Important General Principal to Dynamics Formulas PDF

Formulas
Examples
with Units

List of 19
Important General Principal to Dynamics Formulas

1) Laws of Motion Formulas

1.1) Downward Force due to Mass of Lift, when Lift is Moving Upwards Formula

Evaluate Formula

Formula	Example with Units
$F_{dwn} = m_o \cdot [g]$	$347.6457\,\text{N} = 35.45\,\text{kg} \cdot 9.8066\,\text{m/s}^2$

1.2) Final Momentum Formula

Evaluate Formula

Formula	Example with Units
$P_f = m_o \cdot v_f$	$3190.5\,\text{N*s} = 35.45\,\text{kg} \cdot 90\,\text{m/s}$

1.3) Force Exerted by Mass Carried by Lift on its Floor, when Lift is Moving Upwards Formula

Evaluate Formula

Formula	Example with Units
$F_{up} = m_c \cdot ([g] + a)$	$45.7833\,\text{N} = 4.1\,\text{kg} \cdot (9.8066\,\text{m/s}^2 + 1.36\,\text{m/s}^2)$

1.4) Initial Momentum Formula

Evaluate Formula

Formula	Example with Units
$P_i = m_o \cdot v_i$	$1772.5\,\text{N*s} = 35.45\,\text{kg} \cdot 50\,\text{m/s}$

1.5) Momentum Formula

Evaluate Formula

Formula	Example with Units
$p = m_o \cdot v$	$2127\,\text{N*s} = 35.45\,\text{kg} \cdot 60\,\text{m/s}$

1.6) Net Downward Force, when Lift is Moving Downwards Formula

Evaluate Formula

Formula	Example with Units
$F_{dwn} = m_o \cdot [g] - R$	$347.0457\,\text{N} = 35.45\,\text{kg} \cdot 9.8066\,\text{m/s}^2 - 0.6\,\text{N}$

1.7) Net Upward Force on Lift, when Lift is Moving Upwards Formula

Evaluate Formula

Formula

$$F_{up} = L - m_o \cdot [g]$$

Example with Units

$$45.0543\,\text{N} = 392.7\,\text{N} - 35.45\,\text{kg} \cdot 9.8066\,\text{m/s}^2$$

1.8) Normal Reaction on Inclined Plane due to Mass of Body Formula

Evaluate Formula

Formula

$$R_n = m_o \cdot [g] \cdot \cos\left(\theta_i\right)$$

Example with Units

$$4.2472\,\text{N} = 35.45\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos\left(89.3^\circ\right)$$

1.9) Rate of Change of Momentum given Acceleration and Mass Formula

Evaluate Formula

Formula

$$r_m = m_o \cdot a$$

Example with Units

$$48.212\,\text{N} = 35.45\,\text{kg} \cdot 1.36\,\text{m/s}^2$$

1.10) Rate of Change of Momentum given Initial and Final Velocities Formula

Evaluate Formula

Formula

$$r_m = m_o \cdot \frac{v_f - v_i}{t}$$

Example with Units

$$48.2149\,\text{N} = 35.45\,\text{kg} \cdot \frac{90\,\text{m/s} - 50\,\text{m/s}}{29.41\,\text{s}}$$

1.11) Reaction of Lift when it is Moving Downwards Formula

Evaluate Formula

Formula

$$R_{dwn} = m_o \cdot \left([g] - a\right)$$

Example with Units

$$299.4337\,\text{N} = 35.45\,\text{kg} \cdot \left(9.8066\,\text{m/s}^2 - 1.36\,\text{m/s}^2\right)$$

1.12) Reaction of Lift when it is Moving Upwards Formula

Evaluate Formula

Formula

$$R_{up} = m_o \cdot \left(a + [g]\right)$$

Example with Units

$$395.8577\,\text{N} = 35.45\,\text{kg} \cdot \left(1.36\,\text{m/s}^2 + 9.8066\,\text{m/s}^2\right)$$

1.13) Tension in Cable when Lift is Moving Upwards with Mass Formula

Evaluate Formula

Formula

$$T = \left(m_L + m_c\right) \cdot [g] \cdot a$$

Example with Units

$$281.4116\,\text{N} = \left(17\,\text{kg} + 4.1\,\text{kg}\right) \cdot 9.8066\,\text{m/s}^2 \cdot 1.36\,\text{m/s}^2$$

