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

[Open Calculator ↗](#)

ex $0.06673\text{rad} = a \tan\left(\frac{1.6039\text{m/s}^2}{24\text{m/s}^2}\right)$

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

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

[Open Calculator ↗](#)

ex $120\text{rad} = 15.2\text{rad/s} + \left(\frac{2 \cdot 66\text{s} - 1}{2}\right) \cdot 1.6\text{rad/s}^2$

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

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

[Open Calculator ↗](#)

ex $120\text{rad} = 15.2\text{rad/s} \cdot 6\text{s} + \frac{1.6\text{rad/s}^2 \cdot (6\text{s})^2}{2}$



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

fx $\theta = \left(\frac{\omega_0 + \omega_1}{2} \right) \cdot t$

[Open Calculator ↗](#)

ex $120\text{rad} = \left(\frac{15.2\text{rad/s} + 24.8\text{rad/s}}{2} \right) \cdot 6\text{s}$

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

fx $\theta = \frac{\omega_1^2 - \omega_0^2}{2 \cdot \alpha}$

[Open Calculator ↗](#)

ex $120\text{rad} = \frac{(24.8\text{rad/s})^2 - (15.2\text{rad/s})^2}{2 \cdot 1.6\text{rad/s}^2}$

6) Angular Velocity given Tangential Velocity ↗

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

[Open Calculator ↗](#)

ex $0.327\text{rad/s} = \frac{4.905\text{m/s}}{15\text{m}}$



7) Average Velocity of Body given Initial and Final Velocity ↗

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

[Open Calculator ↗](#)

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

8) Centripetal or Radial Acceleration ↗

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

[Open Calculator ↗](#)

ex $1.603935 \text{ rad/s}^2 = (0.327 \text{ rad/s})^2 \cdot 15 \text{ m}$

9) Displacement of Body given Initial Velocity Acceleration and Time ↗

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

[Open Calculator ↗](#)

ex $225.012 \text{ m} = 35 \text{ m/s} \cdot 6 \text{ s} + \frac{0.834 \text{ m/s}^2 \cdot (6 \text{ s})^2}{2}$

10) Displacement of Body given Initial Velocity and Final Velocity ↗

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

[Open Calculator ↗](#)

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



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 ↗](#)

$$ex \quad 224.8201m = \frac{(40m/s)^2 - (35m/s)^2}{2 \cdot 0.834m/s^2}$$

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 ↗](#)

$$ex \quad 89.627m = 35m/s + \left(\frac{2 \cdot 66s - 1}{2} \right) \cdot 0.834m/s^2$$

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

$$fx \quad \omega_1 = \omega_0 + \alpha \cdot t$$

[Open Calculator ↗](#)

$$ex \quad 24.8\text{rad/s} = 15.2\text{rad/s} + 1.6\text{rad/s}^2 \cdot 6s$$

14) Final Velocity of Body ↗

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

[Open Calculator ↗](#)

$$ex \quad 40.004m/s = 35m/s + 0.834m/s^2 \cdot 6s$$



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

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

[Open Calculator ↗](#)

$$ex \quad 4.00899 = \sqrt{2 \cdot 9.8m/s^2 \cdot 0.82m}$$

16) Normal Acceleration ↗

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

[Open Calculator ↗](#)

$$ex \quad 1.603935m/s^2 = (0.327\text{rad}/s)^2 \cdot 15m$$

17) Resultant Acceleration ↗

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

[Open Calculator ↗](#)

$$ex \quad 24.05353m/s^2 = \sqrt{(24m/s^2)^2 + (1.6039m/s^2)^2}$$

18) Tangential Acceleration ↗

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

[Open Calculator ↗](#)

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



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*)
- **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** Height of Crack (*Meter*)
- **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*)
- **ω_1** Final Angular Velocity (*Radian per Second*)
- **ω_0** Initial Angular Velocity (*Radian per Second*)



Constants, Functions, Measurements used

- **Function:** atan, atan(Number)

Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.

- **Function:** sqrt, sqrt(Number)

A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.

- **Function:** tan, tan(Angle)

The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.

- **Measurement:** Length in Meter (m)

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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