Laminar Flow between Parallel Plates, both plates at rest Formulas

List of 30 Laminar Flow between Parallel Plates, both plates at rest Formulas

Laminar Flow between Parallel Plates, both plates at rest

1) Discharge given Mean Velocity of Flow

Open Calculator

fx $$Q = w \cdot V_{mean}$$

ex $$97.2\text{m}^3/\text{s} = 3\text{m} \cdot 32.4\text{m/s}$$

2) Discharge given Viscosity

Open Calculator

fx $$Q = dp|dr \cdot \frac{w^3}{12 \cdot \mu_{viscosity}}$$

ex $$37.5\text{m}^3/\text{s} = 17\text{N/m}^3 \cdot \frac{(3\text{m})^3}{12 \cdot 10.2\text{P}}$$

3) Distance between Plates given Discharge

Open Calculator

fx $$w = \left(\frac{Q \cdot 12 \cdot \mu_{viscosity}}{dp|dr} \right)^{\frac{1}{3}}$$

ex $$3.408514\text{m} = \left(\frac{55\text{m}^3/\text{s} \cdot 12 \cdot 10.2\text{P}}{17\text{N/m}^3} \right)^{\frac{1}{3}}$$

4) Distance between Plates given Maximum Velocity between Plates

Open Calculator

fx $$w = \sqrt{\frac{8 \cdot \mu_{viscosity} \cdot V_{max}}{dp|dr}}$$

ex $$2.987976\text{m} = \sqrt{\frac{8 \cdot 10.2\text{P} \cdot 18.6\text{m/s}}{17\text{N/m}^3}}$$

5) Distance between Plates given Mean Velocity of Flow

Open Calculator

fx $$w = \frac{Q}{V_{mean}}$$

ex $$1.697531\text{m} = \frac{55\text{m}^3/\text{s}}{32.4\text{m/s}}$$

6) Distance between Plates given Mean Velocity of Flow with Pressure Gradient

Open Calculator

fx $$w = \sqrt{\frac{12 \cdot \mu_{viscosity} \cdot V_{mean}}{dp|dr}}$$

ex $$4.829907\text{m} = \sqrt{\frac{12 \cdot 10.2\text{P} \cdot 32.4\text{m/s}}{17\text{N/m}^3}}$$

7) Distance between Plates given Pressure Difference

Open Calculator

$$w = \sqrt{12 \cdot V_{mean} \cdot \mu_{viscosity} \cdot \frac{L_p}{\Delta P}}$$

$$1.726782\text{m} = \sqrt{12 \cdot 32.4\text{m/s} \cdot 10.2\text{P} \cdot \frac{0.10\text{m}}{13.3\text{N/m}^2}}$$

8) Distance between Plates given Pressure Head Drop

Open Calculator

$$w = \sqrt{\frac{12 \cdot \mu_{viscosity} \cdot L_p \cdot V_{mean}}{\gamma_f \cdot h_{location}}}$$

$$1.458653\text{m} = \sqrt{\frac{12 \cdot 10.2\text{P} \cdot 0.10\text{m} \cdot 32.4\text{m/s}}{9.81\text{kN/m}^3 \cdot 1.9\text{m}}}$$

9) Distance between Plates given Shear Stress Distribution Profile

Open Calculator

$$w = 2 \cdot \left(R - \left(\frac{\tau}{dp|dr}\right)\right)$$

$$2.847059\text{m} = 2 \cdot \left(6.9\text{m} - \left(\frac{93.1\text{Pa}}{17\text{N/m}^3}\right)\right)$$

10) Distance between Plates using Velocity Distribution Profile

Open Calculator

fx $$w = \frac{\left(\frac{-v \cdot 2 \cdot \mu_{viscosity}}{dp|dr} \right) + \left(R^2 \right)}{R}$$

ex $$5.829217\text{m} = \frac{\left(\frac{-61.57\text{m/s} \cdot 2 \cdot 10.2\text{P}}{17\text{N/m}^3} \right) + \left((6.9\text{m})^2 \right)}{6.9\text{m}}$$

11) Horizontal Distance given Shear Stress Distribution Profile

Open Calculator

fx $$R = \frac{w}{2} + \left(\frac{\tau}{dp|dr} \right)$$

ex $$6.976471\text{m} = \frac{3\text{m}}{2} + \left(\frac{93.1\text{Pa}}{17\text{N/m}^3} \right)$$

