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# Optics Formulas

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# List of 38 Optics Formulas

## Optics

### Basics of Optics

#### 1) Angle of Deviation

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

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

#### 2) Angle of Deviation in Dispersion

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

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

#### 3) Angle of Emergence

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

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

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

#### 4) Angle of Incidence

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

[Open Calculator !\[\]\(166772600a13ad0a433053f90fe45649\_img.jpg\)](#)

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



### 5) Angle of Prism

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

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

### 6) Number of Images in Kaleidoscope

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

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

### 7) Power of Lens

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

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

### 8) Power of Lens using Distance Rule

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

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 1.8125 = 0.75 + 1.25 - 0.2m \cdot 0.75 \cdot 1.25$$



## Coefficient of Refraction

### 9) Coefficient of Refraction using Boundary Angles

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

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5\_img.jpg\)](#)

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

### 10) Coefficient of Refraction using Critical Angle

$$\text{fx } \mu = \cos ec(i)$$

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a\_img.jpg\)](#)

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

### 11) Coefficient of Refraction using Depth

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

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a\_img.jpg\)](#)

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

### 12) Coefficient of Refraction using Velocity

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

[Open Calculator !\[\]\(c1168d6a8b365d11e842ece304635fa7\_img.jpg\)](#)

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



## Focal Length of Lens

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

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

[Open Calculator !\[\]\(74d4806277d7e73349d8e8c0897931e9\_img.jpg\)](#)

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

### 14) Focal Length of Concave Lens given Radius

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

[Open Calculator !\[\]\(8bba887393ca45b761e5cb49e755e762\_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3\_img.jpg\)](#)

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

### 16) Focal Length of Convex Lens given Radius

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

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f\_img.jpg\)](#)

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



## 17) Focal Length using Distance Formula

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

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

## 18) Lens Makers Equation

$$fx \quad f_1 = \left( \frac{\mu_1}{\mu_m} - 1 \right) \cdot \left( \frac{1}{R_1} - \frac{1}{R_2} \right)$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

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

## Focal Length of Mirror

### 19) Focal Length of Concave Mirror

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

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7\_img.jpg\)](#)

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



## 20) Focal Length of Concave Mirror with Real Image

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

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

## 21) Focal Length of Concave Mirror with Virtual Image

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)

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

## 22) Focal Length of Convex Mirror

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2\_img.jpg\)](#)

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

## 23) Focal Length of Convex Mirror given Radius

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

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19\_img.jpg\)](#)

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



## Magnification

### 24) Magnification of Concave Lens

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

[Open Calculator !\[\]\(96cc62f861fdd6e50510c0224a756dff\_img.jpg\)](#)

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

### 25) Magnification of Concave Mirror with Real Image

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

[Open Calculator !\[\]\(f95dab70c751fda7d824b8b03650f7aa\_img.jpg\)](#)

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

### 26) Magnification of Concave Mirror with Virtual Image

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

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c\_img.jpg\)](#)

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

### 27) Magnification of Concave Mirror with Virtual Image using Height


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

[Open Calculator !\[\]\(9db214d549b9aeebe72aa11d3a5c4b1a\_img.jpg\)](#)

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





28) Magnification of Convex Lens 

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

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0\_img.jpg\)](#)


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

29) Magnification of Convex Mirror 

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

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1\_img.jpg\)](#)

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

30) Magnification of Convex Mirror using Height 

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

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a\_img.jpg\)](#)

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

31) Total Magnification 

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

[Open Calculator !\[\]\(3342c215b2a8b663596a81468d5dc314\_img.jpg\)](#)

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



## Object and Image Distance

### 32) Image Distance of Concave Mirror with Virtual Image

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

[Open Calculator !\[\]\(339a16584d5da0f0a3ca4e9ec17bf6a1\_img.jpg\)](#)

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

### 33) Image Distance of Convex Mirror

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

[Open Calculator !\[\]\(6059a5aa8b4ca7bb793408023d6c6e42\_img.jpg\)](#)

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

### 34) Object Distance in Concave Lens

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

[Open Calculator !\[\]\(e3275251d0893157c3584e20c81dc3ba\_img.jpg\)](#)

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



### 35) Object Distance in Concave Mirror with Real Image

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

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

### 36) Object Distance in Concave Mirror with Virtual Image

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

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

### 37) Object Distance in Convex Lens

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

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

### 38) Object Distance in Convex Mirror

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

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

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



## Variables Used




- **A** Angle of Prism (Degree)
- **$A_m$**  Angle between Mirrors (Degree)
- **D** Angle of Deviation (Degree)
- **$d_{\text{apparent}}$**  Apparent Depth (Meter)
- **$d_{\text{real}}$**  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)
- **$F_{\text{concave lens}}$**  Focal Length of Concave Lens (Meter)
- **$F_{\text{concave}}$**  Focal Length of Concave Mirror (Meter)
- **$F_{\text{convex lens}}$**  Focal Length of Convex Lens (Meter)
- **$F_{\text{convex}}$**  Focal Length of Convex Mirror (Meter)
- **$h_{\text{image}}$**  Image Height (Meter)
- **$h_{\text{object}}$**  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)
- $r_{\text{curve}}$  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)
- $\mu$  Coefficient of Refraction
- $\mu_l$  Lens Refractive Index
- $\mu_m$  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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