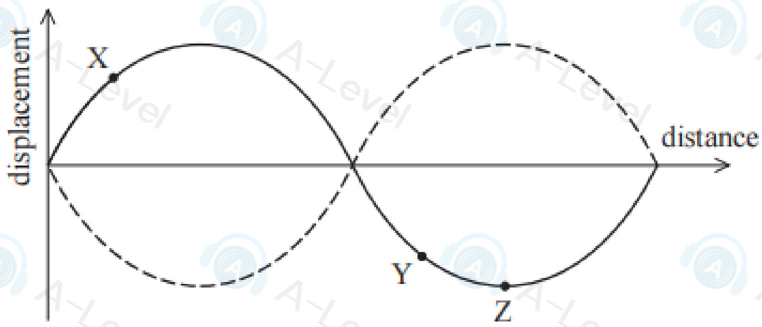
8 A water wave meets a small gap in a barrier.

Which row of the table correctly describes the speed and wavelength of the water wave after passing through the gap?

	speed	wavelength
☒ **A**	unchanged	decreased
☒ **B**	decreased	unchanged
☒ **C**	increased	increased
☒ **D**	unchanged	unchanged

(Total for Question 8 = 1 mark)

10 The diagram shows how the displacement varies with distance along a stationary wave at two instants of time.



Which of the following statements is **not** correct?

☒ **A** Points X and Z are in antiphase with each other.

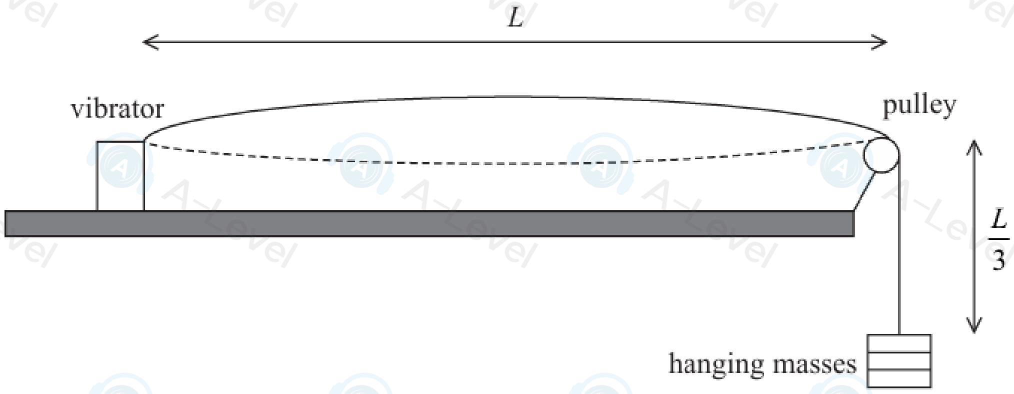
☒ **B** Points Y and Z have the same amplitude of vibration.

☒ **C** Points Y and Z have the same frequency of vibration.

☒ **D** Point Z is an antinode.

(Total for Question 10 = 1 mark)

6 The speed of waves on a vibrating string is investigated using the apparatus shown.



length of string between vibrator and pulley = L

length of string between pulley and hanging masses = $\frac{L}{3}$

mass of whole string = m
mass of hanging masses = M

Which of the following expressions represents the speed of the waves on the string?

☒ **A** $\sqrt{\left(\frac{4MgL}{3m}\right)}$

☒ **B** $\sqrt{\left(\frac{2MgL}{3m}\right)}$

☒ **C** $\sqrt{\left(\frac{MgL}{m}\right)}$

☒ **D** $\sqrt{\left(\frac{MgL}{3m}\right)}$

DO NOT WRITE IN THIS AREA

8 A string is placed under tension T. A wave travels along the string.

A second string has the same mass but twice the length. A wave travels along this string with the same velocity as the wave in the first string.

Which of the following is the tension in the second string?

