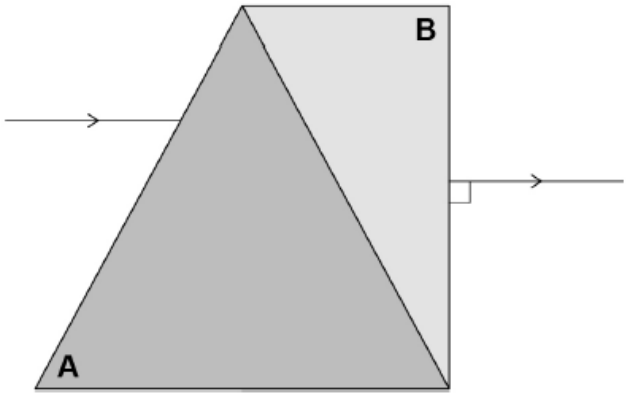
Waves – A2 Physics P1

1. No.3

0 3 **Figure 1** shows two prisms **A** and **B** of different refractive indices joined to make a block.
A ray of monochromatic light is shown entering and then leaving the block.

Figure 1



0 3 . 1 Complete, on **Figure 1**, the path of the ray of light inside the block.

[1 mark]

0 3 . 2 Deduce which prism, **A** or **B**, has the greater refractive index.

[2 marks]

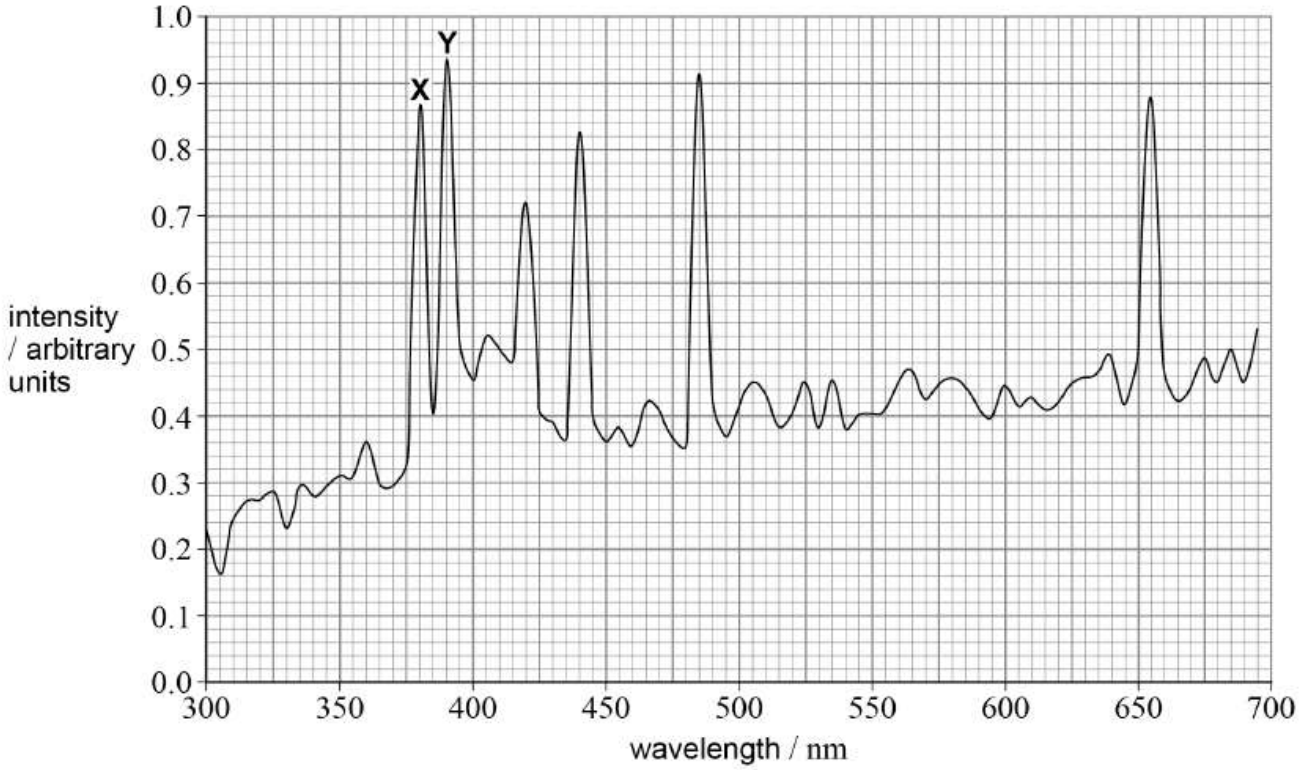
The block is used with a telescope to investigate stars.
The block can be replaced with a diffraction grating.

0 3 . 3 Describe **one** non-astronomical application of a diffraction grating.

[1 mark]

0 3 . 4 **Figure 2** shows a spectrum of light. Two lines in the spectrum are labelled **X** and **Y**.

