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Kinematics Formulas

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List of 18 Kinematics Formulas

Kinematics

1) Angle of Inclination of Resultant Acceleration with Tangential Acceleration

$$fx \quad \Phi = a \tan\left(\frac{a_n}{a_t}\right)$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$ex \quad 1.566796\text{rad} = a \tan\left(\frac{6000\text{m/s}^2}{24\text{m/s}^2}\right)$$

2) Angle Traced in Nth Second (Accelerated Rotatory Motion)

$$fx \quad \theta = \omega_o + \left(\frac{2 \cdot n_{th} - 1}{2}\right) \cdot \alpha$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$ex \quad 19.6\text{rad} = 14\text{rad/s} + \left(\frac{2 \cdot 4\text{s} - 1}{2}\right) \cdot 1.6\text{rad/s}^2$$

3) Angular Displacement given Initial Angular Velocity Angular Acceleration and Time

$$fx \quad \theta = \omega_o \cdot t + \frac{\alpha \cdot t^2}{2}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$ex \quad 112.8\text{rad} = 14\text{rad/s} \cdot 6\text{s} + \frac{1.6\text{rad/s}^2 \cdot (6\text{s})^2}{2}$$



4) Angular Displacement given Initial Angular Velocity Final Angular Velocity and Time

$$fx \quad \theta = \left(\frac{\omega_o + \omega_1}{2} \right) \cdot t$$

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

$$ex \quad 75rad = \left(\frac{14rad/s + 11rad/s}{2} \right) \cdot 6s$$

5) Angular Displacement of Body for given Initial and Final Angular Velocity

$$fx \quad \theta = \frac{\omega_1^2 - \omega_o^2}{2 \cdot \alpha}$$

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

$$ex \quad -23.4375rad = \frac{(11rad/s)^2 - (14rad/s)^2}{2 \cdot 1.6rad/s^2}$$

6) Angular Velocity given Tangential Velocity

$$fx \quad \omega = \frac{v_t}{R_c}$$

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

$$ex \quad 24rad/s = \frac{360m/s}{15m}$$



7) Average Velocity of Body given Initial and Final Velocity

$$fx \quad v_{avg} = \frac{u + v_f}{2}$$

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

$$ex \quad 37.5m/s = \frac{35m/s + 40m/s}{2}$$

8) Centripetal or Radial Acceleration

$$fx \quad \alpha = \omega^2 \cdot R_c$$

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

$$ex \quad 1881.6rad/s^2 = (11.2rad/s)^2 \cdot 15m$$

9) Displacement of Body given Initial Velocity Acceleration and Time

$$fx \quad s_{body} = u \cdot t + \frac{a \cdot t^2}{2}$$

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

$$ex \quad 296.4m = 35m/s \cdot 6s + \frac{4.8m/s^2 \cdot (6s)^2}{2}$$

10) Displacement of Body given Initial Velocity and Final Velocity

$$fx \quad s_{body} = \left(\frac{u + v_f}{2} \right) \cdot t$$

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

$$ex \quad 225m = \left(\frac{35m/s + 40m/s}{2} \right) \cdot 6s$$



11) Displacement of Body given Initial Velocity Final Velocity and Acceleration

$$fx \quad s_{\text{body}} = \frac{v_f^2 - u^2}{2 \cdot a}$$

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

$$ex \quad 39.0625\text{m} = \frac{(40\text{m/s})^2 - (35\text{m/s})^2}{2 \cdot 4.8\text{m/s}^2}$$

12) Distance Travelled in Nth Second (Accelerated Translatory Motion)

$$fx \quad D = u + \left(\frac{2 \cdot n_{\text{th}} - 1}{2} \right) \cdot a$$

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

$$ex \quad 51.8\text{m} = 35\text{m/s} + \left(\frac{2 \cdot 4\text{s} - 1}{2} \right) \cdot 4.8\text{m/s}^2$$

13) Final Angular Velocity given Initial Angular Velocity Angular Acceleration and Time

$$fx \quad \omega_1 = \omega_o + \alpha \cdot t$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 23.6\text{rad/s} = 14\text{rad/s} + 1.6\text{rad/s}^2 \cdot 6\text{s}$$

14) Final Velocity of Body

$$fx \quad v_f = u + a \cdot t$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$ex \quad 63.8\text{m/s} = 35\text{m/s} + 4.8\text{m/s}^2 \cdot 6\text{s}$$



15) Final Velocity of Freely Falling Body from Height when it Reaches Ground

$$fx \quad V = \sqrt{2 \cdot g \cdot h}$$

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

$$ex \quad 15.33623 = \sqrt{2 \cdot 9.8\text{m/s}^2 \cdot 12000\text{mm}}$$

16) Normal Acceleration

$$fx \quad a_n = \omega^2 \cdot R_c$$

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

$$ex \quad 1881.6\text{m/s}^2 = (11.2\text{rad/s})^2 \cdot 15\text{m}$$

17) Resultant Acceleration

$$fx \quad a_r = \sqrt{a_t^2 + a_n^2}$$

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

$$ex \quad 6000.048\text{m/s}^2 = \sqrt{(24\text{m/s}^2)^2 + (6000\text{m/s}^2)^2}$$

18) Tangential Acceleration

$$fx \quad a_t = \alpha \cdot R_c$$

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

$$ex \quad 24\text{m/s}^2 = 1.6\text{rad/s}^2 \cdot 15\text{m}$$










Variables Used

- **a** Acceleration of Body (Meter per Square Second)
- **a_n** Normal Acceleration (Meter per Square Second)
- **a_r** Resultant Acceleration (Meter per Square Second)
- **a_t** Tangential Acceleration (Meter per Square Second)
- **D** Distance Traveled (Meter)
- **g** Acceleration due to Gravity (Meter per Square Second)
- **h** Height of Crack (Millimeter)
- **n_{th}** Nth Second (Second)
- **R_c** Radius of Curvature (Meter)
- **S_{body}** Displacement of Body (Meter)
- **t** Time Taken to Travel the Path (Second)
- **u** Initial Velocity (Meter per Second)
- **V** Velocity on Reaching Ground
- **v_{avg}** Average Velocity (Meter per Second)
- **v_f** Final Velocity (Meter per Second)
- **v_t** Tangential Velocity (Meter per Second)
- **α** Angular Acceleration (Radian per Square Second)
- **θ** Angular Displacement (Radian)
- **Φ** Inclination Angle (Radian)
- **ω** Angular Velocity (Radian per Second)
- **ω₁** Final Angular Velocity (Radian per Second)
- **ω₀** Initial Angular Velocity (Radian per Second)



Constants, Functions, Measurements used

- **Function:** **atan**, atan(Number)
Inverse trigonometric tangent function
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Function:** **tan**, tan(Angle)
Trigonometric tangent function
- **Measurement:** **Length** in Meter (m), Millimeter (mm)
Length Unit Conversion 
- **Measurement:** **Time** in Second (s)
Time Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Acceleration** in Meter per Square Second (m/s²)
Acceleration Unit Conversion 
- **Measurement:** **Angle** in Radian (rad)
Angle Unit Conversion 
- **Measurement:** **Angular Velocity** in Radian per Second (rad/s)
Angular Velocity Unit Conversion 
- **Measurement:** **Angular Acceleration** in Radian per Square Second (rad/s²)
Angular Acceleration Unit Conversion 



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- **Kinematics Formulas** 

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