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# Kinematics and Dynamics Formulas

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# List of 12 Kinematics and Dynamics Formulas

## Kinematics and Dynamics

### Circular Motion

#### 1) Angular Displacement

$$fx \quad \theta = \frac{s_{\text{cir}}}{R_{\text{curvature}}}$$

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

$$ex \quad 37.60799^\circ = \frac{10\text{m}}{15.235\text{m}}$$

#### 2) Angular Speed

$$fx \quad \omega = \frac{\theta}{t_{\text{total}}}$$

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

$$ex \quad 0.005139\text{rev/s} = \frac{37^\circ}{20\text{s}}$$

#### 3) Centripetal Force

$$fx \quad F_C = \frac{M \cdot v^2}{r}$$

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

$$ex \quad 21984.91\text{N} = \frac{35.45\text{kg} \cdot (61\text{m/s})^2}{6\text{m}}$$



#### 4) Speed of Object in Circular Motion

$$fx \quad V = 2 \cdot \pi \cdot r \cdot f$$

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

$$ex \quad 3392.92\text{m/s} = 2 \cdot \pi \cdot 6\text{m} \cdot 90\text{Hz}$$

#### Motion in 1D

#### 5) Acceleration

$$fx \quad a = \frac{\Delta v}{t_{\text{total}}}$$

[Open Calculator !\[\]\(5361750c22c4e047a52f4eac1ec2d4cc\_img.jpg\)](#)

$$ex \quad 12.55\text{m/s}^2 = \frac{251\text{m/s}}{20\text{s}}$$

#### 6) Average Speed

$$fx \quad v_{\text{avg}} = \frac{D}{t_{\text{total}}}$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e\_img.jpg\)](#)

$$ex \quad 3\text{m/s} = \frac{60\text{m}}{20\text{s}}$$

#### 7) Distance Traveled

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

[Open Calculator !\[\]\(84f47badaad7772cd95667a7c387a639\_img.jpg\)](#)

$$ex \quad 331.875\text{m} = 35\text{m/s} \cdot 5\text{s} + \frac{12.55\text{m/s}^2 \cdot (5\text{s})^2}{2}$$



## Rotational Mechanics

### 8) Angular Momentum

$$fx \quad L = I \cdot \omega$$

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

$$ex \quad 0.035343\text{kg} \cdot \text{m}^2/\text{s} = 1.125\text{kg} \cdot \text{m}^2 \cdot 0.005\text{rev}/\text{s}$$

### 9) Torque

$$fx \quad \tau = F \cdot l_{\text{dis}} \cdot \sin(\theta_{\text{FD}})$$

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

$$ex \quad 1.5\text{N} \cdot \text{m} = 2.5\text{N} \cdot 1.2\text{m} \cdot \sin(30^\circ)$$

## Work and Energy

### 10) Kinetic Energy

$$fx \quad KE = \frac{M \cdot v^2}{2}$$

[Open Calculator !\[\]\(a8f9309f944226d1420f5fed22e2b6e6\_img.jpg\)](#)

$$ex \quad 65954.73\text{J} = \frac{35.45\text{kg} \cdot (61\text{m}/\text{s})^2}{2}$$

### 11) Potential Energy

$$fx \quad PE = M \cdot g \cdot h$$

[Open Calculator !\[\]\(cbd8541a32dfc32f356f5c6c994b0a21\_img.jpg\)](#)

$$ex \quad 4168.92\text{J} = 35.45\text{kg} \cdot 9.8\text{m}/\text{s}^2 \cdot 12\text{m}$$



12) Work 

$$fx \quad W = F \cdot d \cdot \cos(\theta_{FD})$$

[Open Calculator](#) 

$$ex \quad 216.5064J = 2.5N \cdot 100m \cdot \cos(30^\circ)$$



## Variables Used










- **a** Acceleration (Meter per Square Second)
- **d** Displacement (Meter)
- **D** Total Distance Traveled (Meter)
- **f** Frequency (Hertz)
- **F** Force (Newton)
- **F<sub>C</sub>** Centripetal Force (Newton)
- **g** Acceleration due to Gravity (Meter per Square Second)
- **h** Height (Meter)
- **I** Moment of Inertia (Kilogram Square Meter)
- **KE** Kinetic Energy (Joule)
- **L** Angular Momentum (Kilogram Square Meter per Second)
- **I<sub>dis</sub>** Length of Displacement Vector (Meter)
- **M** Mass (Kilogram)
- **PE** Potential Energy (Joule)
- **r** Radius (Meter)
- **R<sub>curvature</sub>** Radius of Curvature (Meter)
- **s** Distance Traveled (Meter)
- **S<sub>cir</sub>** Distance Covered on the Circular Path (Meter)
- **t** Time Taken to Travel (Second)
- **t<sub>total</sub>** Total Time Taken (Second)
- **u** Initial Velocity (Meter per Second)
- **v** Velocity (Meter per Second)
- **V** Speed of object moving in Circle (Meter per Second)



- **$V_{avg}$**  Average Velocity (Meter per Second)
- **$W$**  Work (Joule)
- **$\Delta v$**  Change in Velocity (Meter per Second)
- **$\theta$**  Angular Displacement (Degree)
- **$\theta_{FD}$**  Angle between Force and Displacement Vector (Degree)
- **$T$**  Torque Exerted on Wheel (Newton Meter)
- **$\omega$**  Angular Speed (Revolution per Second)







## Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Function:** **cos**,  $\cos(\text{Angle})$   
*Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- **Function:** **sin**,  $\sin(\text{Angle})$   
*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:** **Weight** in Kilogram (kg)  
*Weight 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/s<sup>2</sup>)  
*Acceleration Unit Conversion* 
- **Measurement:** **Energy** in Joule (J)  
*Energy Unit Conversion* 
- **Measurement:** **Force** in Newton (N)  
*Force Unit Conversion* 
- **Measurement:** **Angle** in Degree (°)  
*Angle Unit Conversion* 
- **Measurement:** **Frequency** in Hertz (Hz)  
*Frequency Unit Conversion* 





- **Measurement: Angular Velocity** in Revolution per Second (rev/s)  
*Angular Velocity Unit Conversion* 
- **Measurement: Torque** in Newton Meter (N\*m)  
*Torque Unit Conversion* 
- **Measurement: Moment of Inertia** in Kilogram Square Meter (kg·m<sup>2</sup>)  
*Moment of Inertia Unit Conversion* 
- **Measurement: Angular Momentum** in Kilogram Square Meter per Second (kg\*m<sup>2</sup>/s)  
*Angular Momentum Unit Conversion* 



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