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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

Open Calculator

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

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

2) Focal Length of Concave Lens given Radius

Open Calculator

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

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

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

Open Calculator

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

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

4) Focal Length of Convex Lens given Radius

Open Calculator

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

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

5) Focal Length using Distance Formula

Open Calculator

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

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

6) Lens Makers Equation

Open Calculator

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

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

7) Magnification of Concave Lens

Open Calculator

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

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

8) Magnification of Convex Lens

Open Calculator

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

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

9) Object Distance in Concave Lens

Open Calculator

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

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

10) Object Distance in Convex Lens

Open Calculator

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

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

11) Power of Lens

Open Calculator

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

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

12) Power of Lens using Distance Rule

Open Calculator

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

$$0.4484 = 0.15 + 0.32 - 0.45\text{m} \cdot 0.15 \cdot 0.32$$

13) Total Magnification

Open Calculator

$$m_t = m^2$$

$$0.25 = (0.5)^2$$

Refraction

14) Angle of Deviation

Open Calculator

$$D = i + e - A$$

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

15) Angle of Deviation in Dispersion

Open Calculator

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

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

16) Angle of Emergence

Open Calculator

$$e = A + D - i$$

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

17) Angle of Incidence

Open Calculator

fx $i = D + A - e$

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

18) Angle of Prism

Open Calculator

fx $A = i + e - D$

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

19) Coefficient of Refraction using Boundary Angles

Open Calculator

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

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

20) Coefficient of Refraction using Critical Angle

Open Calculator

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

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

21) Coefficient of Refraction using Depth

Open Calculator

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

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

22) Coefficient of Refraction using Velocity

Open Calculator

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

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

23) Number of Images in Kaleidoscope

Open Calculator

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

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

24) Refractive Index

Open Calculator

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

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

Variables Used

- **A** Angle of Prism *(Degree)*
- $\mathbf{A_m}$ Angle between Mirrors *(Degree)*
- **D** Angle of Deviation *(Degree)*
- $\mathbf{d_{apparent}}$ Apparent Depth *(Meter)*
- $\mathbf{d_{real}}$ Real Depth *(Meter)*
- **e** Angle of Emergence *(Degree)*
- **f** Focal Length of Lens *(Meter)*
- $\mathbf{f_1}$ Focal Length 1 *(Meter)*
- $\mathbf{f_2}$ Focal Length 2 *(Meter)*
- $\mathbf{f_{concave\ lens}}$ Focal Length of Concave Lens *(Meter)*
- $\mathbf{f_{convex\ lens}}$ Focal Length of Convex Lens *(Meter)*
- $\mathbf{f_{thinlens}}$ Focal Length of Thin Lens *(Meter)*
- **i** Angle of Incidence *(Degree)*
- **m** Magnification
- $\mathbf{m_{concave}}$ Magnification of Concave Lens
- $\mathbf{m_{convex}}$ Magnification of Convex Lens
- $\mathbf{m_t}$ Total Magnification
- **n** Refractive Index
- **N** Number of Images
- **P** Power of Lens
- $\mathbf{P_1}$ Power of First Lens
- $\mathbf{P_2}$ 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)*
- $u_{concave}$ 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

- **Lenses and Refraction Formulas**
- **Mirrors Formulas**

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