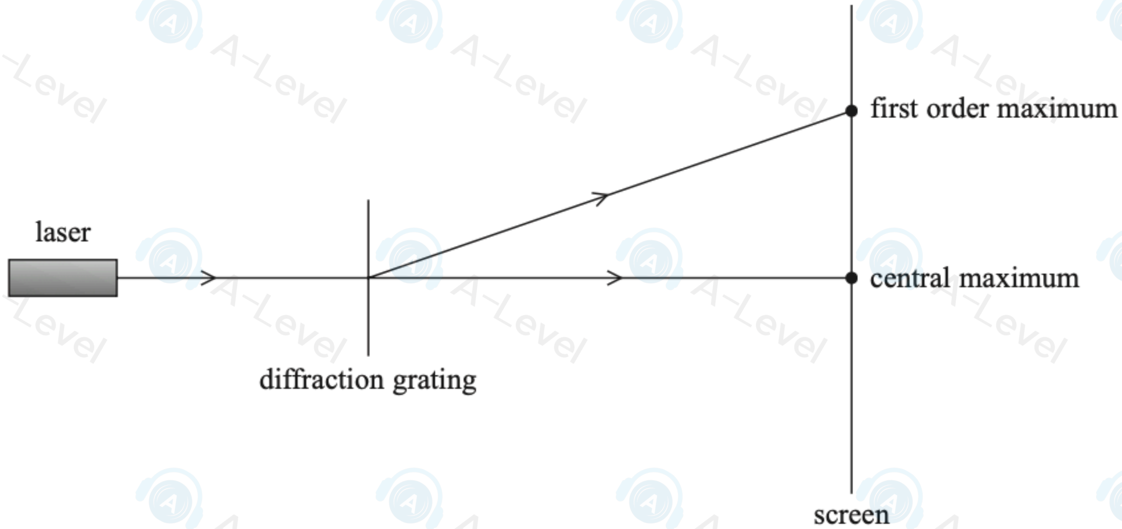
8 Light from a laser is incident on a diffraction grating, causing a series of maxima to be seen on a screen.

The positions of the central maximum and first order maximum are shown.



Which of the following changes would decrease the distance between the central maximum and the first order maximum?

☒ **A** Decreasing the distance from the laser to the diffraction grating

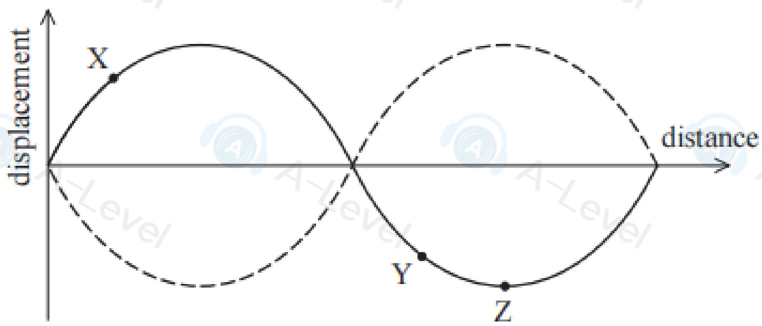
☒ **B** Increasing the distance from the diffraction grating to the screen

☒ **C** Using a diffraction grating with more lines per millimetre

☒ **D** Using light with a smaller wavelength

(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.

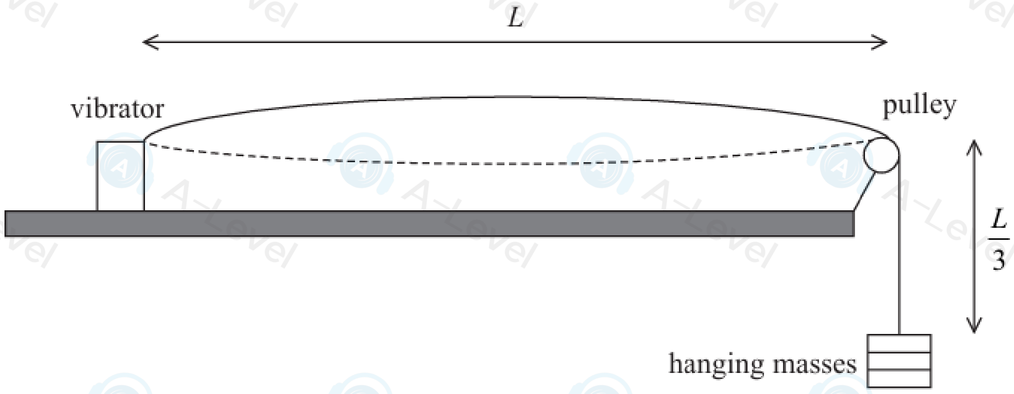
☒ **B** Points Y and Z have the same amplitude of vibration.

