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Lenses and Refraction Formulas

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List of 24 Lenses and Refraction Formulas

Lenses and Refraction

Lenses

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

$$fx \quad f_{\text{concave lens}} = \frac{u \cdot v}{v + u}$$

Open Calculator 

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

2) Focal Length of Concave Lens given Radius

$$fx \quad f_{\text{concave lens}} = \frac{r_{\text{curve}}}{n - 1}$$

Open Calculator 

$$ex \quad 0.242857\text{m} = \frac{0.068\text{m}}{1.280 - 1}$$

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

$$fx \quad f_{\text{convex lens}} = -\frac{u \cdot v}{u + v}$$

Open Calculator 

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



4) Focal Length of Convex Lens given Radius

$$fx \quad f_{\text{convex lens}} = -\frac{r_{\text{curve}}}{n - 1}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad -0.242857\text{m} = -\frac{0.068\text{m}}{1.280 - 1}$$

5) Focal Length using Distance Formula

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 2.239583\text{m} = \frac{0.40\text{m} + 0.48\text{m} - 0.45\text{m}}{0.40\text{m} \cdot 0.48\text{m}}$$

6) Lens Makers Equation

$$fx \quad f_{\text{thinlens}} = \frac{1}{(\mu_1 - 1) \cdot \left(\frac{1}{R_1} - \frac{1}{R_2} \right)}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 0.234509\text{m} = \frac{1}{(10 - 1) \cdot \left(\frac{1}{1.67\text{m}} - \frac{1}{8\text{m}} \right)}$$

7) Magnification of Concave Lens

$$fx \quad m_{\text{concave}} = \frac{v}{u}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

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



8) Magnification of Convex Lens

$$fx \quad m_{\text{convex}} = -\frac{v}{u}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

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

9) Object Distance in Concave Lens

$$fx \quad u_{\text{concave}} = \frac{v \cdot f_{\text{concave lens}}}{v - f_{\text{concave lens}}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 0.771429\text{m} = \frac{0.27\text{m} \cdot 0.20\text{m}}{0.27\text{m} - 0.20\text{m}}$$

10) Object Distance in Convex Lens

$$fx \quad u_{\text{convex}} = \frac{v \cdot f_{\text{convex lens}}}{v - (f_{\text{convex lens}})}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad -0.114894\text{m} = \frac{0.27\text{m} \cdot -0.20\text{m}}{0.27\text{m} - (-0.20\text{m})}$$

11) Power of Lens

$$fx \quad P = \frac{1}{f}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 0.44843 = \frac{1}{2.23\text{m}}$$



12) Power of Lens using Distance Rule

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 0.4484 = 0.15 + 0.32 - 0.45m \cdot 0.15 \cdot 0.32$$

13) Total Magnification

$$fx \quad m_t = m^2$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 0.25 = (0.5)^2$$

Refraction

14) Angle of Deviation

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

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3_img.jpg\)](#)

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

15) Angle of Deviation in Dispersion

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

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f_img.jpg\)](#)

$$ex \quad 9.8^\circ = (1.28 - 1) \cdot 35^\circ$$

16) Angle of Emergence

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

[Open Calculator !\[\]\(e119fc79c8f448683d20ba4c873025a2_img.jpg\)](#)

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



17) Angle of Incidence

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

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

18) Angle of Prism

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

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

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

19) Coefficient of Refraction using Boundary Angles

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

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$ex \quad 1.280161 = \frac{\sin(40^\circ)}{\sin(30.14^\circ)}$$

20) Coefficient of Refraction using Critical Angle

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

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487_img.jpg\)](#)

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



21) Coefficient of Refraction using Depth

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

$$\text{ex } 1.280956 = \frac{1.5\text{m}}{1.171\text{m}}$$

22) Coefficient of Refraction using Velocity

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

$$\text{ex } 1.280617 = \frac{[c]}{234100000\text{m/s}}$$

23) Number of Images in Kaleidoscope

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

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

24) Refractive Index

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

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19_img.jpg\)](#)

$$\text{ex } 1.280161 = \frac{\sin(40^\circ)}{\sin(30.14^\circ)}$$



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)
- **f₁** Focal Length 1 (Meter)
- **f₂** Focal Length 2 (Meter)
- **f_{concave lens}** Focal Length of Concave Lens (Meter)
- **f_{convex lens}** Focal Length of Convex Lens (Meter)
- **f_{thinlens}** Focal Length of Thin Lens (Meter)
- **i** Angle of Incidence (Degree)
- **m** Magnification
- **m_{concave}** Magnification of Concave Lens
- **m_{convex}** Magnification of Convex Lens
- **m_t** Total Magnification
- **n** Refractive Index
- **N** Number of Images
- **P** Power of Lens
- **P₁** Power of First Lens
- **P₂** Power of Second Lens



- **r** Angle of Refraction (Degree)
- **R₁** Radius of Curvature at Section 1 (Meter)
- **R₂** Radius of Curvature at Section 2 (Meter)
- **r_{curve}** Radius (Meter)
- **u** Object Distance (Meter)
- **u_{concave}** Object Distance of Concave Lens (Meter)
- **u_{convex}** Object Distance of Convex Lens (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



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Constant:** **[c]**, 299792458.0
Light speed in vacuum
- **Function:** **cosec**, cosec(Angle)
The cosecant function is a trigonometric function that is the reciprocal of the sine function.
- **Function:** **sec**, sec(Angle)
Secant is a trigonometric function that is defined ratio of the hypotenuse to the shorter side adjacent to an acute angle (in a right-angled triangle); the reciprocal of a cosine.
- **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.
- **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 



Check other formula lists

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- [Mirrors Formulas](#) 

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