Neap:

PHYSICS VCE UNITS 3&4
DIAGNOSTIC TOPIC TESTS 2017

TEST 8: HOW CAN WAVES EXPLAIN THE BEHAVIOUR OF LIGHT? (II)

TOTAL 45 MARKS (45 MINUTES)

Student's Name: _____ Teacher's Name: _____

Directions to students

Write your name and your teacher's name in the spaces provided above.
Answer all questions in the spaces provided.

Use $c = 3.0 \times 10^8$ m s^{-1}.

Question 1 (5 marks)

A polariser has an effect on light that is displayed in the diagram in Figure 1.

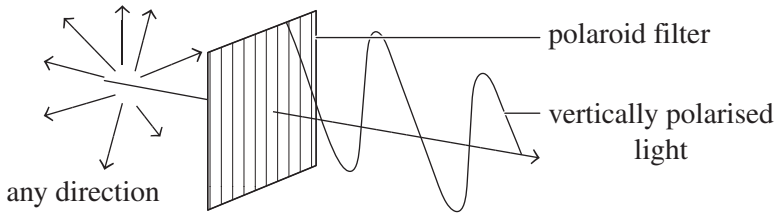

Figure 1

a. Explain how the polariser interacts with light as shown in Figure 1 and relate its interaction to the property of light that is altered by the polariser. 2 marks

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An identical polariser is now placed together with the original one in Figure 1 and this time no light passes through the system of two polarisers.

b. Explain the interaction of light with the system of two polarisers so that no light passes through them. 3 marks

Question 2 (6 marks)

A student conducts a demonstration of dispersion as shown in Figure 2.

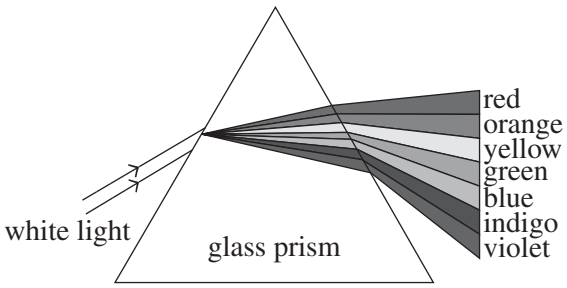

Figure 2

a. Explain the phenomenon of dispersion, making reference to the properties of light and the separation of the colours of light. 3 marks

As a further experiment, the student now passes the green light (only) that is transmitted through the first glass prism into a second identical glass prism as shown in Figure 3.

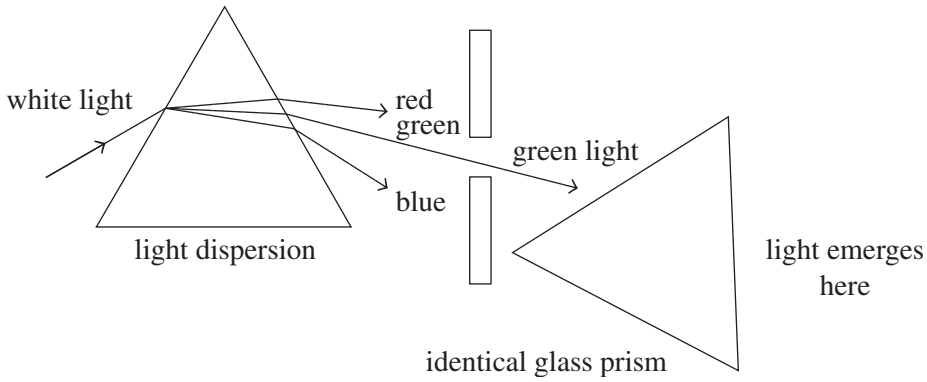

Figure 3

b. What is the reason as to why only green light would be passed into the second prism? 1 mark

c. What does the result of the second part of the experiment regarding light demonstrate? 2 marks

Question 3 (9 marks)

Figure 4 shows the passage of light from one medium into another medium. The angles 40° and 60° are shown.