☒ **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

2 The equation $n\lambda = d\sin\theta$ can be used to determine the wavelength of laser light that has passed through a diffraction grating.

Which of the following is represented by d in the equation?

A distance between adjacent lines on the diffraction grating

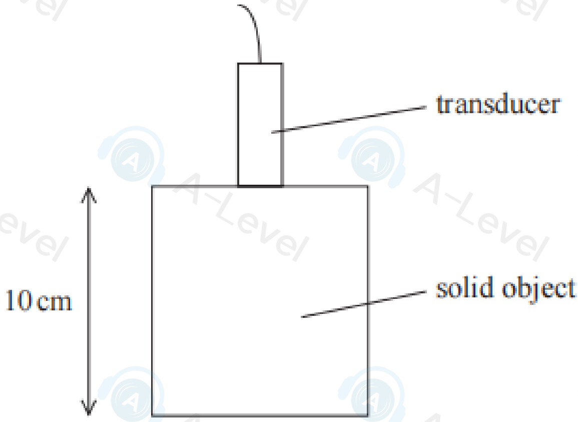
B distance between the diffraction grating and the screen

C number of lines per metre on the diffraction grating

D order of the maximum observed on the screen

(Total for Question 2 = 1 mark)

7 An ultrasound transducer is placed on the surface of a solid object as shown.



A pulse of ultrasound is transmitted into the object. The pulse is received at the transducer 50 μs after it is emitted.

Which of the following can be used to calculate the speed of sound in this object?

☒ **A** $\frac{0.10}{50 \times 10^{-6}}$

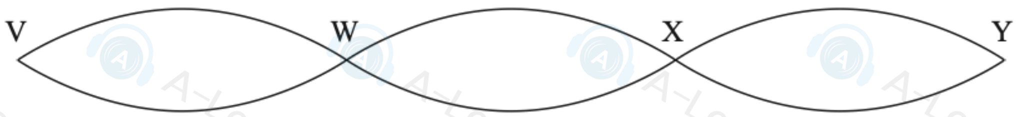
☒ **B** $\frac{0.10}{25 \times 10^{-6}}$

☒ **C** $\frac{0.10}{100 \times 10^{-6}}$

☒ **D** $\frac{0.20}{25 \times 10^{-6}}$

(Total for Question 7 = 1 mark)

Questions 6 and 7 refer to the standing wave pattern on a string as shown.



6 The length of the string VY is 0.6 m.

Which of the following is the wavelength of the standing wave?

☒ **A** 0.2 m

☒ **B** 0.4 m

☒ **C** 0.6 m

☒ **D** 0.9 m

(Total for Question 6 = 1 mark)

3 When a guitar string is plucked, a sound of constant frequency is heard.

The wave produced on the vibrating guitar string is

☒ **A** longitudinal and progressive.

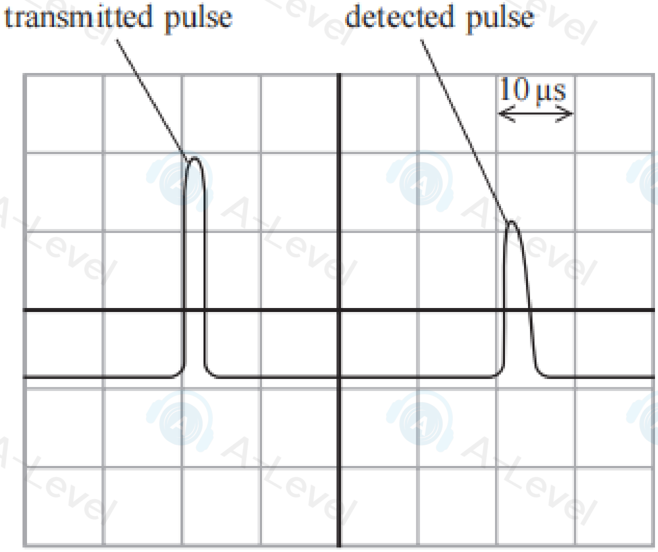
☒ **B** longitudinal and stationary.

☒ **C** transverse and progressive.

☒ **D** transverse and stationary.

(Total for Question 3 = 1 mark)

8 The oscilloscope screen below shows the transmitted and detected pulses.



The speed of ultrasound in the first material is v.
Each division on the oscilloscope screen represents 10 μs.

What is the approximate thickness of the first material?

☒ **A** $(20 \times 10^{-6})\ v$

☒ **B** $(25 \times 10^{-6})\ v$

☒ **C** $(40 \times 10^{-6})\ v$

☒ **D** $(80 \times 10^{-6})\ v$

(Total for Question 8 = 1 mark)

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)

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

Calculate the frequency of the microwaves.

