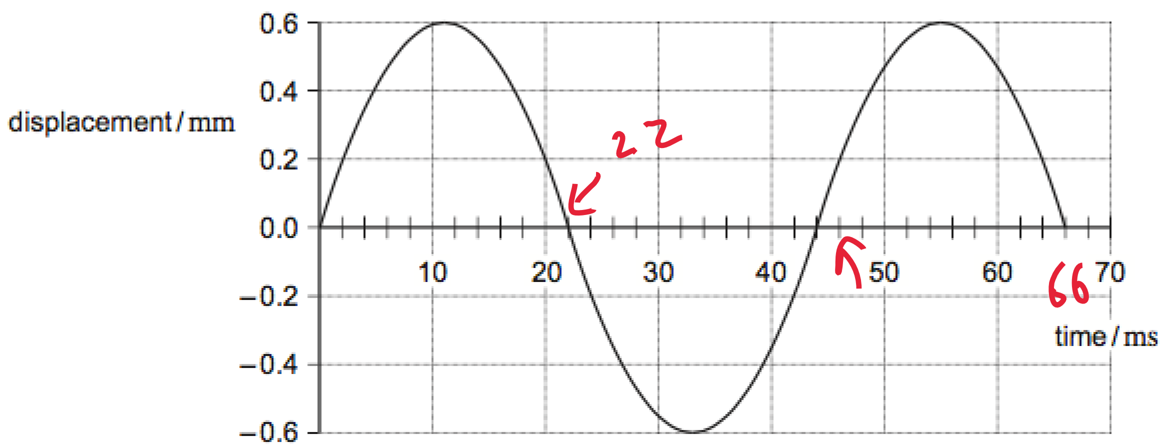
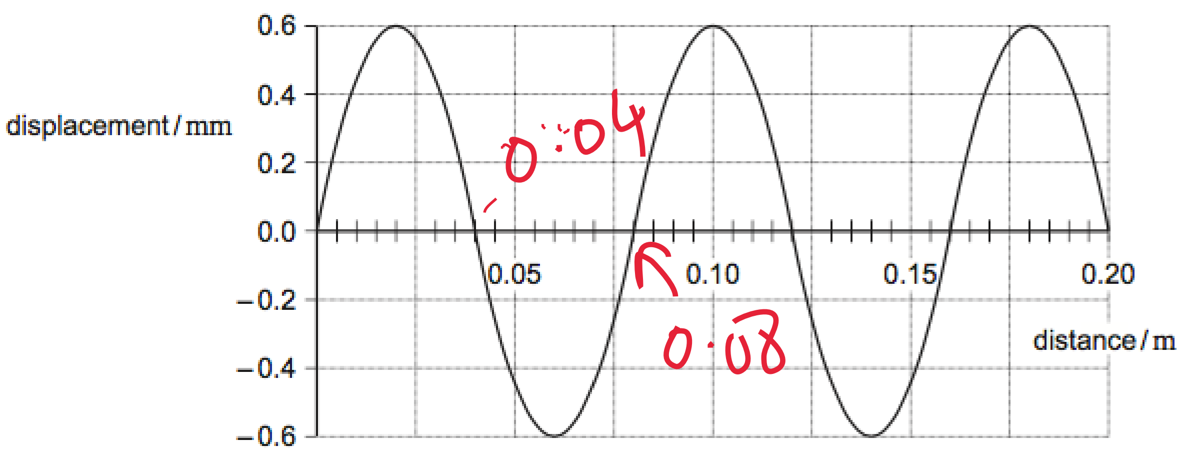


Figure 2 shows the variation of displacement of the same wave with distance.

Figure 2



Use **Figures 1 and 2** to determine

(i) the amplitude of the wave

amplitude = 0.6 mm

(1)

(ii) the wavelength of the wave

wavelength = 0.08 m

(1)

(iii) the frequency of the wave

T = 44 ms

frequency = 23 (25) Hz

(1)

(iv) the speed of the wave

c = fλ

speed = 1.8 m s^{-1}

(1)

(c) Which of the following statements apply?
Place a tick (✓) in the right-hand column for each correct statement.