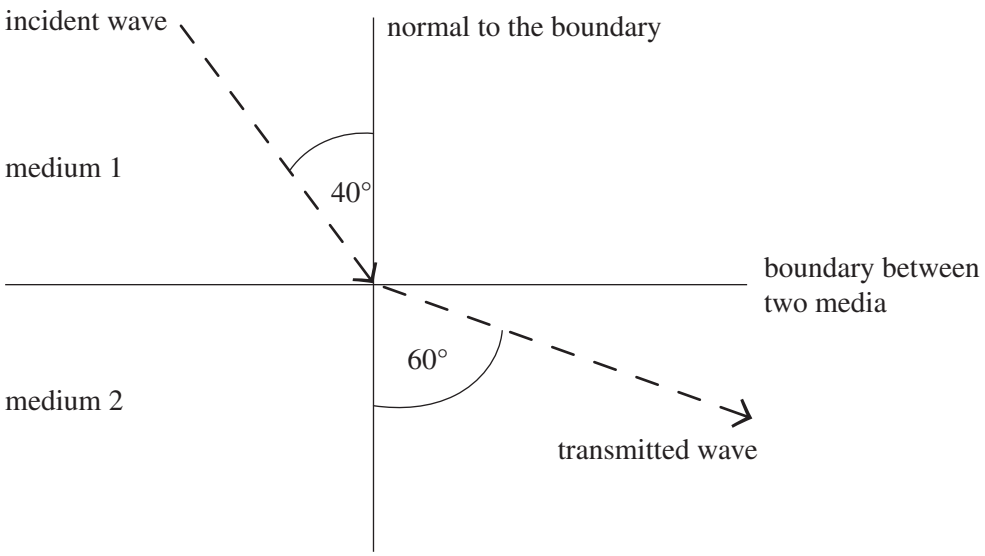

Figure 4

The table below shows data about the speed of light and refractive indices of the media. The table is incomplete.

Medium	Refractive index	Speed of light (m s^{-1})
1	1.85	
2		2.18×10^8

a. Determine the refractive index of medium 2 to two decimal places. 2 marks

b. Determine the speed of light in medium 1 to three significant figures. 2 marks

m s^{-1}

The angle of incidence is now increased to 55°.

c. Determine whether or not the incident ray can pass into medium 2. Provide evidence and an explanation for your answer. 5 marks

Question 4 (6 marks)

A student is given a rectangular block of glass and a rectangular plastic container filled with formazin, a liquid polymer, of refractive index 1.85. The student is now asked to find the refractive index of the glass by placing them one on top of each other and passing a ray of laser light through both. In doing so, the student finds that refraction occurs for angles less than 63°, but at angles of greater than 63°, refraction from the oil into the glass does not occur. This situation is shown in Figure 5.

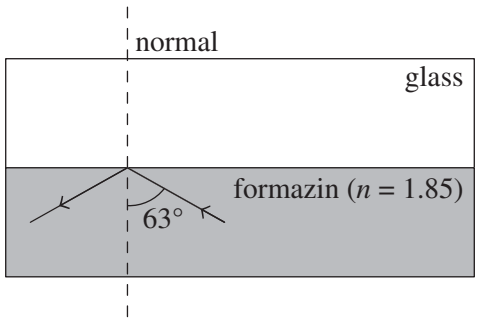

Figure 5

a. Explain why the refractive index of the glass is less than 1.85 giving evidence for your answer. 2 marks

b. Calculate the refractive index of the glass. 2 marks

c. Explain if dispersion is able to occur for white light incident at 70° as it is shone through the oil toward the oil–glass interface. 2 marks

Question 5 (19 marks)

In Young's double slit experiment, light of the same colour is shone through two identical slits, S_1 and S_2. The experimental set-up and the resulting pattern of the light is shown in Figure 6.

The distance between neighbouring bright bands, Δx, is shown in Figure 4. Between bright bands exist dark bands (the absence of light). The distances d and L are also indicated on Figure 6.

