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Fundamentals of Fluid Flow Formulas

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List of 71 Fundamentals of Fluid Flow Formulas

Fundamentals of Fluid Flow

Circulation and Vorticity

1) Area of Curve using Vorticity

$$\text{fx } A = \frac{\Gamma}{\Omega}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

$$\text{ex } 50\text{m}^2 = \frac{350\text{m}^2/\text{s}}{7/\text{s}}$$

2) Circulation using Vorticity

$$\text{fx } \Gamma = \Omega \cdot A$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

$$\text{ex } 350\text{m}^2/\text{s} = 7/\text{s} \cdot 50\text{m}^2$$

3) Vorticity of Fluid Flows

$$\text{fx } \Omega = \frac{\Gamma}{A}$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)

$$\text{ex } 7/\text{s} = \frac{350\text{m}^2/\text{s}}{50\text{m}^2}$$



Continuity Equation

4) Cross Sectional Area at Section 1 for Steady Flow

$$\text{fx } A_{cs} = \frac{Q}{\rho_1 \cdot V_{\text{Negativesurges}}}$$

[Open Calculator !\[\]\(a03a7eb2f4046e1d3c76772003e549ea_img.jpg\)](#)

$$\text{ex } 16.83333\text{m}^2 = \frac{1.01\text{m}^3/\text{s}}{0.02\text{kg}/\text{m}^3 \cdot 3\text{m}/\text{s}}$$

5) Cross Sectional Area at Section 2 given Flow at Section 1 for Steady Flow

$$\text{fx } A_{cs} = \frac{Q}{\rho_2 \cdot V_2}$$

[Open Calculator !\[\]\(5361750c22c4e047a52f4eac1ec2d4cc_img.jpg\)](#)

$$\text{ex } 9.619048\text{m}^2 = \frac{1.01\text{m}^3/\text{s}}{0.021\text{kg}/\text{m}^3 \cdot 5\text{m}/\text{s}}$$

6) Cross Sectional Area at Section given Discharge for Steady Incompressible Fluid

$$\text{fx } A_{cs} = \frac{Q}{u_{\text{Fluid}}}$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e_img.jpg\)](#)

$$\text{ex } 12.625\text{m}^2 = \frac{1.01\text{m}^3/\text{s}}{0.08\text{m}/\text{s}}$$



7) Discharge through Section for Steady Incompressible Fluid

$$\text{fx } Q = A_{cs} \cdot u_{\text{Fluid}}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } 1.04\text{m}^3/\text{s} = 13\text{m}^2 \cdot 0.08\text{m/s}$$

8) Mass Density at Section 1 for Steady Flow

$$\text{fx } \rho_1 = \frac{Q}{A_{cs} \cdot V_{\text{Negativesurges}}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } 0.025897\text{kg}/\text{m}^3 = \frac{1.01\text{m}^3/\text{s}}{13\text{m}^2 \cdot 3\text{m/s}}$$

9) Mass Density at Section 2 given Flow at Section 1 for Steady Flow

$$\text{fx } \rho_2 = \frac{Q}{A_{cs} \cdot V_2}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$\text{ex } 0.015538\text{kg}/\text{m}^3 = \frac{1.01\text{m}^3/\text{s}}{13\text{m}^2 \cdot 5\text{m/s}}$$

10) Velocity at Section 1 for Steady Flow

$$\text{fx } u_{01} = \frac{Q}{A_{cs} \cdot \rho_1}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$\text{ex } 3.884615\text{m/s} = \frac{1.01\text{m}^3/\text{s}}{13\text{m}^2 \cdot 0.02\text{kg}/\text{m}^3}$$



11) Velocity at Section 2 given Flow at Section 1 for Steady Flow

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

$$\text{fx } u_{02} = \frac{Q}{A_{cs} \cdot \rho_2}$$

$$\text{ex } 3.699634\text{m/s} = \frac{1.01\text{m}^3/\text{s}}{13\text{m}^2 \cdot 0.021\text{kg}/\text{m}^3}$$