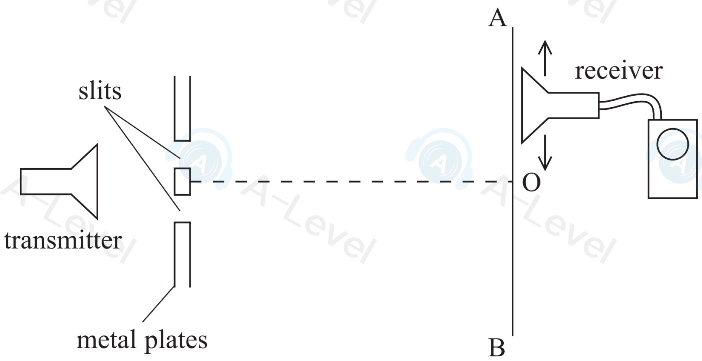
(3)

Frequency = ...

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

(1)

(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)

....

....

....

....

....

....

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

(2)

....

....

....

....

(Total for Question 16 = 12 marks)

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.

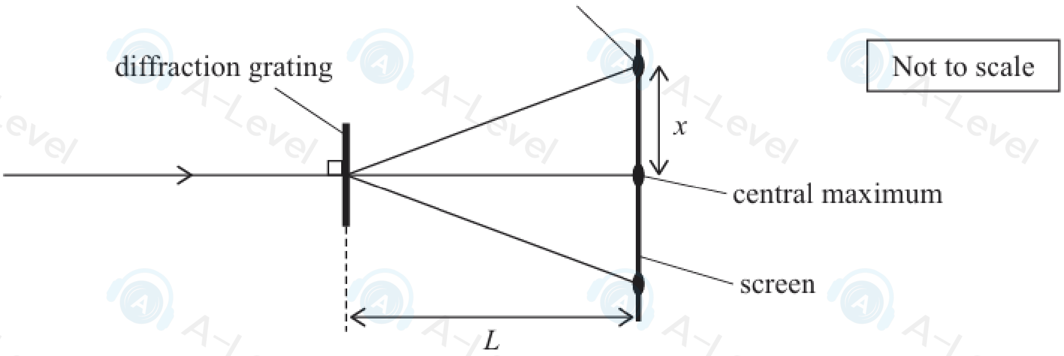
State what is meant by a transverse wave.

(1)

....

....

(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.

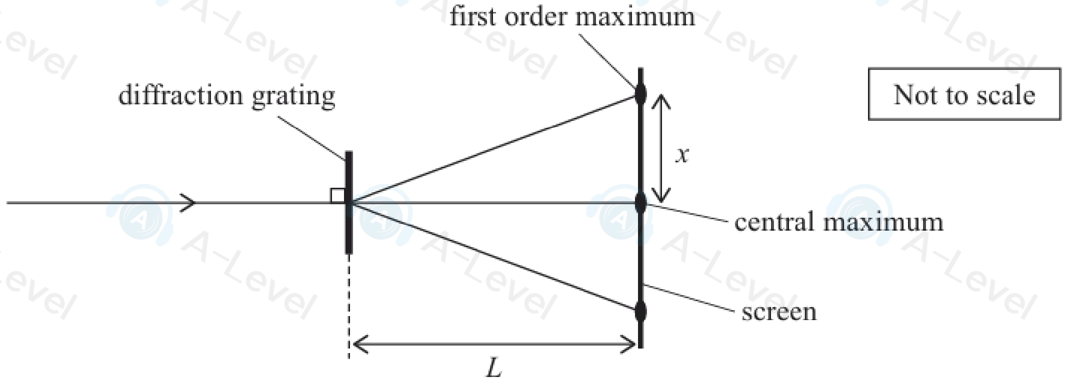
State what is meant by a transverse wave.

(1)

....

....

(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)

....

....

....

....

....

....

....

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)

....

....

(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)

DO NOT WRITE IN THIS AREA

(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.

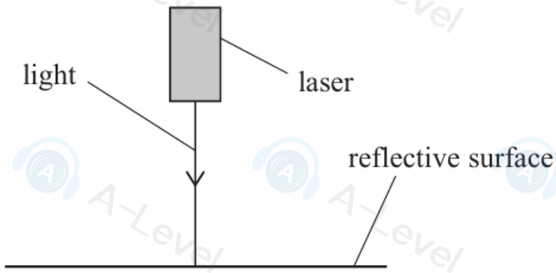
String	Mass of string / g
A	1.5
B	3.1
C	4.4
D	6.3

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)

11 Light from a laser is incident at 90° to a reflective surface, as shown.



(a) Light from the laser is coherent.

State what is meant by coherent.

(1)

....

....

(b) State why a standing wave forms between the laser and the reflective surface.

(1)

....

....

(Total for Question 11 = 2 marks)