☒ **A** $4T$

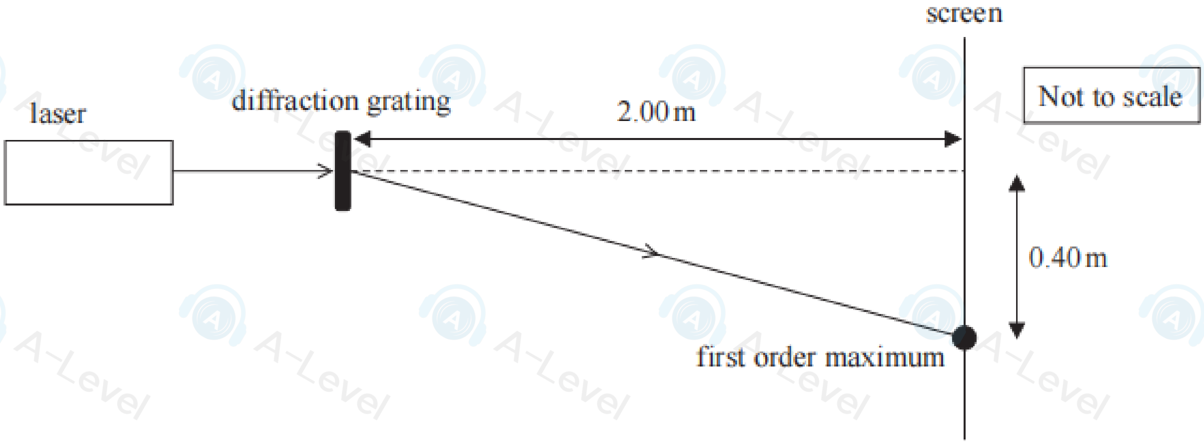
☒ **B** $2T$

☒ **C** $\frac{T}{2}$

☒ **D** $\frac{T}{4}$

(Total for Question 8 = 1 mark)

3 A diffraction grating has 300 lines per mm. When laser light is directed towards the diffraction grating, a diffraction pattern is observed on a screen. The position of a first order maximum on the screen is shown in the diagram.



Which of the following calculations should be used to determine the wavelength, in mm, of the laser light used?

☒ **A** $300\sin\theta$ where $\theta = \sin^{-1}\left(\frac{0.40}{2.00}\right)$

☒ **B** $300\sin\theta$ where $\theta = \tan^{-1}\left(\frac{0.40}{2.00}\right)$

☒ **C** $\frac{\sin\theta}{300}$ where $\theta = \sin^{-1}\left(\frac{0.40}{2.00}\right)$

☒ **D** $\frac{\sin\theta}{300}$ where $\theta = \tan^{-1}\left(\frac{0.40}{2.00}\right)$

(Total for Question 3 = 1 mark)

2 A student determines the wavelength of the light emitted by a laser. She uses the laser, a diffraction grating and a screen.

Which of the following measurements is **not** required?

☒ **A** the distance from the diffraction grating to the screen

☒ **B** the distance from the central maximum to the first order maximum

☒ **C** the distance from the laser to the diffraction grating

☒ **D** the distance between the slits in the diffraction grating

(Total for Question 2 = 1 mark)

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1 The spreading of a wave as it passes around an obstacle is called

☒ **A** diffraction.