12) Velocity at Section for Discharge through Section for Steady Incompressible Fluid

[Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba_img.jpg\)](#)

$$\text{fx } u_{\text{Fluid}} = \frac{Q}{A_{cs}}$$

$$\text{ex } 0.077692\text{m/s} = \frac{1.01\text{m}^3/\text{s}}{13\text{m}^2}$$

Description of the Flow Pattern

13) Component of Velocity in X Direction using Slope of Streamline

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{fx } u = \frac{v}{\tan\left(\frac{\pi}{180} \cdot \theta\right)}$$

$$\text{ex } 8.011511\text{m/s} = \frac{10\text{m/s}}{\tan\left(\frac{\pi}{180} \cdot 51.3\right)}$$



14) Component of Velocity in Y Direction given Slope of Streamline

$$\text{fx } v = u \cdot \tan\left(\frac{\pi}{180} \cdot \theta\right)$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 9.985632\text{m/s} = 8\text{m/s} \cdot \tan\left(\frac{\pi}{180} \cdot 51.3\right)$$

15) Slope of Streamline

$$\text{fx } \theta = \arctan\left(\frac{v}{u}\right) \cdot \left(\frac{180}{\pi}\right)$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } 51.34019 = \arctan\left(\frac{10\text{m/s}}{8\text{m/s}}\right) \cdot \left(\frac{180}{\pi}\right)$$

Streamlines, Equipotential Lines and Flow Net

16) Component of Velocity in X Direction given Slope of Equipotential Line



$$\text{fx } u = v \cdot \Phi$$

[Open Calculator !\[\]\(aab88c0d099e5d18d6533a97b13ec28d_img.jpg\)](#)

$$\text{ex } 8\text{m/s} = 10\text{m/s} \cdot 0.8$$

17) Component of Velocity in X Direction using Slope of Streamline

$$\text{fx } u = \frac{v}{\tan\left(\frac{\pi}{180} \cdot \theta\right)}$$

[Open Calculator !\[\]\(097cdd6c9c875b64d9b8c9a2409491c4_img.jpg\)](#)

$$\text{ex } 8.011511\text{m/s} = \frac{10\text{m/s}}{\tan\left(\frac{\pi}{180} \cdot 51.3\right)}$$



18) Component of Velocity in Y Direction given Slope of Equipotential Line



$$fx \quad v = \frac{u}{\Phi}$$

Open Calculator

$$ex \quad 10m/s = \frac{8m/s}{0.8}$$

19) Component of Velocity in Y Direction given Slope of Streamline

$$fx \quad v = u \cdot \tan\left(\frac{\pi}{180} \cdot \theta\right)$$

Open Calculator

$$ex \quad 9.985632m/s = 8m/s \cdot \tan\left(\frac{\pi}{180} \cdot 51.3\right)$$

20) Slope of Equipotential Line

$$fx \quad \Phi = \frac{u}{v}$$

Open Calculator

$$ex \quad 0.8 = \frac{8m/s}{10m/s}$$

21) Slope of Streamline

$$fx \quad \theta = \arctan\left(\frac{v}{u}\right) \cdot \left(\frac{180}{\pi}\right)$$

Open Calculator

$$ex \quad 51.34019 = \arctan\left(\frac{10m/s}{8m/s}\right) \cdot \left(\frac{180}{\pi}\right)$$



Torque Exerted on a Wheel with Radial Curved Vanes



22) Angular Momentum at Inlet



$$\text{fx } L = \left(\frac{w_f \cdot v_f}{G} \right) \cdot r$$

[Open Calculator](#)

$$\text{ex } 148.32 \text{kg} \cdot \text{m}^2/\text{s} = \left(\frac{12.36 \text{N} \cdot 40 \text{m/s}}{10} \right) \cdot 3 \text{m}$$