Figure 2



The light passes at normal incidence through a diffraction grating. The number of lines per metre for the grating is G.

The first-order diffraction angle of **X** is at $28.2°$ to the normal.

Calculate G.

[3 marks]

$G =$ _____ m^{-1}

0 3 . 5 A scientist wants to obtain an accurate value for the difference in wavelength between line **X** and line **Y**.

She has two options:

- option 1: to analyse the second-order spectrum from the original grating
- option 2: to analyse the first-order spectrum from a grating with $2G$ lines per metre.

Discuss which option she should choose.

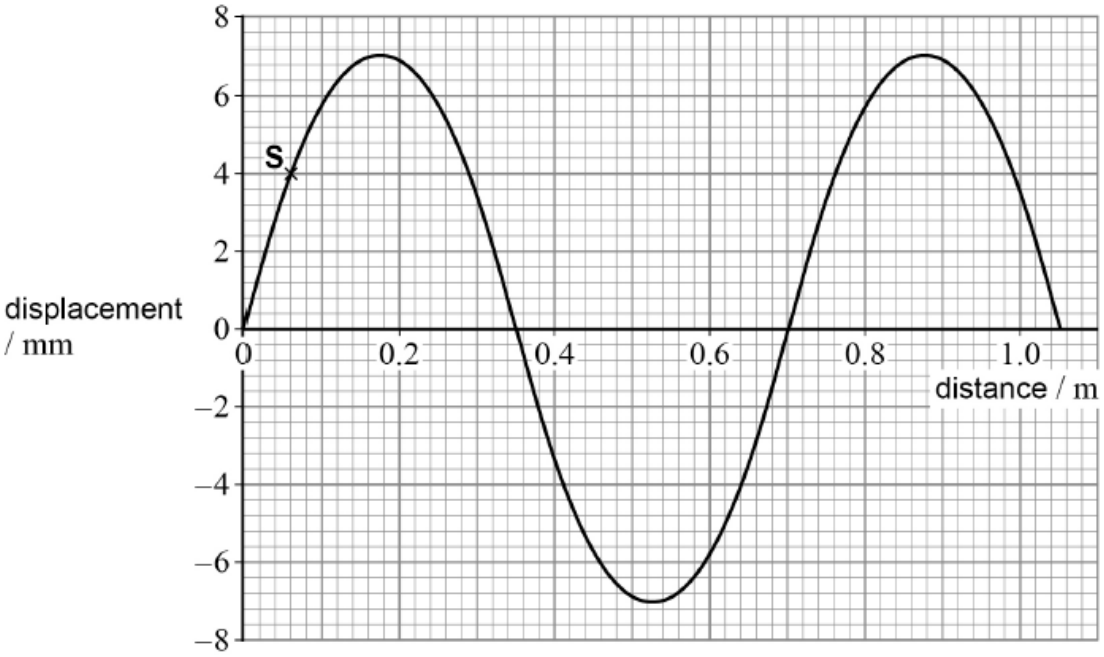
[3 marks]

2. No.7

0 7 An experiment is done to investigate stationary waves on a string.
A string of length 1.05 m is attached between a clamp stand and a vibration generator. A stationary wave is formed on the string when the vibration generator frequency is 625 Hz.

Figure 6 shows the variation of displacement with distance from one end of the string at time $t = 0$
At this time all points on the string have their maximum displacement.
S is one point on the string.

Figure 6



The stationary wave is produced by two progressive waves travelling in opposite directions on the string.

0 7 . 1 Deduce the amplitude of one of the progressive waves.

[1 mark]

amplitude = _____ mm

0 7 . 2 Determine, in $\mathrm{m\ s^{-1}}$, the speed of one of the progressive waves.

[2 marks]