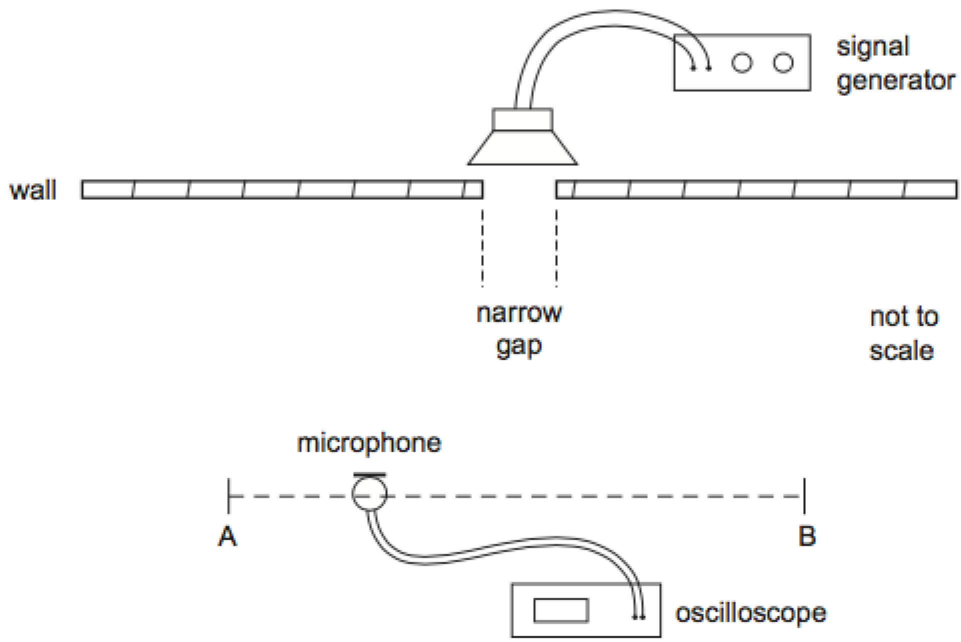
	✓ if correct
sound waves are transverse	
sound waves are longitudinal	✓
sound waves can interfere	✓
sound waves can be polarised	

(1)

(d) In an investigation, a single loudspeaker is positioned behind a wall with a narrow gap as shown in **Figure 3**.

A microphone attached to an oscilloscope enables changes in the amplitude of the sound to be determined for different positions of the microphone.

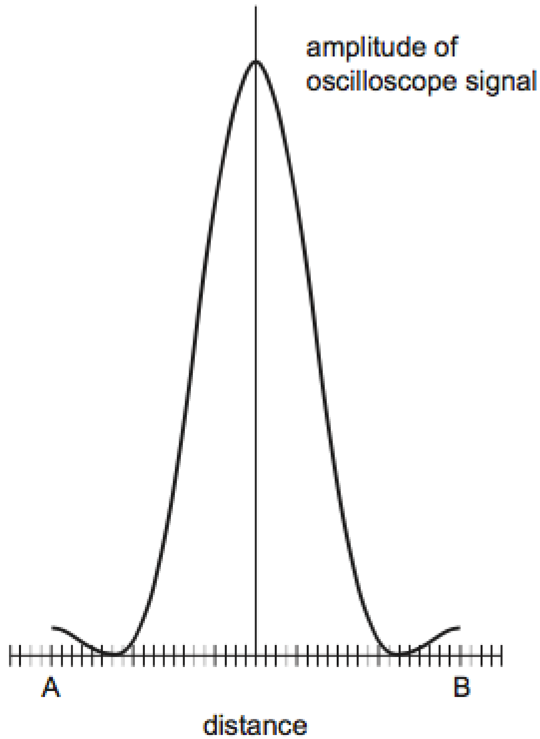
Figure 3



The amplitude of sound is recorded as the microphone position is moved along the line AB a large distance from the gap.

The result of the measurements is shown in **Figure 4**.

Figure 4



The signal generator is adjusted so that sound waves of the same amplitude but of a higher frequency are emitted by the loudspeaker. The investigation using the apparatus shown in **Figure 3** is then repeated.

Explain the effect this has on **Figure 4**.

f ↑ so λ ↓

therefore lambda is smaller compared to the slit width so less diffraction meaning the central max is narrower

As it is narrower the energy is spead over a smaller distance and so the peak is higher.

(3)

(Total 10 marks)

Mark schemes

1 **C**

[1]

2 D

[1]

3 (a) A wave transfers energy <u>from one point to another</u> ✓
without transferring material / (causing permanent displacement of the medium) ✓ owtte

2

(b) (i) 0.6 (mm) or 0.60 (mm) ✓

1

(ii) 0.080 (m) ✓

Allow 1 sig fig

1

(iii) $f = 1/T = 1/0.044 = 23$ (Hz) ✓ (22.7 Hz)

1

(iv) $v = f\lambda = 22.7 \times 0.080 = 1.8$ (m s^{-1}) ✓ (1.82 m s^{-1})

allow CE v = (biii) × (bii) but working must be shown

1 sig fig not acceptable

1

(c)

sound waves are transverse	sound waves are longitudinal	sound waves can interfere	sound waves can be polarised
	√	√	

1

(d) the wavelength would be smaller
smaller spread in main peak or more peaks (between A and B)
the central peak is higher (owtte)
as the energy is concentrated over a smaller area (owtte)
reference to ($\sin \theta_{min} = \lambda/d$)
✓ ✓ ✓ any 3 lines max 3

Note that the marks here are for use of knowledge rather than performing calculations.

No bod if writing does not make <u>in</u>crease or <u>de</u>crease clearly distinct.

Marking should be lenient.

3

[10]