23) Angular Momentum at Outlet



$$\text{fx } L = \left(\frac{w_f \cdot v}{G} \right) \cdot r$$

[Open Calculator](#)

$$\text{ex } 35.93052 \text{kg} \cdot \text{m}^2/\text{s} = \left(\frac{12.36 \text{N} \cdot 9.69 \text{m/s}}{10} \right) \cdot 3 \text{m}$$

24) Angular Velocity for Work Done on Wheel per Second



$$\text{fx } \omega = \frac{w \cdot G}{w_f \cdot (v_f \cdot r + v \cdot r_O)}$$

[Open Calculator](#)

$$\text{ex } 13.35424 \text{rad/s} = \frac{3.9 \text{KJ} \cdot 10}{12.36 \text{N} \cdot (40 \text{m/s} \cdot 3 \text{m} + 9.69 \text{m/s} \cdot 12 \text{m})}$$



25) Efficiency of System

[Open Calculator !\[\]\(666e09182d4cd268646ea700ea60dcdf_img.jpg\)](#)

$$\text{fx } \eta = \left(1 - \left(\frac{v}{v_f} \right)^2 \right)$$

$$\text{ex } 0.941315 = \left(1 - \left(\frac{9.69\text{m/s}}{40\text{m/s}} \right)^2 \right)$$

26) Initial Velocity for Work Done if Jet leaves in Motion of Wheel

[Open Calculator !\[\]\(003082e50e3009141f59bd5df831749f_img.jpg\)](#)

$$\text{fx } u = \frac{\left(\frac{P_{dc} \cdot G}{w_f} \right) + (v \cdot v_f)}{v_f}$$

$$\text{ex } 54.37042\text{m/s} = \frac{\left(\frac{2209\text{W} \cdot 10}{12.36\text{N}} \right) + (9.69\text{m/s} \cdot 40\text{m/s})}{40\text{m/s}}$$

27) Initial Velocity given Power Delivered to Wheel

[Open Calculator !\[\]\(d3102649f02e825ddb76dc3de0190154_img.jpg\)](#)

$$\text{fx } u = \left(\left(\frac{P_{dc} \cdot G}{w_f \cdot v_f} \right) - (v) \right)$$

$$\text{ex } 34.99042\text{m/s} = \left(\left(\frac{2209\text{W} \cdot 10}{12.36\text{N} \cdot 40\text{m/s}} \right) - (9.69\text{m/s}) \right)$$



28) Initial Velocity when Work Done at Vane Angle is 90 and Velocity is Zero

$$\text{fx } u = \frac{w \cdot G}{w_f \cdot v_f}$$

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$\text{ex } 78.8835\text{m/s} = \frac{3.9\text{KJ} \cdot 10}{12.36\text{N} \cdot 40\text{m/s}}$$

29) Mass of Fluid Striking Vane per Second

$$\text{fx } m_f = \frac{w_f}{G}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

$$\text{ex } 1.236\text{kg} = \frac{12.36\text{N}}{10}$$

30) Power Delivered to Wheel

$$\text{fx } P_{dc} = \left(\frac{w_f}{G} \right) \cdot (v_f \cdot u + v \cdot v_f)$$

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

$$\text{ex } 2209.474\text{W} = \left(\frac{12.36\text{N}}{10} \right) \cdot (40\text{m/s} \cdot 35\text{m/s} + 9.69\text{m/s} \cdot 40\text{m/s})$$



31) Radius at Inlet for Work Done on Wheel per Second [Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

$$\text{fx } r = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega} \right) - (v \cdot r_O)}{v_f}$$

$$\text{ex } 3.160961\text{m} = \frac{\left(\frac{3.9\text{KJ} \cdot 10}{12.36\text{N} \cdot 13\text{rad/s}} \right) - (9.69\text{m/s} \cdot 12\text{m})}{40\text{m/s}}$$

32) Radius at Inlet with Known Torque by Fluid [Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1_img.jpg\)](#)

$$\text{fx } r = \frac{\left(\frac{\tau \cdot G}{w_f} \right) + (v \cdot r_O)}{v_f}$$

$$\text{ex } 8.813149\text{m} = \frac{\left(\frac{292\text{N} \cdot \text{m} \cdot 10}{12.36\text{N}} \right) + (9.69\text{m/s} \cdot 12\text{m})}{40\text{m/s}}$$

