



VCE PHYSICS UNITS 3&4 [2020]

Unit 4 AOS 1 - How can waves explain the behaviour of light? - Topic exam 2

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STRUCTURE OF EXAM

Section A - Section A	12 questions	41 marks
		41 marks

WHEN YOU FINISH

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SECTION A – SECTION A

Question 1 (5 marks)

Students set up the apparatus shown in Figure 1 to repeat Young's double slit experiment. They use a laser of $\lambda = 560\text{nm}$ as the light source. In the first experiment, the separation, d , of the two narrow slits S_1 and S_2 is 0.32 nm . P is a point on the interference pattern at the centre of the second dark band out of the centre.

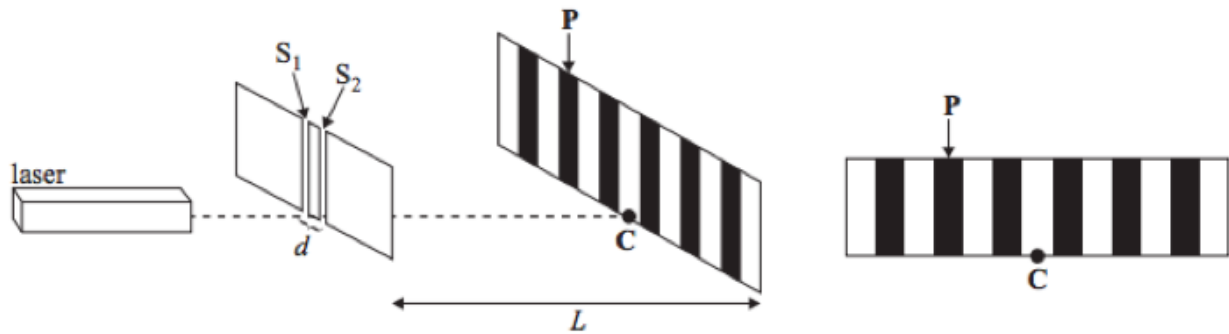


Figure 1

Question 1.a

2 marks

Calculate the path difference $S_2P - S_1P$. Show your working out.

Question 1.b

1 mark

The distance, L , is now increased. Describe the effect of this change on the spacing of the observed interference pattern.

Question 1.c

2 marks

L is reset to its original value. The separation of the slits, d , is then decreased. Describe the effect of this change on the spacing of the observed interference pattern.

Question 2

3 marks

At the time of Young's double-slit experiment there were two competing models of the nature of light. Explain how Young's experiment supported one of these models compared with the other.

Question 3 (1 mark)

Choose the correct statement from the options below.

- A When light passes from water into air, its frequency decreases.
- B When light passes from air into glass, its frequency decreases.
- C When light passes from glass to air, its wavelength decreases.
- D When light passes from air to water, its wavelength decreases.

Question 4

2 marks

Light can be modelled as a wave or as a particle, depending on its observed behaviour. Polarisation of light provides evidence that light behaves like a particular type of wave. Identify which wave this is and explain why this wave model can explain polarisation.

Question 5

2 marks

A particular electromagnetic wave is passed through a tank of water. If the wavelength and frequency were measured to be 430 nm and 440×10^{12} Hz respectively, at what speed is this wave traveling in the water?

Question 6

3 marks

In the paragraph below, options to complete each sentence are given within the brackets. Re-write the paragraph with the correct options only.

Jamie is listening to the sound of an orchestra through a small gap in a partly open sliding door. When the sound wave travels through the gap, **[constructive interference / destructive interference / diffraction]** occurs and spreading of the wave results. High pitched (frequency) instruments such as flutes experience **[more / the same / less]** spreading than lower pitched instruments. As the size of the gap decreases, the angle of spreading will **[increase / not change / decrease]**.

Question 7

2 marks

A child is being pushed by his father on a swing in the local park and complains to his father that he is not moving fast enough. His father reassures his son that he will push the swing more frequently to make him go faster and higher.

Explain whether this will work, making reference to resonance in your answer.

Question 8 (5 marks)

A musician sets up a string under tension and plucks it, observing that a standing wave is established. By changing the tension and length of the string she hears different tones.

Question 8.a

2 marks

What does the difference in tone suggest about the standing wave?

Question 8.b

3 marks

When the ends of the string are set to be 1.0m apart, a standing wave is established with a wave length of 0.4m. Sketch this standing wave below. Clearly label a point on the wave that corresponds to an antinode.