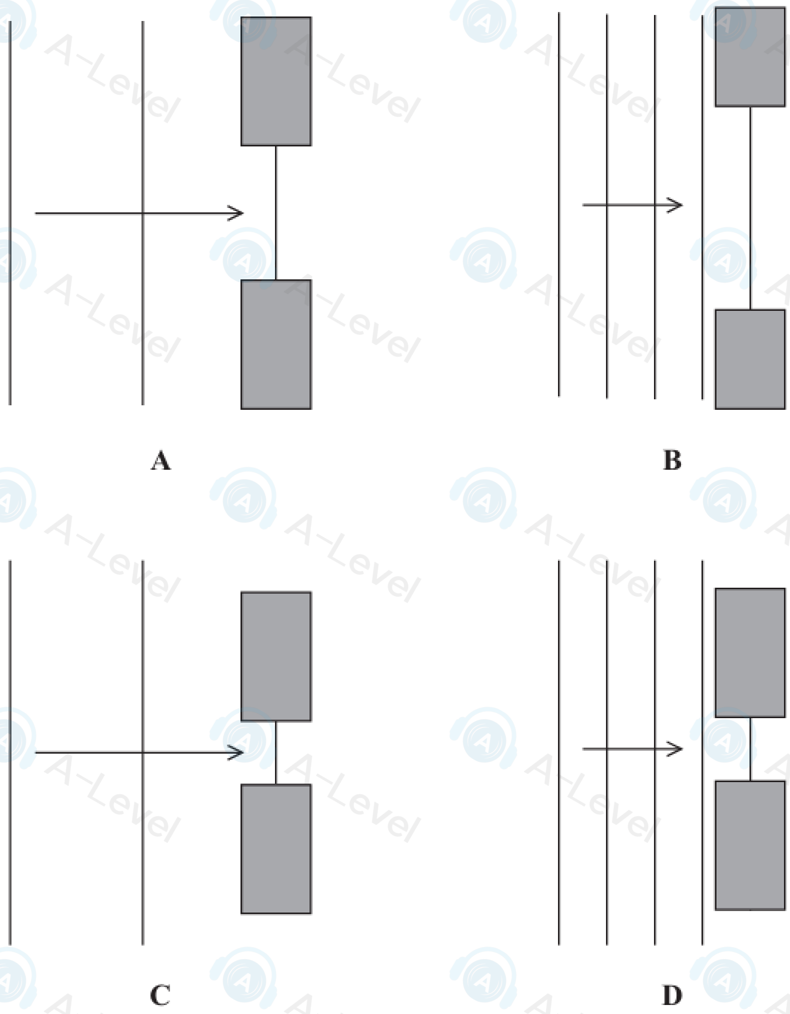
☒ **B** polarisation.

☒ **C** reflection.

☒ **D** refraction.

(Total for Question 1 = 1 mark)

9 The wavefront diagrams show consecutive waves approaching gaps of different sizes.



The wavefronts diffract as they pass through each gap.

In which diagram will the diffracted wavefronts **not** be semicircular?

☒ **A**

☒ **B**

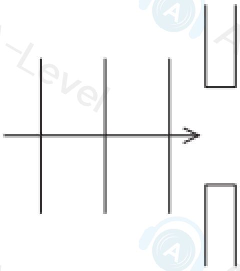
☒ **C**

☒ **D**

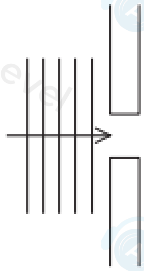
(Total for Question 9 = 1 mark)

4 The four diagrams represent moving wavefronts that are one wavelength apart. In each set-up, diffraction will occur as the wavefront passes through the gap.

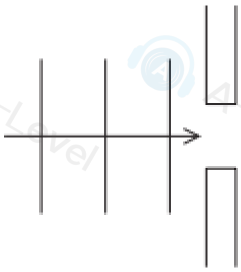
Which set-up will produce the greatest diffraction?



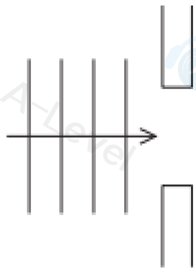
A



B



C

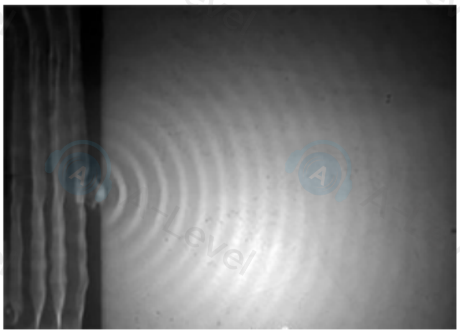


D

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 4 = 1 mark)

8 The photograph shows waves in a ripple tank passing through a gap in a barrier.



Which of the following properties of waves is being demonstrated as the waves pass through the gap?