12) Length of Pipe given Pressure Difference

Open Calculator

fx $$L_p = \frac{\Delta P \cdot w \cdot w}{\mu_{viscosity} \cdot 12 \cdot V_{mean}}$$

ex $$0.301834\text{m} = \frac{13.3\text{N/m}^2 \cdot 3\text{m} \cdot 3\text{m}}{10.2\text{P} \cdot 12 \cdot 32.4\text{m/s}}$$

13) Length of Pipe given Pressure Head Drop

Open Calculator

fx $$L_p = \frac{\gamma_f \cdot w \cdot w \cdot h_{location}}{12 \cdot \mu_{viscosity} \cdot V_{mean}}$$

ex $$0.422998\text{m} = \frac{9.81\text{kN/m}^3 \cdot 3\text{m} \cdot 3\text{m} \cdot 1.9\text{m}}{12 \cdot 10.2\text{P} \cdot 32.4\text{m/s}}$$

14) Maximum Shear Stress in fluid

Open Calculator

fx $$\tau_{smax} = 0.5 \cdot dp|dr \cdot w$$

ex $$25.5\text{N/mm}^2 = 0.5 \cdot 17\text{N/m}^3 \cdot 3\text{m}$$

15) Maximum Velocity between Plates

Open Calculator

fx $$V_{max} = \frac{\left(w^2\right) \cdot dp|dr}{8 \cdot \mu_{viscosity}}$$

ex $$18.75\text{m/s} = \frac{\left((3\text{m})^2\right) \cdot 17\text{N/m}^3}{8 \cdot 10.2\text{P}}$$

16) Maximum Velocity given Mean Velocity of Flow

Open Calculator

fx $$V_{max} = 1.5 \cdot V_{mean}$$

ex $$48.6\text{m/s} = 1.5 \cdot 32.4\text{m/s}$$

17) Pressure Difference

Open Calculator

fx $$\Delta P = 12 \cdot \mu_{viscosity} \cdot V_{mean} \cdot \frac{L_p}{w^2}$$

ex $$4.4064\text{N/m}^2 = 12 \cdot 10.2\text{P} \cdot 32.4\text{m/s} \cdot \frac{0.10\text{m}}{(3\text{m})^2}$$

18) Pressure Head Drop

Open Calculator

fx $$h_{location} = \frac{12 \cdot \mu_{viscosity} \cdot L_p \cdot V_{mean}}{\gamma_f}$$

ex $$4.042569\text{m} = \frac{12 \cdot 10.2\text{P} \cdot 0.10\text{m} \cdot 32.4\text{m/s}}{9.81\text{kN/m}^3}$$

19) Shear Stress Distribution Profile

Open Calculator

fx $$\tau = -dp|dr \cdot \left(\frac{w}{2} - R\right)$$

ex $$91.8\text{Pa} = -17\text{N/m}^3 \cdot \left(\frac{3\text{m}}{2} - 6.9\text{m}\right)$$

20) Velocity Distribution Profile

Open Calculator

fx
$$v = -\left(\frac{1}{2 \cdot \mu_{viscosity}}\right) \cdot dp|dr \cdot \left(w \cdot R - \left(R^2\right)\right)$$

ex
$$224.25 \mathrm{m/s} = -\left(\frac{1}{2 \cdot 10.2 \mathrm{P}}\right) \cdot 17 \mathrm{N/m^3} \cdot \left(3 \mathrm{m} \cdot 6.9 \mathrm{m} - \left((6.9 \mathrm{m})^2\right)\right)$$

Mean Velocity of Flow

21) Mean Velocity of Flow given Maximum Velocity

Open Calculator

fx
$$V_{mean} = \left(\frac{2}{3}\right) \cdot V_{max}$$

ex
$$12.4 \mathrm{m/s} = \left(\frac{2}{3}\right) \cdot 18.6 \mathrm{m/s}$$

22) Mean Velocity of Flow given Pressure Difference

Open Calculator

fx
$$V_{mean} = \frac{\Delta P \cdot w}{12 \cdot \mu_{viscosity} \cdot L_p}$$

ex
$$32.59804 \mathrm{m/s} = \frac{13.3 \mathrm{N/m^2} \cdot 3 \mathrm{m}}{12 \cdot 10.2 \mathrm{P} \cdot 0.10 \mathrm{m}}$$

23) Mean Velocity of Flow given Pressure Gradient

Open Calculator

fx $$V_{mean} = \left(\frac{w^2}{12 \cdot \mu_{viscosity}}\right) \cdot dp|dr$$

ex $$12.5\text{m/s} = \left(\frac{(3\text{m})^2}{12 \cdot 10.2\text{P}}\right) \cdot 17\text{N/m}^3$$