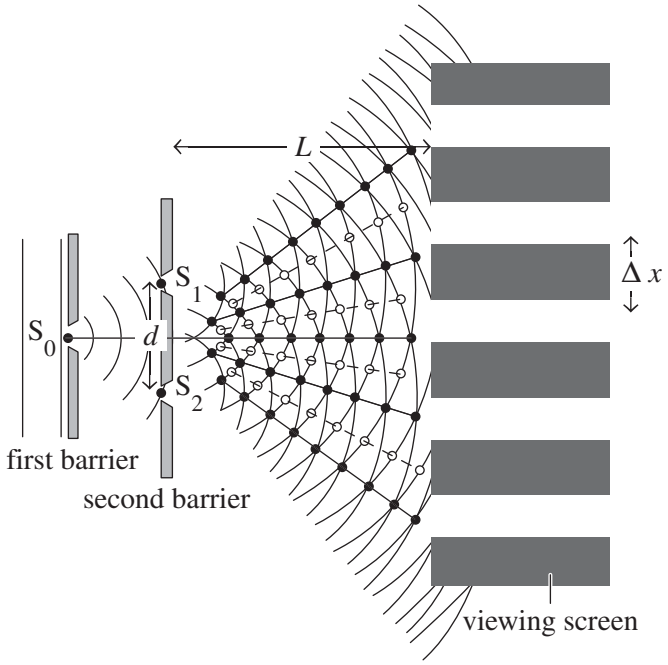

Figure 6

a. Explain how the light behaves once it has passed through the two slits. As part of your explanation, discuss the production of the bright and dark bands and under what conditions these bands are produced. 5 marks

Figure 7 shows the original pattern and a new pattern produced when changes were made to some experimental conditions.

Figure 7

b. Explain two possible changes in the conditions of the initial experiment that would lead to the production of the new pattern. 3 marks

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Figure 8 shows two points, A and B on the screen.

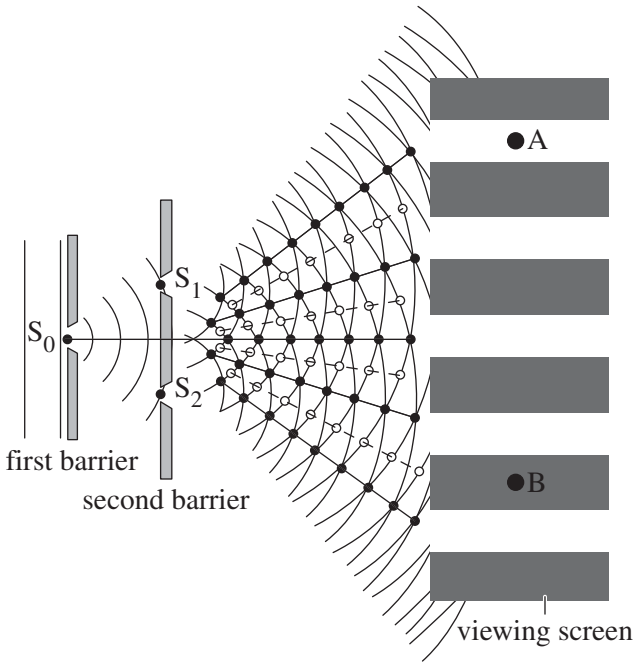

Figure 8

Some information is provided about the experiment in the table below.

Distance (S_2 A)	3.800×10^{-5} m
Distance (S_2 B)	3.500×10^{-5} m
Wavelength (m)	6.0×10^{-7} m

c. Determine the distance (S_1 B). 3 marks

m

d. Determine the distance (S_1 A). 3 marks

m

The wave model accounts for the observation of the interference of the light coming from the two slits.

e. Explain what the particle model would predict in terms of the pattern expected to be observed on the screen. 2 marks

f. Explain why the particle model is able to account for the production of a bright band as light rays meet but it is not able to account for the production of a dark band as the light rays meet. 3 marks