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Optics Formulas

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List of 38 Optics Formulas

Optics

Basics of Optics

1) Angle of Deviation

fx $D = i + e - A$

Open Calculator

ex $9^\circ = 40^\circ + 4^\circ - 35^\circ$

2) Angle of Deviation in Dispersion

fx $D = (\mu - 1) \cdot A$

Open Calculator

ex $11.55^\circ = (1.33 - 1) \cdot 35^\circ$

3) Angle of Emergence

fx $e = A + D - i$

Open Calculator

ex $7.5^\circ = 35^\circ + 12.5^\circ - 40^\circ$

4) Angle of Incidence

fx $i = D + A - e$

Open Calculator

ex $43.5^\circ = 12.5^\circ + 35^\circ - 4^\circ$

5) Angle of Prism

Open Calculator

fx $$A = i + e - D$$

ex $$31.5^\circ = 40^\circ + 4^\circ - 12.5^\circ$$

6) Number of Images in Kaleidoscope

Open Calculator

fx $$N = \left(\frac{2 \cdot \pi}{A_m}\right) - 1$$

ex $$5 = \left(\frac{2 \cdot \pi}{60^\circ}\right) - 1$$

7) Power of Lens

Open Calculator

fx $$P_1 = \frac{1}{f_1}$$

ex $$2.5 = \frac{1}{0.40\text{m}}$$

8) Power of Lens using Distance Rule

Open Calculator

fx $$P = P_1 + P_2 - w \cdot P_1 \cdot P_2$$

ex $$1.8125 = 0.75 + 1.25 - 0.2\text{m} \cdot 0.75 \cdot 1.25$$

Coefficient of Refraction

9) Coefficient of Refraction using Boundary Angles

Open Calculator

fx $$\mu = \frac{\sin(i)}{\sin(r)}$$

ex $$1.285575 = \frac{\sin(40^\circ)}{\sin(30^\circ)}$$

10) Coefficient of Refraction using Critical Angle

Open Calculator

fx $$\mu = \cos ec(i)$$

ex $$1.555724 = \cos ec(40^\circ)$$

11) Coefficient of Refraction using Depth

Open Calculator

fx $$\mu = \frac{d_{real}}{d_{apparent}}$$

ex $$3 = \frac{1.5m}{0.50m}$$

12) Coefficient of Refraction using Velocity

Open Calculator

fx $$\mu = \frac{[c]}{v_m}$$

ex $$1.332411 = \frac{[c]}{225000000m/s}$$

Focal Length of Lens

13) Focal Length of Concave Lens given Image and Object Distance

Open Calculator

fx $$F_{\text{concave lens}} = \frac{u \cdot v}{v - u}$$

ex $$-0.385714\text{m} = \frac{0.90\text{m} \cdot 0.27\text{m}}{0.27\text{m} - 0.90\text{m}}$$

14) Focal Length of Concave Lens given Radius

Open Calculator

fx $$F_{\text{concave lens}} = -\frac{r_{\text{curve}}}{2}$$

ex $$-4.5\text{m} = -\frac{9\text{m}}{2}$$

15) Focal Length of Convex Lens given Object and Image Distance

Open Calculator

fx $$F_{\text{convex lens}} = \frac{u \cdot v}{u - v}$$

ex $$0.385714\text{m} = \frac{0.90\text{m} \cdot 0.27\text{m}}{0.90\text{m} - 0.27\text{m}}$$

16) Focal Length of Convex Lens given Radius

Open Calculator

fx $$F_{\text{convex lens}} = \frac{r_{\text{curve}}}{2}$$

ex $$4.5\text{m} = \frac{9\text{m}}{2}$$

17) Focal Length using Distance Formula

Open Calculator

fx $$F = \frac{f_1 + f_2 - w}{f_1 \cdot f_2}$$

ex $$3.541667\text{m} = \frac{0.40\text{m} + 0.48\text{m} - 0.2\text{m}}{0.40\text{m} \cdot 0.48\text{m}}$$

18) Lens Makers Equation

Open Calculator

fx $$f_1 = \left(\frac{\mu_l}{\mu_m} - 1\right) \cdot \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

ex $$3.346154\text{m} = \left(\frac{10}{1.3} - 1\right) \cdot \left(\frac{1}{1.6\text{m}} - \frac{1}{8\text{m}}\right)$$

Focal Length of Mirror

19) Focal Length of Concave Mirror

Open Calculator

fx $$F_{concave} = -\frac{r_{curve}}{2}$$

ex $$-4.5\text{m} = -\frac{9\text{m}}{2}$$

20) Focal Length of Concave Mirror with Real Image

Open Calculator

fx $$F_{concave} = \frac{v \cdot u}{v + u}$$

ex $$0.207692\text{m} = \frac{0.27\text{m} \cdot 0.90\text{m}}{0.27\text{m} + 0.90\text{m}}$$

21) Focal Length of Concave Mirror with Virtual Image

Open Calculator

fx $$F_{concave} = \frac{v \cdot u}{u - v}$$

ex $$0.385714\text{m} = \frac{0.27\text{m} \cdot 0.90\text{m}}{0.90\text{m} - 0.27\text{m}}$$

22) Focal Length of Convex Mirror

Open Calculator

fx $$F_{convex} = \frac{u \cdot v}{v - u}$$

ex $$-0.385714\text{m} = \frac{0.90\text{m} \cdot 0.27\text{m}}{0.27\text{m} - 0.90\text{m}}$$