24) Mean Velocity of Flow given Pressure Head Drop

Open Calculator

fx $$V_{mean} = \frac{\Delta P \cdot S \cdot (D_{pipe}^2)}{12 \cdot \mu_{viscosity} \cdot L_p}$$

ex $$8.313315\text{m/s} = \frac{13.3\text{N/m}^2 \cdot 0.75\text{kN/m}^3 \cdot \left((1.01\text{m})^2\right)}{12 \cdot 10.2\text{P} \cdot 0.10\text{m}}$$

Pressure Gradient

25) Pressure Gradient given Maximum Velocity between Plates

Open Calculator

fx $$dp|dr = \frac{V_{max} \cdot 8 \cdot \mu_{viscosity}}{w^2}$$

ex $$16.864\text{N/m}^3 = \frac{18.6\text{m/s} \cdot 8 \cdot 10.2\text{P}}{(3\text{m})^2}$$

26) Pressure Gradient given Shear Stress Distribution Profile

Open Calculator

fx $$\mathrm{dp|dr} = -\frac{\tau}{\frac{\mathrm{w}}{2} - \mathrm{R}}$$

ex $$17.24074\mathrm{N/m^3} = -\frac{93.1\mathrm{Pa}}{\frac{3\mathrm{m}}{2} - 6.9\mathrm{m}}$$

Dynamic Viscosity

27) Dynamic Viscosity given Maximum Velocity between Plates

Open Calculator

fx $$\mu_{\mathrm{viscosity}} = \frac{\left(\mathrm{w}^2\right) \cdot \mathrm{dp|dr}}{8 \cdot \mathrm{V_{max}}}$$

ex $$10.28226\mathrm{P} = \frac{\left((3\mathrm{m})^2\right) \cdot 17\mathrm{N/m^3}}{8 \cdot 18.6\mathrm{m/s}}$$

28) Dynamic Viscosity given Mean Velocity of Flow with Pressure Gradient

Open Calculator

fx $$\mu_{\mathrm{viscosity}} = \left(\frac{\mathrm{w}^2}{12 \cdot \mathrm{V_{mean}}}\right) \cdot \mathrm{dp|dr}$$

ex $$3.935185\mathrm{P} = \left(\frac{(3\mathrm{m})^2}{12 \cdot 32.4\mathrm{m/s}}\right) \cdot 17\mathrm{N/m^3}$$

29) Dynamic Viscosity given Pressure Difference

Open Calculator

fx $$\mu_{viscosity} = \frac{\Delta P \cdot w}{12 \cdot V_{mean} \cdot L_p}$$

ex $$10.26235P = \frac{13.3N/m^2 \cdot 3m}{12 \cdot 32.4m/s \cdot 0.10m}$$

30) Dynamic Viscosity using Velocity Distribution Profile

Open Calculator

fx $$\mu_{viscosity} = \left(\frac{1}{2 \cdot v}\right) \cdot dp|dr \cdot \left(w \cdot R^2\right)$$

ex $$197.1829P = \left(\frac{1}{2 \cdot 61.57m/s}\right) \cdot 17N/m^3 \cdot \left(3m \cdot (6.9m)^2\right)$$

Variables Used

- D_{pipe} Diameter of Pipe *(Meter)*
- **dp|dr** Pressure Gradient *(Newton per Cubic Meter)*
- $h_{location}$ Head Loss due to Friction *(Meter)*
- L_p Length of Pipe *(Meter)*
- **Q** Discharge in Laminar Flow *(Cubic Meter per Second)*
- **R** Horizontal Distance *(Meter)*
- **S** Specific Weight of Liquid in Piezometer *(Kilonewton per Cubic Meter)*
- **v** Velocity of Liquid *(Meter per Second)*
- V_{max} Maximum Velocity *(Meter per Second)*
- V_{mean} Mean Velocity *(Meter per Second)*
- **w** Width *(Meter)*
- γ_f Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- ΔP Pressure Difference *(Newton per Square Meter)*
- $\mu_{viscosity}$ Dynamic Viscosity *(Poise)*
- τ_{smax} Maximum Shear Stress in Shaft *(Newton per Square Millimeter)*
- τ Shear Stress *(Pascal)*

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Pressure** in Newton per Square Meter (N/m^2)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m^3)
  Specific Weight Unit Conversion
- Measurement: **Pressure Gradient** in Newton per Cubic Meter (N/m^3)
  Pressure Gradient Unit Conversion
- Measurement: **Stress** in Pascal (Pa), Newton per Square Millimeter (N/mm^2)
  Stress Unit Conversion

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- **Laminar Flow of Fluid in an Open Channel Formulas**
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