Unit 11 · Interference of Light

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 Key words [4]

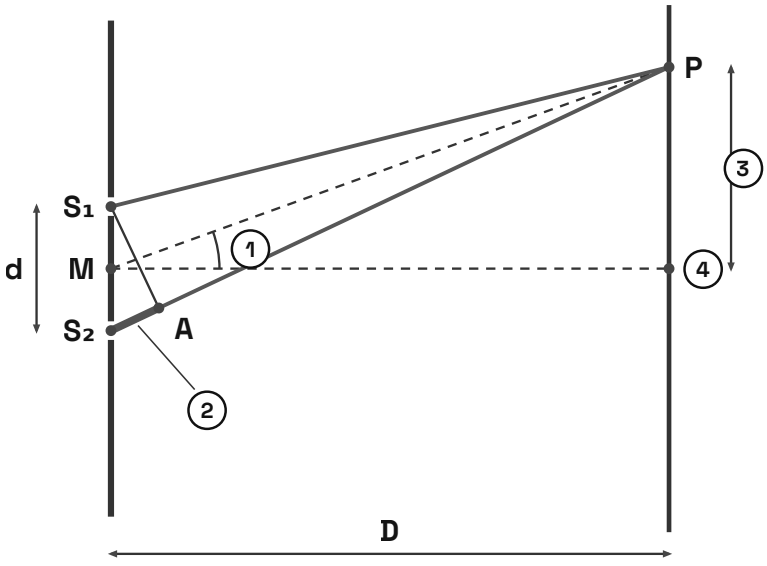
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

coherent sources	**constructive interference**	**destructive interference**	**dispersion**	
fringe width	**optical path**	**path difference**	**polarization**	**superposition**
sustained interference				

Two sources that send out waves of the same wavelength with a constant phase difference are _____. Where two waves meet in phase they make _____, and where they meet in antiphase _____. A pattern that stays in place long enough to be seen is _____. The distance light would travel in a vacuum in the time it takes in a medium is its _____. The difference in the distances two waves travel to a point is their _____. In Young's experiment the distance between two neighboring bright fringes is the _____. When two waves overlap, the resultant displacement is the sum of the separate ones, by the principle of _____.

2 Label the diagram [2]

The diagram shows the geometry of Young's double slit experiment. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. Two coherent waves meet with a path difference of 3λ. The point is: [1]

a. bright, since 3λ is a whole number of wavelengths

b. dark, since 3 is an odd number

c. neither bright nor dark

d. bright only if the waves have equal amplitudes

ii. In a Young's experiment with light of wavelength 650 nm, the slits are 0.40 mm apart and the screen is 1.6 m away. The fringe width is: [1]

a. 0.26 mm **b.** 2.6 mm

c. 26 mm **d.** 1.6 mm

iii. A Young's experiment is done in air, and then with the whole apparatus under water ($\mu = 1.33$). The fringes: [1]

a. get wider **b.** get narrower, by 1.33 times

c. stay the same **d.** disappear

iv. Two coherent waves of wavelength 540 nm reach a point with a path difference of 1.62 μm. The point is: [1]

a. bright, with a phase difference of 6π **b.** dark, with a phase difference of 3π

c. dark, with a phase difference of 5π **d.** bright, with a phase difference of 3π

v. In a Young's experiment with two equal narrow slits, each giving an intensity I_0 alone, the intensity at a bright fringe is: [1]

a. I_0 **b.** $2I_0$

c. $4I_0$ **d.** zero

4 Short answers [7]

Write short answers to the following questions.

a. Write any two conditions for sustained interference of light. [2]

b. Why does a soap film in sunlight show different colors in different places? [2]

c. In a Young's experiment, light of wavelength 550 nm falls on slits 0.30 mm apart, with the screen 1.2 m away. Find the fringe width, and the distances from the center of the third dark fringe and the fourth bright fringe. **[3]**

5 Long answer **[4]**

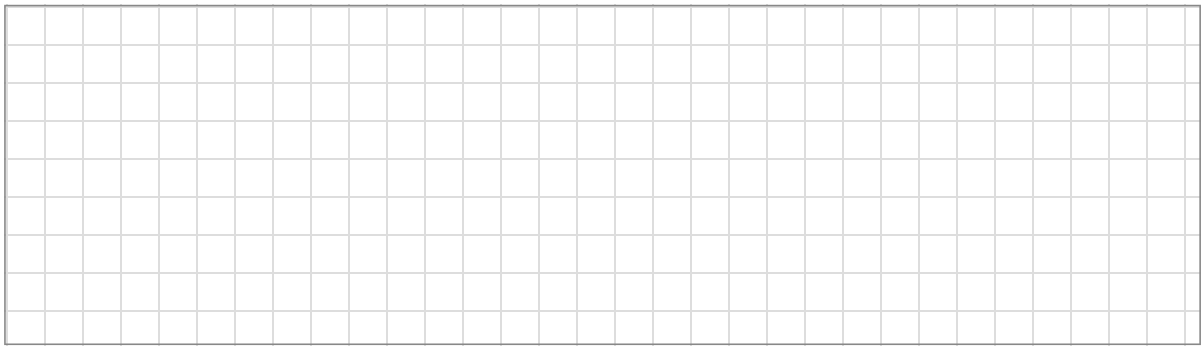
Write a long answer to the following question.

Two slits a distance d apart are lit by monochromatic light of wavelength λ, and the screen is a distance D away (D much larger than d). Show that the bright fringes are equally spaced, with fringe width $\beta = \lambda D/d$.

6 Numerical problems **[8]**

Solve the following problems. Show your working.

a. In a Young's experiment the slits are 0.50 mm apart and the screen is 1.5 m away. Ten fringe widths together measure 18.9 mm. Find i. the fringe width, ii. the wavelength of the light, iii. the fringe width when the screen is moved to 2.0 m, and iv. the angle of the first bright fringe from the center, in radians. **[4]**



Answer:

b. Light of two wavelengths, 520 nm and 650 nm, falls on slits 0.40 mm apart, with the screen 1.2 m away. Find i. the fringe width for each wavelength, and ii. the least distance from the center at which a bright fringe of one falls exactly on a bright fringe of the other. **[4]**

Answer: _____

7 Think **[3]**

In a Young's experiment, one slit is covered with a filter that halves the amplitude of the light through it. What happens to the bright and the dark fringes? Explain.

_____

_____

_____

_____

_____

8 Activity: Colors on an oil film (not marked)

Fill a dark tray or bowl with water and let it settle. Add one small drop of cooking oil or kerosene, and watch it spread, looking at the reflection of a white light or the sky.

Time	Colors you see	Where (center or edge)
At once		
After 1 min		
After 5 min		

Why do the colors change as the film spreads?

_____

_____