33) Radius at Outlet for Torque Exerted by Fluid [Open Calculator !\[\]\(4fe57c3593bf1b21d272ae7ac8dfaf77_img.jpg\)](#)

$$\text{fx } r_O = \frac{\left(\frac{\tau \cdot G}{w_f} \right) - (v_f \cdot r)}{v}$$

$$\text{ex } 11.99649\text{m} = \frac{\left(\frac{292\text{N} \cdot \text{m} \cdot 10}{12.36\text{N}} \right) - (40\text{m/s} \cdot 3\text{m})}{9.69\text{m/s}}$$



34) Radius at Outlet for Work Done on Wheel per Second [Open Calculator !\[\]\(dfbd6b3763a6d1d9afaa974f64e2e4b5_img.jpg\)](#)

$$\text{fx } r_O = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega} \right) - (v_f \cdot r)}{v}$$

$$\text{ex } 12.66444\text{m} = \frac{\left(\frac{3.9\text{KJ} \cdot 10}{12.36\text{N} \cdot 13\text{rad/s}} \right) - (40\text{m/s} \cdot 3\text{m})}{9.69\text{m/s}}$$

35) Speed of Wheel given Tangential Velocity at Inlet Tip of Vane [Open Calculator !\[\]\(ec9132f1d27c8919987d92907322654d_img.jpg\)](#)

$$\text{fx } \Omega = \frac{v_{\text{tangential}} \cdot 60}{2 \cdot \pi \cdot r}$$

$$\text{ex } 3.183099\text{rev/s} = \frac{60\text{m/s} \cdot 60}{2 \cdot \pi \cdot 3\text{m}}$$

36) Speed of Wheel given Tangential Velocity at Outlet Tip of Vane [Open Calculator !\[\]\(758ebdf4629c903da74c2e079717ae32_img.jpg\)](#)

$$\text{fx } \Omega = \frac{v_{\text{tangential}} \cdot 60}{2 \cdot \pi \cdot r_O}$$

$$\text{ex } 0.795775\text{rev/s} = \frac{60\text{m/s} \cdot 60}{2 \cdot \pi \cdot 12\text{m}}$$

37) Torque Exerted by Fluid [Open Calculator !\[\]\(248b91fcdac4810ffd15cf33fb6aec6f_img.jpg\)](#)

$$\text{fx } \tau = \left(\frac{w_f}{G} \right) \cdot (v_f \cdot r + v \cdot r_O)$$

$$\text{ex } 292.0421\text{N} \cdot \text{m} = \left(\frac{12.36\text{N}}{10} \right) \cdot (40\text{m/s} \cdot 3\text{m} + 9.69\text{m/s} \cdot 12\text{m})$$



38) Velocity at Point given Efficiency of System

$$\text{fx } v = \sqrt{1 - \eta} \cdot v_f$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$\text{ex } 17.88854\text{m/s} = \sqrt{1 - 0.80} \cdot 40\text{m/s}$$

39) Velocity for Work Done if there is no Loss of Energy

$$\text{fx } v_f = \sqrt{\left(\frac{w \cdot 2 \cdot G}{w_f} \right) + v^2}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 80.02859\text{m/s} = \sqrt{\left(\frac{3.9\text{KJ} \cdot 2 \cdot 10}{12.36\text{N}} \right) + (9.69\text{m/s})^2}$$

40) Velocity given Angular Momentum at Inlet

$$\text{fx } v_f = \frac{L \cdot G}{w_f \cdot r}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{ex } 67.42179\text{m/s} = \frac{250\text{kg} \cdot \text{m}^2/\text{s} \cdot 10}{12.36\text{N} \cdot 3\text{m}}$$

