Important Mechanics of Train Movement Formulas PDF

Formulas
Examples
with Units

List of 13
Important Mechanics of Train Movement Formulas

1) Accelerating Weight of Train Formula

Evaluate Formula

Formula

$$W_e = W \cdot 1.10$$

Example with Units

$$33000\,\text{AT (US)} = 30000\,\text{AT (US)} \cdot 1.10$$

2) Aerodynamic Drag Force Formula

Evaluate Formula

Formula

$$F_{drag} = C_{drag} \cdot \left(\frac{\rho \cdot V_f^{\,2}}{2} \right) \cdot A_{ref}$$

Example with Units

$$1091.3745\,\text{N} = 1.39 \cdot \left(\frac{98\,\text{kg/m}^3 \cdot 6.4\,\text{km/h}^{\,2}}{2} \right) \cdot 5.07\,\text{m}^2$$

3) Coefficient of Adhesion Formula

Evaluate Formula

Formula

$$\mu = \frac{F_t}{W}$$

Example with Units

$$0.6229 = \frac{545\,\text{N}}{30000\,\text{AT (US)}}$$

4) Crest Speed given Time for Acceleration Formula

Evaluate Formula

Formula

$$V_m = t_\alpha \cdot \alpha$$

Example with Units

$$98.352\,\text{km/h} = 6.83\,\text{s} \cdot 14.40\,\text{km/h*s}$$

5) Gradient of Train for Proper Movement of Traffic Formula

Evaluate Formula

Formula

$$G = \sin\left(\angle D \right) \cdot 100$$

Example with Units

$$0.5236 = \sin\left(0.3° \right) \cdot 100$$

6) Retardation of Train Formula

Evaluate Formula

Formula

$$\beta = \frac{V_m}{t_\beta}$$

Example with Units

$$10.3635\,\text{km/h*s} = \frac{98.35\,\text{km/h}}{9.49\,\text{s}}$$

7) Rotating Speed of Driven Wheel Formula

Evaluate Formula

Formula

$$N_w = \frac{N_{pp}}{i \cdot i_o}$$

Example with Units

$$956.6667\,\text{rev/min} = \frac{4879\,\text{rev/min}}{2.55 \cdot 2}$$

8) Schedule Speed Formula

Evaluate Formula

Formula

$$V_s = \frac{D}{T_{run} + T_{stop}}$$

Example with Units

$$25.1299\,\text{km/h} = \frac{258\,\text{km}}{10\,\text{h} + 16\,\text{min}}$$

9) Schedule Time Formula

Evaluate Formula

Formula

$$T_s = T_{run} + T_{stop}$$

Example with Units

$$10.2667\,\text{h} = 10\,\text{h} + 16\,\text{min}$$

10) Time for Acceleration Formula

Evaluate Formula

Formula

$$t_\alpha = \frac{V_m}{\alpha}$$

Example with Units

$$6.8299\,\text{s} = \frac{98.35\,\text{km/h}}{14.40\,\text{km/h*s}}$$

11) Time for Retardation Formula

Evaluate Formula

Formula

$$t_\beta = \frac{V_m}{\beta}$$

Example with Units

$$9.4932\,\text{s} = \frac{98.35\,\text{km/h}}{10.36\,\text{km/h*s}}$$

12) Translational Speed of Wheel Center Formula

Evaluate Formula

Formula

$$V_t = \frac{\pi \cdot r_d \cdot N_{pp}}{30 \cdot i \cdot i_o}$$

Example with Units

$$162.2947\,\text{km/h} = \frac{3.1416 \cdot 0.45\,\text{m} \cdot 4879\,\text{rev/min}}{30 \cdot 2.55 \cdot 2}$$

13) Wheel Force Function Formula

Evaluate Formula

Formula

$$F_w = \frac{i \cdot i_o \cdot \tau_e}{2 \cdot r_w}$$

Example with Units

$$5.3968\,\text{N} = \frac{2.55 \cdot 2 \cdot 4\,\text{N*m}}{2 \cdot 1.89\,\text{m}}$$

Variables used in list of Mechanics of Train Movement Formulas above

- $\angle D$ Angle D *(Degree)*
- A_{ref} Reference Area *(Square Meter)*
- C_{drag} Drag Coefficient
- D Distance Travelled by Train *(Kilometer)*
- F_{drag} Drag Force *(Newton)*
- F_t Tractive Effort *(Newton)*
- F_w Wheel Force Function *(Newton)*
- G Gradient
- i Gear Ratio of Transmission
- i_o Gear Ratio of Final Drive
- N_{pp} Speed of Motor Shaft in Powerplant *(Revolution per Minute)*
- N_w Rotating Speed of Driven Wheels *(Revolution per Minute)*
- r_d Effective Radius of Wheel *(Meter)*
- r_w Radius of Wheel *(Meter)*
- T_{run} Running Time of Train *(Hour)*
- T_s Schedule Time *(Hour)*
- T_{stop} Stop Time of Train *(Minute)*
- t_α Time for Acceleration *(Second)*
- t_β Time for Retardation *(Second)*
- V_f Flow Velocity *(Kilometer per Hour)*
- V_m Crest Speed *(Kilometer per Hour)*
- V_s Schedule Speed *(Kilometer per Hour)*
- V_t Translational Speed *(Kilometer per Hour)*
- W Weight of Train *(Ton (Assay) (US))*
- W_e Accelerating Weight of Train *(Ton (Assay) (US))*
- α Acceleration of Train *(Kilometer per Hour Second)*
- β Retardation of Train *(Kilometer per Hour Second)*
- μ Coefficient of Adhesion

Constants, Functions, Measurements used in list of Mechanics of Train Movement Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **sin**, sin(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 Kilometer (km), Meter (m) *Length Unit Conversion*
- Measurement: **Weight** in Ton (Assay) (US) (AT (US)) *Weight Unit Conversion*
- Measurement: **Time** in Second (s), Hour (h), Minute (min) *Time Unit Conversion*
- Measurement: **Area** in Square Meter (m²) *Area Unit Conversion*
- Measurement: **Speed** in Kilometer per Hour (km/h) *Speed Unit Conversion*
- Measurement: **Acceleration** in Kilometer per Hour Second (km/h*s) *Acceleration Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m³) *Mass Concentration Unit Conversion*
- Measurement: **Angular Velocity** in Revolution per Minute (rev/min) *Angular Velocity Unit Conversion*
- Measurement: **Torque** in Newton Meter (N*m) *Torque Unit Conversion*

- ρ Mass Density *(Kilogram per Cubic Meter)*
- τ_e Engine Torque *(Newton Meter)*

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