Important Kinematics Formulas PDF

Formulas
Examples
with Units

List of 18
Important Kinematics Formulas

1) Angle of Inclination of Resultant Acceleration with Tangential Acceleration Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0667\,\text{rad} = atan\left(\frac{1.6039\,\text{m/s}^2}{24\,\text{m/s}^2}\right)$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

6) Angular Velocity given Tangential Velocity Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

8) Centripetal or Radial Acceleration Formula

Evaluate Formula

Formula

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

Example with Units

$$1.6039\,\text{rad/s}^2 = 0.327\,\text{rad/s}^2 \cdot 15\,\text{m}$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$224.8201\,\text{m} = \frac{40\,\text{m/s}^2 - 35\,\text{m/s}^2}{2 \cdot 0.834\,\text{m/s}^2}$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

14) Final Velocity of Body Formula

Evaluate Formula

Formula

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

Example with Units

$$40.004\,\text{m/s} = 35\,\text{m/s} + 0.834\,\text{m/s}^2 \cdot 6\,\text{s}$$

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

Evaluate Formula

Formula

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

Example with Units

$$4.009 = \sqrt{2 \cdot 9.8\,\text{m/s}^2 \cdot 0.82\,\text{m}}$$

16) Normal Acceleration Formula

Evaluate Formula

Formula

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

Example with Units

$$1.6039\,\text{m/s}^2 = 0.327\,\text{rad/s}^2 \cdot 15\,\text{m}$$

17) Resultant Acceleration Formula

Evaluate Formula

Formula

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

Example with Units

$$24.0535\,\text{m/s}^2 = \sqrt{24\,\text{m/s}^2{}^2 + 1.6039\,\text{m/s}^2{}^2}$$

18) Tangential Acceleration Formula

Evaluate Formula

Formula

$$a_t = \alpha \cdot R_c$$

Example with Units

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

Variables used in list of Kinematics Formulas above

- **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_o Initial Angular Velocity *(Radian per Second)*

Constants, Functions, Measurements used in list of Kinematics Formulas above

- Functions: **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.
- Functions: **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.
- Functions: **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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