In His Name

Physics Quiz 4

SY: 2022/2023

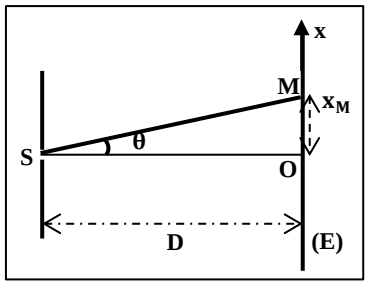
Duration: 30 min

Al-Mahdi Schools – Shahed

Score: /10

Name: …… Grade: G12 LS Date: / /

A laser beam (S) of wave length $\lambda = 633\ nm$ illuminates in air, at normal incidence, a vertical thin slit, of width $a = 0.2\ mm$, which is cut in an opaque plane (P). We observe a diffraction pattern on a screen (E) placed parallel to (P) at a distance $D = 1.5\ m$ away from it. A point M on the screen belongs to the obtained diffraction pattern, and it has a position $x = OM$ relative to the center O of the central bright fringe. (Document 1) The diffraction angles of the fringes in the following questions are small. Given: $c = 3 \times 10^8\ m/s$.



Document-1

1) The laser beam is monochromatic. Why? Calculate its frequency. (0.5 pt +0.5 pt)

2) Indicate the name of the phenomenon that takes place when light crosses the slit. Justify. (0.25 pt +0.5 pt)

3) Describe what you would observe on the screen. (1 pt)

4) Draw (in Box 1) a diagram showing the pattern observed on the screen (E). (0.75 pt)

5) Draw (in Box 2) a rough diagram that shows the variation of the intensity I of the diffracted light on the screen, as a function of sin θ (θ is the angle of diffraction of a point in the diffraction pattern). Indicate the first and second dark fringes on the figure. (1 pt)

Box 1

Box 2

6) The above phenomenon confirms a certain aspect of light. Name this aspect. (0.25 pt)

7) Write in terms of a, n, and λ, the expression of the diffraction angle θ of M. (0.5 pt)

8) Show that the abscissa of MO is $x_M = \frac{n\lambda D}{a}$. Deduce the **positions** of the first dark **fringes.** (1.5 pt)

9) Deduce the linear width of the central bright fringe. (0.75 pt)

10) The laser beam is replaced by another one emitting light of same intensity and of wavelength $\lambda' = 400$ nm. In order to obtain the same diffraction pattern as the one obtained with $\lambda = 633$ nm, determine the new value of D, if a is not changed. (1 pt)

11) M is a point on the screen which has an abscissa x (x = OM). M is the center of a dark fringe of order n of the red color (λ = 633 nm). Also, M is the center of a dark fringe of order (n +1) of a color of wavelength λ' = 422 nm. Determine n and x. (1.5 pt)

Blessed Efforts