23) Focal Length of Convex Mirror given Radius

Open Calculator

fx $$F_{convex} = \frac{r_{curve}}{2}$$

ex $$4.5\text{m} = \frac{9\text{m}}{2}$$

Magnification

24) Magnification of Concave Lens

Open Calculator

fx $$m = \frac{v}{u}$$

ex $$0.3 = \frac{0.27m}{0.90m}$$

25) Magnification of Concave Mirror with Real Image

Open Calculator

fx $$m = -\frac{v}{u}$$

ex $$-0.3 = -\frac{0.27m}{0.90m}$$

26) Magnification of Concave Mirror with Virtual Image

Open Calculator

fx $$m = \frac{v}{u}$$

ex $$0.3 = \frac{0.27m}{0.90m}$$

27) Magnification of Concave Mirror with Virtual Image using Height

Open Calculator

fx $$m = \frac{h_{image}}{h_{object}}$$

ex $$2.5 = \frac{0.70m}{0.28m}$$

28) Magnification of Convex Lens

Open Calculator

fx $$m = -\frac{v}{u}$$

ex $$-0.3 = -\frac{0.27m}{0.90m}$$

29) Magnification of Convex Mirror

Open Calculator

fx $$m = \frac{v}{u}$$

ex $$0.3 = \frac{0.27m}{0.90m}$$

30) Magnification of Convex Mirror using Height

Open Calculator

fx $$m = \frac{h_{image}}{h_{object}}$$

ex $$2.5 = \frac{0.70m}{0.28m}$$

31) Total Magnification

Open Calculator

fx $$m_t = m^2$$

ex $$0.4356 = (0.66)^2$$

Object and Image Distance

32) Image Distance of Concave Mirror with Virtual Image

Open Calculator

fx $$v = \frac{u \cdot F_{concave}}{F_{concave} - u}$$

ex $$-0.225m = \frac{0.90m \cdot 0.18m}{0.18m - 0.90m}$$

33) Image Distance of Convex Mirror

Open Calculator

fx $$v = \frac{u \cdot F_{convex}}{u + F_{convex}}$$

ex $$0.252m = \frac{0.90m \cdot 0.35m}{0.90m + 0.35m}$$

34) Object Distance in Concave Lens

Open Calculator

fx $$u = \frac{v \cdot F_{concave\ lens}}{F_{concave\ lens} - v}$$

ex $$0.16875m = \frac{0.27m \cdot -0.45m}{-0.45m - 0.27m}$$

35) Object Distance in Concave Mirror with Real Image

Open Calculator

fx $$u = \frac{v \cdot F_{concave}}{v - F_{concave}}$$

ex $$0.54m = \frac{0.27m \cdot 0.18m}{0.27m - 0.18m}$$

36) Object Distance in Concave Mirror with Virtual Image

Open Calculator

fx $$u = \frac{v \cdot F_{concave}}{v + F_{concave}}$$

ex $$0.108m = \frac{0.27m \cdot 0.18m}{0.27m + 0.18m}$$

37) Object Distance in Convex Lens

Open Calculator

fx $$u = \frac{v \cdot F_{convex\ lens}}{v - F_{convex\ lens}}$$

ex $$3.375m = \frac{0.27m \cdot 0.25m}{0.27m - 0.25m}$$

38) Object Distance in Convex Mirror

Open Calculator

fx $$u = \frac{v \cdot F_{convex}}{v - F_{convex}}$$

ex $$-1.18125m = \frac{0.27m \cdot 0.35m}{0.27m - 0.35m}$$

Variables Used

- **A** Angle of Prism *(Degree)*
- A_m Angle between Mirrors *(Degree)*
- **D** Angle of Deviation *(Degree)*
- $d_{apparent}$ Apparent Depth *(Meter)*
- d_{real} Real Depth *(Meter)*
- **e** Angle of Emergence *(Degree)*
- **F** Focal Length of Lens *(Meter)*
- f_1 Focal Length 1 *(Meter)*
- f_2 Focal Length 2 *(Meter)*
- $F_{concave\ lens}$ Focal Length of Concave Lens *(Meter)*
- $F_{concave}$ Focal Length of Concave Mirror *(Meter)*
- $F_{convex\ lens}$ Focal Length of Convex Lens *(Meter)*
- F_{convex} Focal Length of Convex Mirror *(Meter)*
- h_{image} Image Height *(Meter)*
- h_{object} Object Height *(Meter)*
- **i** Angle of Incidence *(Degree)*
- **m** Magnification
- m_t Total Magnification
- **N** Number of Images
- **P** Power of Lens
- P_1 Power of First Lens
- P_2 Power of Second Lens

- **r** Angle of Refraction *(Degree)*
- R_1 Radius of Curvature at Section 1 *(Meter)*
- R_2 Radius of Curvature at Section 2 *(Meter)*
- r_{curve} Radius *(Meter)*
- **u** Object Distance *(Meter)*
- **v** Image Distance *(Meter)*
- v_m Velocity of Light in Medium *(Meter per Second)*
- **w** Width of Lens *(Meter)*
- **μ** Coefficient of Refraction
- μ_l Lens Refractive Index
- μ_m Medium Refractive Index

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[c]**, 299792458.0 Meter/Second
  Light speed in vacuum
- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Function: **cosec**, cosec(Angle)
  Trigonometric cosecant function
- Function: **sec**, sec(Angle)
  Trigonometric secant function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion

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