☒ **A** diffraction

☒ **B** reflection

☒ **C** refraction

☒ **D** superposition

(Total for Question 8 = 1 mark)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

16 (a) Microwave ovens are used to cook food. Microwaves are emitted inside the oven and reflected from the sides, forming standing waves.

*(i) One problem with using a microwave oven is the formation of hot and cold spots within the food.

Explain how hot and cold spots are formed within the food.

(3)

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(ii) The distance between two adjacent hot spots in the food is 1.4 cm.

Calculate the frequency of the microwaves.

(3)

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Frequency = ...

(iii) Suggest how the effect of hot and cold spots is reduced by placing food on a rotating turntable.

(1)

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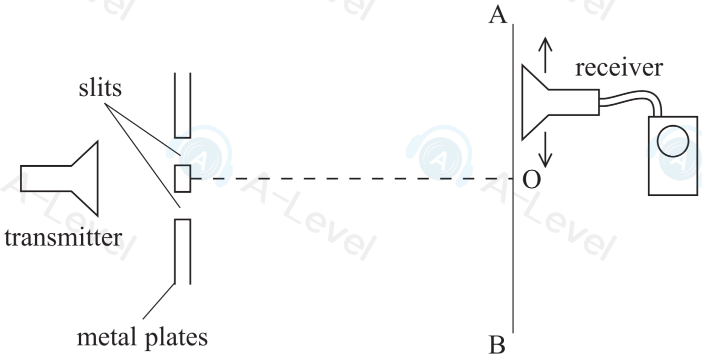
(b) The interference of microwaves can be investigated in the laboratory using a microwave transmitter and receiver. Microwaves from the transmitter pass through two slits formed between metal plates, as shown.



As the receiver is moved along AB, alternate points of maximum and minimum readings are observed.

*(i) Explain why O is a point of maximum reading.

(3)

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(ii) Explain why maximum and minimum readings are observed alternately as the receiver is moved along the line AB.

(2)

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(Total for Question 16 = 12 marks)

18 The photograph shows a musical instrument called a violin.

The violin has four strings. Each string is held in a fixed position by a peg and at the bridge.

When a string is plucked, a stationary wave forms on the string.

(a) Explain how a stationary wave forms on the string.

(3)

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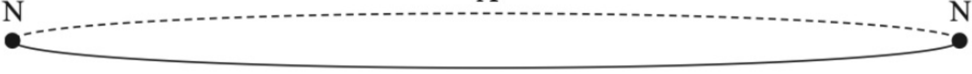
(b) The simplest stationary wave that can be formed on the string has a node (N) at each end and an antinode (A) at the centre, as shown.



The frequency of this wave is called the fundamental frequency.

The strings on a violin have different fundamental frequencies, as shown in the table.

String	Fundamental frequency/Hz
1	196
2	294
3	440
4	659

The tension in one of the strings is 71.5 N. The length of the string is 32 cm and the mass per unit length of the string is 2.03×10^{-3} kg m^{-1}.

Deduce whether this is string 1, 2, 3 or 4.

(4)

14 A student used a diffraction grating to investigate the properties of light.

(a) Light is a transverse wave.

State what is meant by a transverse wave.

(1)

....

14 A student used a diffraction grating to investigate the properties of light.

(a) Light is a transverse wave.

State what is meant by a transverse wave.