1.14) Velocity of Body given Momentum Formula

Evaluate Formula

Formula

$$v = \frac{p}{m_o}$$

Example with Units

$$60\,\text{m/s} = \frac{2127\,\text{N*s}}{35.45\,\text{kg}}$$

2) Principal Parameters Formulas

2.1) Angle of banking Formula

Evaluate Formula

Formula

$$\theta_b = atan\left(\frac{v^2}{[g] \cdot r}\right)$$

Example with Units

$$74.762° = atan\left(\frac{60\,m/s^2}{9.8066\,m/s^2 \cdot 100\,m}\right)$$

2.2) Force of attraction between two masses separated by distance Formula

Evaluate Formula

Formula

$$F_g = \frac{[G.] \cdot m_1 \cdot m_2}{d_m^2}$$

Example with Units

$$4.6E\text{-}14\,N = \frac{6.7E\text{-}11 \cdot 40\,kg \cdot 25\,kg}{1200\,m^2}$$

2.3) Maximum velocity to avoid overturning of vehicle along level circular path Formula

Evaluate Formula

Formula

$$v = \sqrt{\frac{[g] \cdot r \cdot d_w}{2 \cdot G}}$$

Example with Units

$$60.6423\,m/s = \sqrt{\frac{9.8066\,m/s^2 \cdot 100\,m \cdot 1.5\,m}{2 \cdot 0.2\,m}}$$

2.4) Maximum velocity to avoid skidding away of vehicle along level circular path Formula

Evaluate Formula

Formula

$$v = \sqrt{\mu \cdot [g] \cdot r}$$

Example with Units

$$60.2367\,m/s = \sqrt{3.7 \cdot 9.8066\,m/s^2 \cdot 100\,m}$$

2.5) Superelevation in railways Formula

Evaluate Formula

Formula

$$S = \frac{G \cdot \left(v^2\right)}{[g] \cdot r}$$

Example with Units

$$0.7342\,m = \frac{0.2\,m \cdot \left(60\,m/s^2\right)}{9.8066\,m/s^2 \cdot 100\,m}$$

Variables used in list of General Principal to Dynamics Formulas above

- **a** Acceleration *(Meter per Square Second)*
- d_m Distance between two Masses *(Meter)*
- d_w Distance between Center Lines of two Wheels *(Meter)*
- F_{dwn} Downward Force *(Newton)*
- F_g Gravitational Force of Attraction *(Newton)*
- F_{up} Upward Force *(Newton)*
- **G** Gauge of Track *(Meter)*
- **L** Lift *(Newton)*
- m_1 Mass of First Particle *(Kilogram)*
- m_2 Mass of Second Particle *(Kilogram)*
- m_c Mass Carried by Lift *(Kilogram)*
- m_L Mass of Lift *(Kilogram)*
- m_o Mass *(Kilogram)*
- **p** Momentum *(Newton Second)*
- P_f Final Momentum *(Newton Second)*
- P_i Initial Momentum *(Newton Second)*
- **r** Radius of Circular Path *(Meter)*
- **R** Reaction of Lift *(Newton)*
- R_{dwn} Reaction of Lift in Downwards Direction *(Newton)*
- r_m Rate of Change of Momentum *(Newton)*
- R_n Normal Reaction *(Newton)*
- R_{up} Reaction of Lift in Upwards Direction *(Newton)*
- **S** Superelevation *(Meter)*
- **t** Time *(Second)*
- **T** Tension in Cable *(Newton)*
- **v** Velocity *(Meter per Second)*
- v_f Final Velocity of Mass *(Meter per Second)*
- v_i Initial Velocity of Mass *(Meter per Second)*
- θ_b Angle of Banking *(Degree)*

Constants, Functions, Measurements used in list of General Principal to Dynamics Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- constant(s): **[G.]**, 6.67408E-11
  Gravitational constant
- 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: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the 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: **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/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Momentum** in Newton Second (N*s)
  Momentum Unit Conversion

- θ_i Angle of Inclination *(Degree)*
- μ Coefficient of Friction between Wheels and Ground

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