speed = _____ $\mathrm{m\ s^{-1}}$

0 7 . 3 State the phase relationship between the two waves when $t = 0$

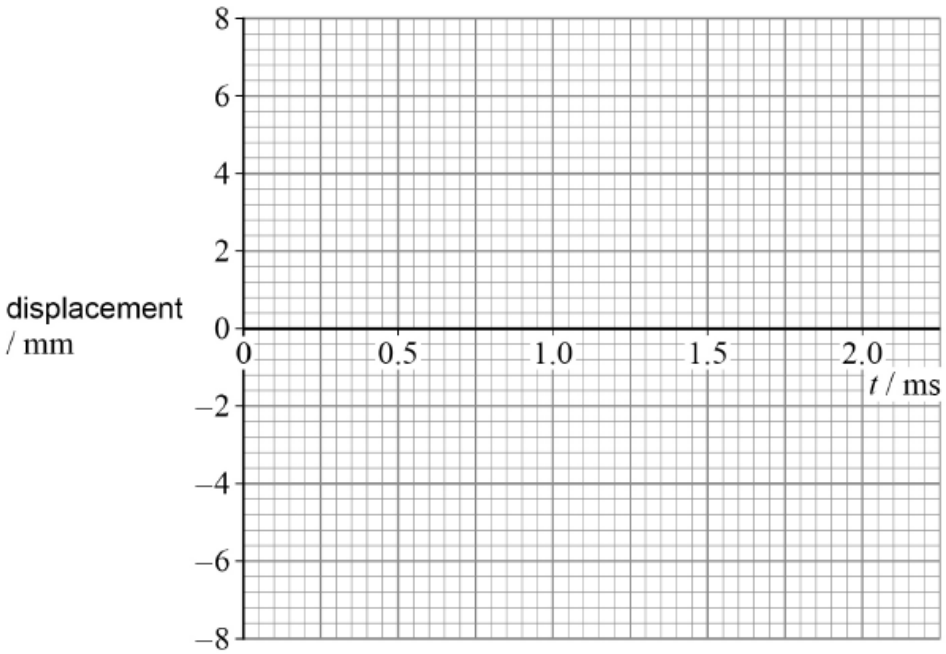
[1 mark]

_____

0 7 . 4 Sketch, on **Figure 7**, a graph to show how the displacement of **S** varies with t.

[3 marks]

Figure 7



3. No.13

A laser emits light of wavelength 600 nm for 10 ns.

What is the number of complete waves emitted by the laser?

[1 mark]

A 5×10^{17} ⬭

B 5×10^{12} ⬭

C 5×10^{8} ⬭

D 5×10^{6} ⬭

4. No.14

A detector measures the intensity of light from a source S_1.
Polaroid material is placed between source S_1 and the detector. When the material is rotated through a small angle, the detected intensity does not change.
When this procedure is repeated for a source S_2, the detected intensity decreases.

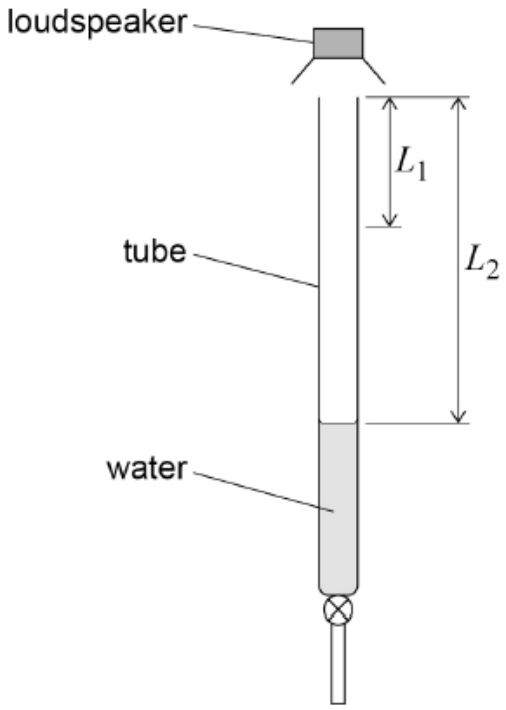
Which is correct?

[1 mark]

	Light waves from S_1	**Light waves from S_2**	
A	unpolarised	polarised	⬭
B	unpolarised	unpolarised	⬭
C	polarised	polarised	⬭
D	polarised	unpolarised	⬭

5. No.15

A loudspeaker producing a single-frequency sound is mounted above a tube filled with water. A tap at the bottom of the tube is opened to allow the water to run out.



A student observes the change in loudness of the sound emitted by the tube as the water runs out.

When the length of the column of air in the tube reaches L_1, the loudness is at its first maximum.

The next maximum is reached when the length of the column of air is L_2.

What is the wavelength of the sound emitted by the loudspeaker?

[1 mark]

A L_2 ⬭

B $2L_1$ ⬭

C $L_2 - L_1$ ⬭

D $2(L_2 - L_1)$ ⬭

6. No.16

Point sources of sound of the same frequency are placed at S_1 and S_2.

A sound detector is moved slowly along the line **PQ**. Consecutive maxima of sound intensity are detected at **W** and **Y** and consecutive minima are detected at **X** and **Z**.

What is the wavelength of the sound?

[1 mark]

A $(S_1Y–S_2Y) – (S_1W–S_2W)$ ⬭

B $(S_1X–S_2X) – (S_1W–S_2W)$ ⬭

C $(S_1Y–S_2Y) – (S_1X–S_2X)$ ⬭

D $(S_1Z–S_2Z) – (S_1W–S_2W)$ ⬭

7. No.17

Monochromatic light is used in a Young's double-slit interference experiment after passing through a single slit. The resulting fringe pattern is observed on a screen.

The separation of the fringes can be increased by

[1 mark]

A using monochromatic light of lower frequency. ⬭

B decreasing the width of the single slit. ⬭

C increasing the separation of the double slits. ⬭

D decreasing the distance between the double slits and the screen. ⬭