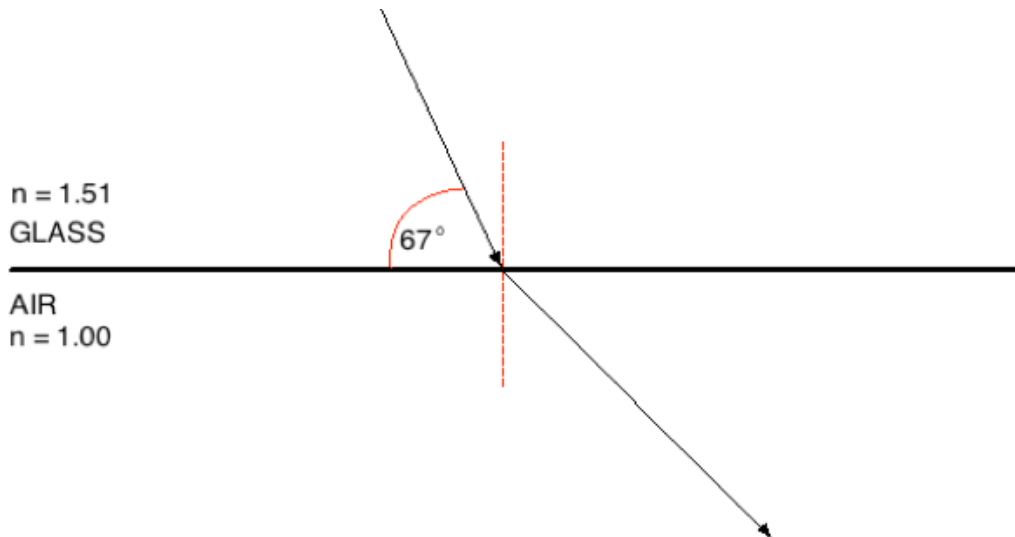
Question 9

2 marks

A sinusoidal wave (amplitude 3 cm) moving to the left across a ripple tank meets a sinusoidal wave (amplitude 4.5 cm) moving to the right across the tank. What is the maximum possible variation in height of the water from its rest position as these waves pass through each other and what is the name of this phenomenon?

Question 10 (12 marks)

Light is travelling through a glass medium before meeting an interface with an air medium, as shown in the diagram below.

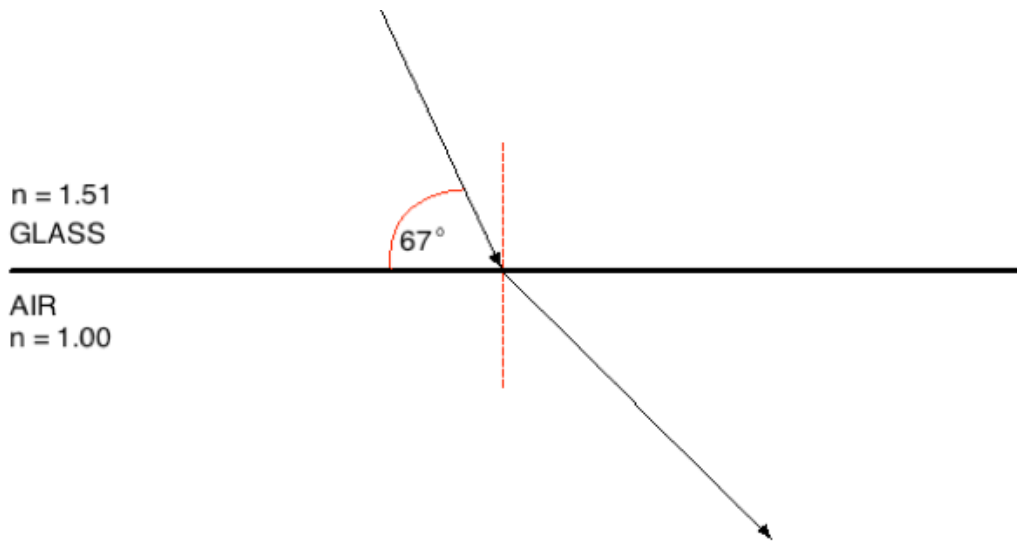


Question 10.a

3 marks

On the diagram, label the following:

- Normal
- Angle of refraction
- Angle of incidence

**Question 10.b**

1 mark

What is the angle of incidence?

Question 10.c

2 marks

Calculate the speed of light in the glass.

Question 10.d

3 marks

Calculate the angle of refraction correct to 2 significant figures.

Question 10.e

3 marks

State what is meant by the term critical angle in this instance and calculate this angle for the glass-air interface.

Question 11

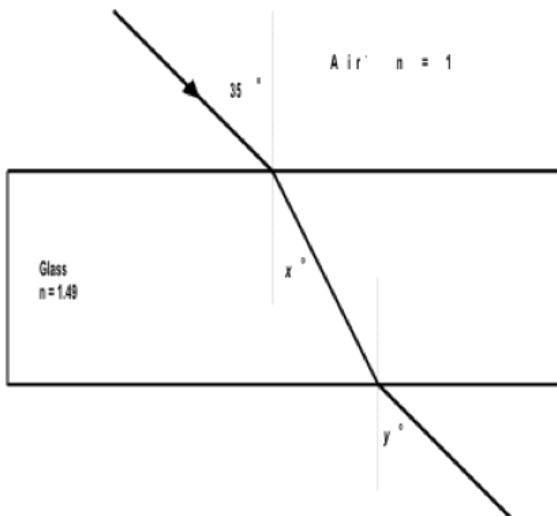
2 marks

Explain why light changes direction as it passes from air to glass, clearly stating the name for this phenomena.

Question 12

2 marks

The diagram below shows the path of green light passing through a glass block. When the beam of green light was replaced with blue light it followed a different path. Add arrows to the diagram below to clearly show the path of the blue beam both inside and outside the glass block.



Please use pen and paper to complete your response.