41) Velocity given Angular Momentum at Outlet

$$\text{fx } v = \frac{T_m \cdot G}{w_f \cdot r}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$\text{ex } 10.38296\text{m/s} = \frac{38.5\text{kg} \cdot \text{m}/\text{s} \cdot 10}{12.36\text{N} \cdot 3\text{m}}$$



42) Velocity given Efficiency of System

$$\text{fx } v_f = \frac{v}{\sqrt{1 - \eta}}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 21.6675\text{m/s} = \frac{9.69\text{m/s}}{\sqrt{1 - 0.80}}$$

Radius of the Wheel

43) Radius of Wheel for Tangential Velocity at Inlet Tip of Vane

$$\text{fx } r = \frac{v}{\frac{2 \cdot \pi \cdot \Omega}{60}}$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

$$\text{ex } 7.012873\text{m} = \frac{9.69\text{m/s}}{\frac{2 \cdot \pi \cdot 2.1\text{rev/s}}{60}}$$

44) Radius of Wheel for Tangential Velocity at Outlet Tip of Vane

$$\text{fx } r = \frac{v_{\text{tangential}}}{\frac{2 \cdot \pi \cdot \Omega}{60}}$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

$$\text{ex } 4.547284\text{m} = \frac{60\text{m/s}}{\frac{2 \cdot \pi \cdot 2.1\text{rev/s}}{60}}$$



45) Radius of Wheel given Angular Momentum at Inlet

$$\text{fx } r = \frac{L}{\frac{w_f \cdot v_f}{G}}$$

Open Calculator 

$$\text{ex } 5.056634\text{m} = \frac{250\text{kg} \cdot \text{m}^2/\text{s}}{\frac{12.36\text{N} \cdot 40\text{m/s}}{10}}$$

Tangential momentum and Tangential velocity 46) Tangential Momentum of Fluid Striking Vanes at Inlet

$$\text{fx } T_m = \frac{w_f \cdot v_f}{G}$$

Open Calculator 

$$\text{ex } 49.44\text{kg} \cdot \text{m/s} = \frac{12.36\text{N} \cdot 40\text{m/s}}{10}$$

47) Tangential Momentum of Fluid Striking Vanes at Outlet

$$\text{fx } T_m = \frac{w_f \cdot v}{G}$$

Open Calculator 

$$\text{ex } 11.97684\text{kg} \cdot \text{m/s} = \frac{12.36\text{N} \cdot 9.69\text{m/s}}{10}$$



48) Tangential Velocity at Inlet Tip of Vane

$$\text{fx } v_{\text{tangential}} = \left(\frac{2 \cdot \pi \cdot \Omega}{60} \right) \cdot r$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$\text{ex } 39.58407\text{m/s} = \left(\frac{2 \cdot \pi \cdot 2.1\text{rev/s}}{60} \right) \cdot 3\text{m}$$

49) Tangential Velocity at Outlet Tip of Vane

$$\text{fx } v_{\text{tangential}} = \left(\frac{2 \cdot \pi \cdot \Omega}{60} \right) \cdot r$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

$$\text{ex } 39.58407\text{m/s} = \left(\frac{2 \cdot \pi \cdot 2.1\text{rev/s}}{60} \right) \cdot 3\text{m}$$

50) Velocity given Tangential Momentum of Fluid Striking Vanes at Inlet

$$\text{fx } u = \frac{T_m \cdot G}{W_f}$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$\text{ex } 31.14887\text{m/s} = \frac{38.5\text{kg} \cdot \text{m/s} \cdot 10}{12.36\text{N}}$$



51) Velocity given Tangential Momentum of Fluid Striking Vanes at Outlet



$$fx \quad u = \frac{T_m \cdot G}{W_f}$$

Open Calculator

$$ex \quad 31.14887m/s = \frac{38.5kg \cdot m/s \cdot 10}{12.36N}$$

Velocity at Inlet

52) Velocity at Inlet given Torque by Fluid

$$fx \quad v_f = \frac{\left(\frac{\tau \cdot G}{W_f} \right) + (v \cdot r)}{r_O}$$