(1)

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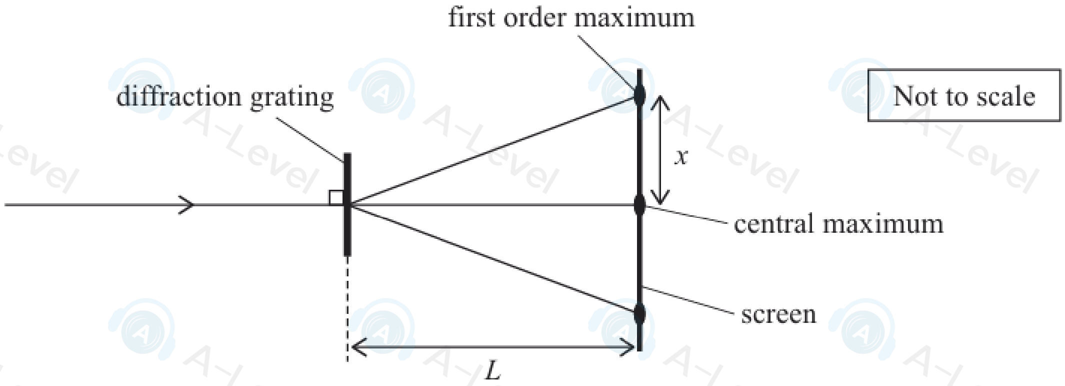
....

(b) The student directed monochromatic light of wavelength λ onto the diffraction grating. A series of maxima was produced on a screen a distance L from the diffraction grating, as shown.



The distance between the central maximum and the first order maximum was x.

(i) Calculate the number of lines per mm on the diffraction grating.

$\lambda = 650\,\text{nm}$
$L = 1.30\,\text{m}$
$x = 0.22\,\text{m}$

(4)

....

14 A student used a diffraction grating to investigate the properties of light.

(a) Light is a transverse wave.

State what is meant by a transverse wave.

(1)

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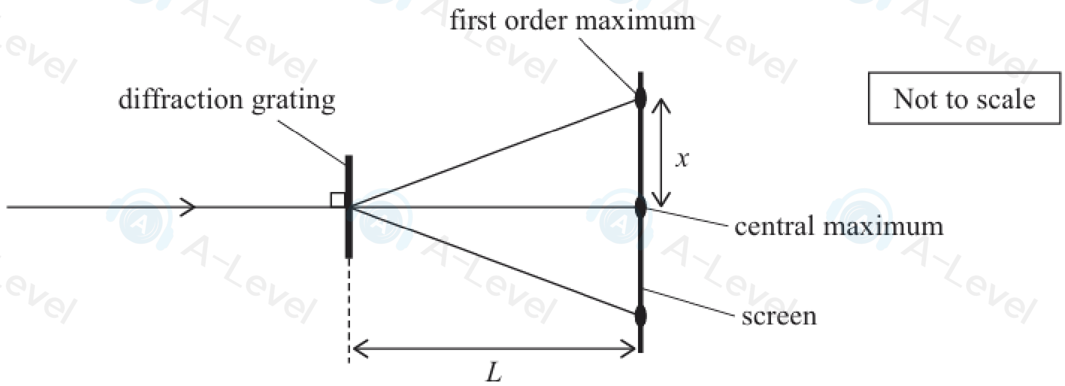

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$\lambda = 650\,\text{nm}$
$L = 1.30\,\text{m}$
$x = 0.22\,\text{m}$

(4)

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Number of lines per mm = ...

(ii) Explain how a first order maximum is produced on the screen.

(3)

15 The photograph shows a musical instrument called a harp.

When a harp string is plucked, transverse waves travel along the string forming a standing wave.

(a) State what is meant by a transverse wave.

(1)

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(b) The diagram represents one string of the harp.

The string is fixed at both ends.

The string is made to vibrate at its lowest frequency.

Add to the diagram to show the stationary wave on the string. You should label any nodes and antinodes.

(2)

(c) One string produces sound with a frequency of 196 Hz. The wavelength of the wave on the string is 0.72 m. The tension in the string is 41 N.

This string breaks and needs replacing with a new string.

The table shows the mass of four new strings, A, B, C and D.
Each new string has a length of 1.5 m.

