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Turning Flight Formulas

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List of 13 Turning Flight Formulas

Turning Flight

1) Bank angle during level turn

Open Calculator

fx $$\Phi = a\cos\left(\frac{W}{F_L}\right)$$

ex $$0.451027\text{rad} = a\cos\left(\frac{18\text{N}}{20\text{N}}\right)$$

2) Lift during level turn

Open Calculator

fx $$F_L = \frac{W}{\cos(\Phi)}$$

ex $$19.99007\text{N} = \frac{18\text{N}}{\cos(0.45\text{rad})}$$

3) Lift for given Load Factor

Open Calculator

fx $$F_L = n \cdot W$$

ex $$19.98\text{N} = 1.11 \cdot 18\text{N}$$

4) Load factor given Lift Force and Weight of Aircraft

Open Calculator

fx $$n = \frac{F_L}{W}$$

ex $$1.111111 = \frac{20N}{18N}$$

5) Load Factor given Turn Radius

Open Calculator

fx $$n = \sqrt{1 + \left(\frac{V^2}{[g] \cdot R}\right)^2}$$

ex $$1.11 = \sqrt{1 + \left(\frac{(200m/s)^2}{[g] \cdot 8466.46m}\right)^2}$$

6) Load Factor given Turn Rate

Open Calculator

fx $$n = \sqrt{\left(V \cdot \frac{\omega}{[g]}\right)^2 + 1}$$

ex $$1.11101 = \sqrt{\left(200m/s \cdot \frac{1.36degree/s}{[g]}\right)^2 + 1}$$

7) Rate of Turn

Open Calculator

fx $$\omega = 1091 \cdot \frac{\tan(\Phi)}{V}$$

ex $$1.355595\text{degree/s} = 1091 \cdot \frac{\tan(0.45\text{rad})}{200\text{m/s}}$$

8) Turn radius

Open Calculator

fx $$R = \frac{V^2}{[g] \cdot \sqrt{(n^2) - 1}}$$

ex $$8466.458\text{m} = \frac{(200\text{m/s})^2}{[g] \cdot \sqrt{\left((1.11)^2\right) - 1}}$$

9) Turn rate

Open Calculator

fx $$\omega = [g] \cdot \frac{\sqrt{n^2 - 1}}{V}$$

ex $$1.353477\text{degree/s} = [g] \cdot \frac{\sqrt{(1.11)^2 - 1}}{200\text{m/s}}$$

10) Velocity for given turn radius

Open Calculator

fx $$V = \sqrt{R \cdot [g] \cdot \left(\sqrt{n^2 - 1}\right)}$$

ex $$200\text{m/s} = \sqrt{8466.46\text{m} \cdot [g] \cdot \left(\sqrt{(1.11)^2 - 1}\right)}$$

11) Velocity for given turn rate

Open Calculator

fx $$V = [g] \cdot \frac{\sqrt{n^2 - 1}}{\omega}$$

ex $$199.0407\text{m/s} = [g] \cdot \frac{\sqrt{(1.11)^2 - 1}}{1.36\text{degree/s}}$$

12) Weight for given Load Factor

Open Calculator

fx $$W = \frac{F_L}{n}$$

ex $$18.01802\text{N} = \frac{20\text{N}}{1.11}$$

13) Weight of aircraft during level turn

Open Calculator

fx $$W = F_L \cdot \cos(\Phi)$$

ex $$18.00894\text{N} = 20\text{N} \cdot \cos(0.45\text{rad})$$

Variables Used

- F_L Lift Force *(Newton)*
- **n** Load Factor
- **R** Turn Radius *(Meter)*
- **V** Flight Velocity *(Meter per Second)*
- **W** Aircraft Weight *(Newton)*
- **Φ** Bank Angle *(Radian)*
- **ω** Turn Rate *(Degree per Second)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **acos**, acos(Number)
  The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the 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: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Angular Velocity** in Degree per Second (degree/s)
  Angular Velocity Unit Conversion

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- **Climbing Flight Formulas**
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