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Wave Optics Formulas

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List of 27 Wave Optics Formulas

Wave Optics

Intensity and Interference of Light Waves

1) Angular Width of Central Maxima

Open Calculator

fx $$d_{angular} = \frac{2 \cdot \lambda}{a}$$

ex $$6.00989^\circ = \frac{2 \cdot 26.8\text{cm}}{5.11}$$

2) Intensity of Constructive Interference

Open Calculator

fx $$I_C = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$

ex $$52.45584\text{cd} = \left(\sqrt{9\text{cd}} + \sqrt{18\text{cd}}\right)^2$$

3) Intensity of Destructive Interference

Open Calculator

fx $$I_D = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$$

ex $$1.544156\text{cd} = \left(\sqrt{9\text{cd}} - \sqrt{18\text{cd}}\right)^2$$

4) Interference of Waves of Two Intensities

Open Calculator

fx $$I = I_1 + I_2 + 2 \cdot \sqrt{I_1 \cdot I_2} \cdot \cos(\Phi)$$

ex $$46.92195\text{cd} = 9\text{cd} + 18\text{cd} + 2 \cdot \sqrt{9\text{cd} \cdot 18\text{cd}} \cdot \cos(38.5^\circ)$$

5) Malus Law

Open Calculator

fx $$I_T = I_1 \cdot (\cos(\theta))^2$$

ex $$8.340979\text{cd} = 9\text{cd} \cdot (\cos(15.7^\circ))^2$$

6) Path Difference of Two Progressive Wave

Open Calculator

fx $\Delta x = \frac{\lambda \cdot \Phi}{2 \cdot \pi}$

ex $2.866111\text{cm} = \frac{26.8\text{cm} \cdot 38.5^\circ}{2 \cdot \pi}$

7) Phase Difference

Open Calculator

fx $\Phi = \frac{2 \cdot \pi \cdot \Delta x}{\lambda}$

ex $38.49985^\circ = \frac{2 \cdot \pi \cdot 2.8661\text{cm}}{26.8\text{cm}}$

8) Phase Difference of Constructive Interference

Open Calculator

fx $\Phi_{ci} = 2 \cdot \pi \cdot n$

ex $1800^\circ = 2 \cdot \pi \cdot 5$

9) Phase Difference of Destructive Interference

Open Calculator

fx $\Phi_{di} = (2 \cdot n + 1) \cdot \pi$

ex $1980^\circ = (2 \cdot 5 + 1) \cdot \pi$

10) Resultant Intensity of Incoherent Sources

Open Calculator

fx $I_{IS} = I_1 + I_2$

ex $27\text{cd} = 9\text{cd} + 18\text{cd}$

11) Resultant Intensity On-Screen of Young's Double-Slit Experiment

Open Calculator

fx $I = 4 \cdot (I_{S1}) \cdot \cos\left(\frac{\Phi}{2}\right)^2$

ex $46.92538\text{cd} = 4 \cdot (13.162\text{cd}) \cdot \cos\left(\frac{38.5^\circ}{2}\right)^2$

Thin Film Interference and Optical Path Difference

12) Optical Activity

Open Calculator

fx $$\alpha = \frac{\theta}{L \cdot C_x}$$

ex $$1.957262 = \frac{15.7^\circ}{35\text{cm} \cdot 0.4}$$

13) Optical Path Difference

Open Calculator

fx $$\Delta = (RI - 1) \cdot \frac{D}{d}$$

ex $$0.634585 = (1.333 - 1) \cdot \frac{20.2\text{cm}}{10.6\text{cm}}$$

14) Optical Path Difference given Fringe Width

Open Calculator

fx $$\Delta = (RI - 1) \cdot t \cdot \frac{\beta}{\lambda}$$

ex $$0.634564 = (1.333 - 1) \cdot 100\text{cm} \cdot \frac{51.07\text{cm}}{26.8\text{cm}}$$

15) Thin-Film Constructive Interference in Reflected Light

Open Calculator

fx $$I_c = \left(n + \frac{1}{2}\right) \cdot \lambda$$

ex $$1.474 = \left(5 + \frac{1}{2}\right) \cdot 26.8\text{cm}$$

16) Thin-Film Constructive Interference in Transmitted Light

Open Calculator

fx $$I_c = n \cdot \lambda$$

ex $$1.34 = 5 \cdot 26.8\text{cm}$$

17) Thin-Film Destructive Interference in Reflected Light

Open Calculator

fx $I_d = n \cdot \lambda$

ex $1.34 = 5 \cdot 26.8\text{cm}$

18) Thin-Film Destructive Interference in Transmitted Light

Open Calculator

fx $I_d = \left(n + \frac{1}{2}\right) \cdot \lambda$

ex $1.474 = \left(5 + \frac{1}{2}\right) \cdot 26.8\text{cm}$

Young's Double Slit Experiment (YDSE)