String	Mass of string / g
A	1.5
B	3.1
C	4.4
D	6.3

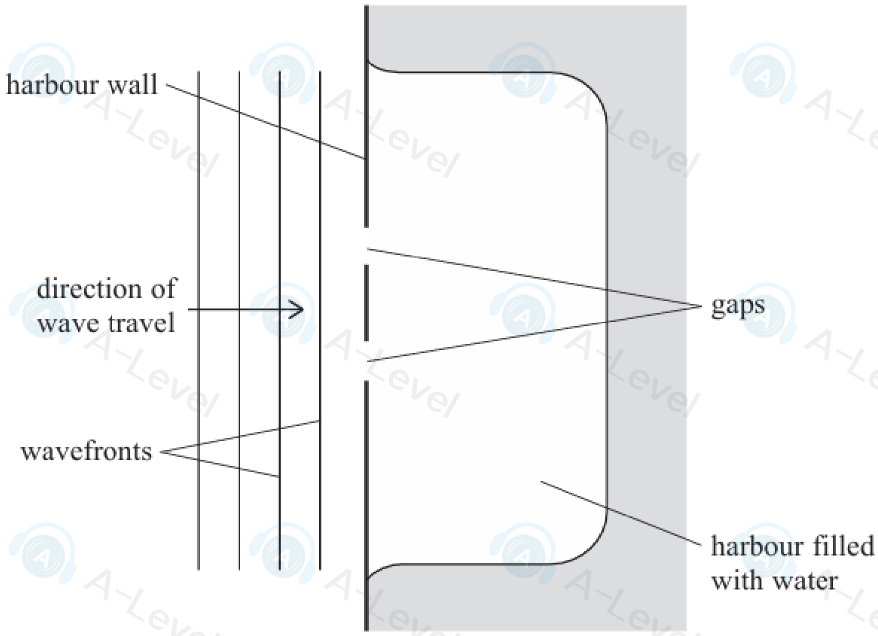
The new string is cut to the same length as the broken string, and is placed under the same tension.

Deduce which new string, A, B, C or D, should be used to replace the broken string.

(4)

17 Boats can shelter from waves on the sea in a harbour.

The diagram shows a harbour where boats can enter and leave through two gaps in the harbour wall.



Waves on the sea are diffracted as they pass through the gaps in the harbour wall.

(a) Describe how Huygens' construction can be used to predict the shape of diffracted wavefronts.

(2)

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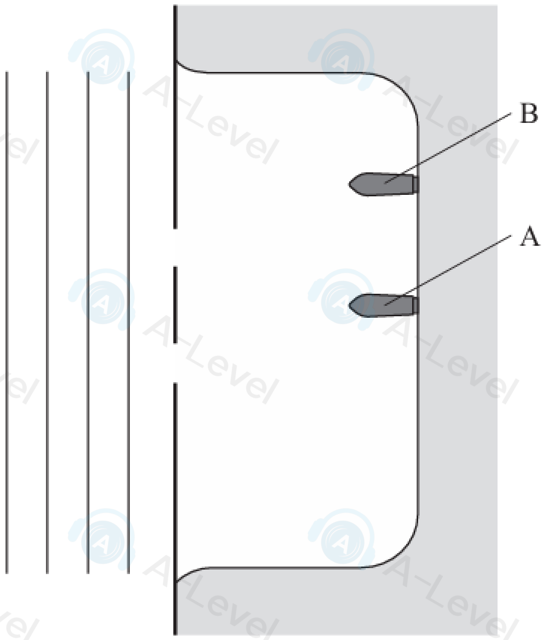
*(b) The wavefronts in the sea arrive parallel to the harbour wall. The wavelength of the waves varies as the weather varies.

There are identical boats at two positions, A and B, in the harbour, as shown.



As the wavelength of the waves varies:

- the boat at position A always oscillates with a large amplitude
- the boat at position B sometimes oscillates with a large amplitude and sometimes oscillates with a very small amplitude.

Explain why the boats oscillate as described.