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Wave Optics Formulas

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List of 28 Wave Optics Formulas

Wave Optics

Basics

1) Angular Width of Central Maxima

Open Calculator

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

ex $$8.774439^\circ = 2 \cdot \frac{26.8\text{cm}}{3.5}$$

2) Malus Law

Open Calculator

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

ex $$7.392544\text{cd} = 9\text{cd} \cdot (\cos(25^\circ))^2$$

3) Optical Activity

Open Calculator

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

ex $$3.116659 = \frac{25^\circ}{35\text{cm} \cdot 0.4}$$

4) Path Difference of Two Progressive Wave

Open Calculator

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

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

5) Phase Difference

Open Calculator

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

ex $671.6418^\circ = \frac{2 \cdot \pi \cdot 50\text{cm}}{26.8\text{cm}}$

6) Phase Difference of Constructive Interference

Open Calculator

fx $\Phi = 2 \cdot \pi \cdot n$

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

7) Phase Difference of Destructive Interference

Open Calculator

fx $\Phi = (2 \cdot n + 1) \cdot \pi$

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

Interference of Waves of Two Intensities

8) Intensity of Constructive Interference

Open Calculator

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

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

9) Intensity of Destructive Interference

Open Calculator

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

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

10) 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 $$46.92195\text{cd} = 9\text{cd} + 18\text{cd} + 2 \cdot \sqrt{9\text{cd} \cdot 18\text{cd}} \cdot \cos(38.5^\circ)$$

Optical Path Difference

11) Optical Path Difference

Open Calculator

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

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

12) Optical Path Difference given Fringe Width

Open Calculator

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

ex $$0.024751 = (1.333 - 1) \cdot 12\text{cm} \cdot \frac{16.6\text{cm}}{26.8\text{cm}}$$

Thin-Film Interference

13) Thin-Film Constructive Interference in Reflected Light

Open Calculator

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

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

14) Thin-Film Constructive Interference in Transmitted Light

Open Calculator

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

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

15) Thin-Film Destructive Interference in Reflected Light

Open Calculator

fx $I_d = n \cdot \lambda$

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

16) 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)

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

Open Calculator

fx $y = \frac{n \cdot \lambda \cdot D}{d}$

ex $255.3585\text{cm} = \frac{5 \cdot 26.8\text{cm} \cdot 20.2\text{cm}}{10.6\text{cm}}$

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

Open Calculator

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

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

19) Fringe Width

Open Calculator

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

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

20) Resultant Intensity of Incoherent Sources

Open Calculator

fx $I = I_1 + I_2$

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

21) Resultant Intensity On-Screen of YDSE when Intensities are Different

Open Calculator

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

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

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

Open Calculator

fx $I = 4 \cdot I_1 \cdot \left(\cos\left(\frac{\Phi}{2}\right)\right)^2$

ex $32.08695\text{cd} = 4 \cdot 9\text{cd} \cdot \left(\cos\left(\frac{38.5^\circ}{2}\right)\right)^2$

Path Difference in YDSE

23) Path Difference for Constructive Interference in YDSE

Open Calculator

fx $\Delta x = \frac{y \cdot d}{D}$

ex $1.311881\text{cm} = \frac{2.5\text{cm} \cdot 10.6\text{cm}}{20.2\text{cm}}$

24) Path Difference for Destructive Interference in YDSE

Open Calculator

fx $y = (2 \cdot n + 1) \cdot \frac{\lambda}{2}$

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

25) Path Difference for Maxima in YDSE

Open Calculator

fx $\Delta x = n \cdot \lambda$

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

26) Path Difference for Minima in YDSE

Open Calculator

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

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

27) Path Difference in YDSE given Distance between Coherent Sources

Open Calculator

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

ex $4.479754\text{cm} = 10.6\text{cm} \cdot \sin(25^\circ)$

28) 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 $1.260501\text{cm} = \sqrt{\left(2.5\text{cm} + \frac{10.6\text{cm}}{2}\right)^2 + (20.2\text{cm})^2} - \sqrt{\left(2.5\text{cm} - \frac{10.6\text{cm}}{2}\right)^2 + (20.2\text{cm})^2}$

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_d Destructive Interference
- **L** Length *(Centimeter)*
- **n** Number n
- **RI** Refractive Index
- **t** Thickness *(Centimeter)*
- **y** Distance from Center to Light Source *(Centimeter)*
- **α** Optical Activity
- **β** Fringe Width *(Centimeter)*
- **Δ** Optical Path Difference
- **Δx** Path Difference *(Centimeter)*
- **θ** Angle from Slit Center to Light Source *(Degree)*
- **λ** Wavelength *(Centimeter)*
- **Φ** Phase Difference *(Degree)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- 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

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