19) Distance from Center to Light Source for Constructive Interference in YDSE

Open Calculator

fx $y_{CI} = \left(n + \left(\frac{1}{2}\right)\right) \cdot \frac{\lambda \cdot D}{d}$

ex $280.8943\text{cm} = \left(5 + \left(\frac{1}{2}\right)\right) \cdot \frac{26.8\text{cm} \cdot 20.2\text{cm}}{10.6\text{cm}}$

20) Distance from Center to Light Source for Destructive Interference in YDSE

Open Calculator

fx $y_{DI} = (2 \cdot n - 1) \cdot \frac{\lambda \cdot D}{2 \cdot d}$

ex $229.8226\text{cm} = (2 \cdot 5 - 1) \cdot \frac{26.8\text{cm} \cdot 20.2\text{cm}}{2 \cdot 10.6\text{cm}}$

21) Fringe Width

Open Calculator

fx $\beta = \frac{\lambda \cdot D}{d}$

ex $51.0717\text{cm} = \frac{26.8\text{cm} \cdot 20.2\text{cm}}{10.6\text{cm}}$

22) Path Difference for Constructive Interference in YDSE

Open Calculator

fx $$\Delta x_{CI} = \frac{y_{CI} \cdot d}{D}$$

ex $$147.3505\text{cm} = \frac{280.8\text{cm} \cdot 10.6\text{cm}}{20.2\text{cm}}$$

23) Path Difference for Destructive Interference in YDSE

Open Calculator

fx $$\Delta x_{DI} = (2 \cdot n - 1) \cdot \left(\frac{\lambda}{2}\right)$$

ex $$120.6\text{cm} = (2 \cdot 5 - 1) \cdot \left(\frac{26.8\text{cm}}{2}\right)$$

24) Path Difference for Maxima in YDSE

Open Calculator

fx $$\Delta x_{max} = n \cdot \lambda$$

ex $$134\text{cm} = 5 \cdot 26.8\text{cm}$$

25) Path Difference for Minima in YDSE

Open Calculator

fx $$\Delta x_{min} = (2 \cdot n + 1) \cdot \frac{\lambda}{2}$$

ex $$147.4\text{cm} = (2 \cdot 5 + 1) \cdot \frac{26.8\text{cm}}{2}$$

26) Path Difference in YDSE given Distance between Coherent Sources

Open Calculator

fx $$\Delta x = d \cdot \sin(\theta)$$

ex $$2.868365\text{cm} = 10.6\text{cm} \cdot \sin(15.7^\circ)$$

27) Path Difference in Young's Double-Slit Experiment

Open Calculator

fx $$\Delta x = \sqrt{\left(y + \frac{d}{2}\right)^2 + D^2} - \sqrt{\left(y - \frac{d}{2}\right)^2 + D^2}$$

ex $$2.866408\text{cm} = \sqrt{\left(5.852\text{cm} + \frac{10.6\text{cm}}{2}\right)^2 + (20.2\text{cm})^2} - \sqrt{\left(5.852\text{cm} - \frac{10.6\text{cm}}{2}\right)^2 + (20.2\text{cm})^2}$$

Variables Used

- **a** Aperture of Objective
- C_x Concentration at x Distance
- **d** Distance between Two Coherent Sources *(Centimeter)*
- **D** Distance between Slits and Screen *(Centimeter)*
- $d_{angular}$ Angular Width *(Degree)*
- **I** Resultant Intensity *(Candela)*
- I_1 Intensity 1 *(Candela)*
- I_2 Intensity 2 *(Candela)*
- I_c Constructive Interference
- I_C Resultant Intensity of Constructive *(Candela)*
- I_d Destructive Interference
- I_D Resultant Intensity of Destructive *(Candela)*
- I_{IS} Resultant Intensity of Incoherent Sources *(Candela)*
- I_{S1} Intensity from Slit 1 *(Candela)*
- I_T Transmitted Intensity *(Candela)*
- **L** Length *(Centimeter)*
- **n** Integer
- **RI** Refractive Index
- **t** Thickness *(Centimeter)*
- **y** Distance from Center to Light Source *(Centimeter)*
- y_{CI} Distance from Center to Light Source for C I *(Centimeter)*
- y_{DI} Distance from Center to Light Source for D I *(Centimeter)*
- **α** Optical Activity
- **β** Fringe Width *(Centimeter)*
- **Δ** Optical Path Difference
- **Δx** Path Difference *(Centimeter)*
- Δx_{CI} Path Difference for Constructive Interference *(Centimeter)*
- Δx_{DI} Path Difference for Destructive Interference *(Centimeter)*
- Δx_{max} Path Difference for Maxima *(Centimeter)*
- Δx_{min} Path Difference for Minima *(Centimeter)*

- θ Angle from Slit Center to Light Source *(Degree)*
- λ Wavelength *(Centimeter)*
- Φ Phase Difference *(Degree)*
- Φ_{ci} Phase Difference of Constructive Interference *(Degree)*
- Φ_{di} Phase Difference of Destructive Interference *(Degree)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Centimeter (cm)
  Length Unit Conversion
- Measurement: **Luminous Intensity** in Candela (cd)
  Luminous Intensity Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion

Check other formula lists

- **Wave Optics Formulas**

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