Open Calculator

$$ex \quad 22.10966m/s = \frac{\left(\frac{292N \cdot m \cdot 10}{12.36N} \right) + (9.69m/s \cdot 3m)}{12m}$$

53) Velocity at Inlet given Work Done on Wheel

$$fx \quad v_f = \frac{\left(\frac{W \cdot G}{W_f \cdot \omega} \right) - v \cdot r_O}{r}$$

Open Calculator

$$ex \quad 42.14615m/s = \frac{\left(\frac{3.9KJ \cdot 10}{12.36N \cdot 13rad/s} \right) - 9.69m/s \cdot 12m}{3m}$$



54) Velocity at Inlet when Work Done at Vane Angle is 90 and Velocity is Zero

$$\text{fx } v_f = \frac{w \cdot G}{w_f \cdot u}$$

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$\text{ex } 90.15257\text{m/s} = \frac{3.9\text{KJ} \cdot 10}{12.36\text{N} \cdot 35\text{m/s}}$$

Velocity at Outlet

55) Velocity at Outlet given Power Delivered to Wheel

$$\text{fx } v = \frac{\left(\frac{P_{dc} \cdot G}{w_f} \right) - (v_f \cdot u)}{v_f}$$

[Open Calculator !\[\]\(6059a5aa8b4ca7bb793408023d6c6e42_img.jpg\)](#)

$$\text{ex } 9.680421\text{m/s} = \frac{\left(\frac{2209\text{W} \cdot 10}{12.36\text{N}} \right) - (40\text{m/s} \cdot 35\text{m/s})}{40\text{m/s}}$$

56) Velocity at Outlet given Torque by Fluid

$$\text{fx } v = \frac{\left(\frac{\tau \cdot G}{w_f} \right) - (v_f \cdot r)}{r_O}$$

[Open Calculator !\[\]\(e3275251d0893157c3584e20c81dc3ba_img.jpg\)](#)

$$\text{ex } 9.687163\text{m/s} = \frac{\left(\frac{292\text{N} \cdot \text{m} \cdot 10}{12.36\text{N}} \right) - (40\text{m/s} \cdot 3\text{m})}{12\text{m}}$$



57) Velocity at Outlet given Work Done if Jet leaves in Motion of Wheel [Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

$$\text{fx } v = \frac{\left(\frac{w \cdot G}{w_f} \right) - (v_f \cdot u)}{v_f}$$

$$\text{ex } 43.8835\text{m/s} = \frac{\left(\frac{3.9\text{KJ} \cdot 10}{12.36\text{N}} \right) - (40\text{m/s} \cdot 35\text{m/s})}{40\text{m/s}}$$

58) Velocity at Outlet given Work Done on Wheel [Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1_img.jpg\)](#)

$$\text{fx } v = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega} \right) - (v_f \cdot r)}{r_O}$$

$$\text{ex } 10.22654\text{m/s} = \frac{\left(\frac{3.9\text{KJ} \cdot 10}{12.36\text{N} \cdot 13\text{rad/s}} \right) - (40\text{m/s} \cdot 3\text{m})}{12\text{m}}$$

Weight of the Fluid 59) Weight of Fluid for Work Done if there is no loss of Energy [Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{fx } w_f = \frac{w \cdot 2 \cdot G}{v_f^2 - v^2}$$

$$\text{ex } 51.78926\text{N} = \frac{3.9\text{KJ} \cdot 2 \cdot 10}{(40\text{m/s})^2 - (9.69\text{m/s})^2}$$



60) Weight of Fluid for Work Done on Wheel per Second

$$fx \quad w_f = \frac{w \cdot G}{(v_f \cdot r + v \cdot r_O) \cdot \omega}$$

Open Calculator 

$$ex \quad 12.6968N = \frac{3.9KJ \cdot 10}{(40m/s \cdot 3m + 9.69m/s \cdot 12m) \cdot 13rad/s}$$

61) Weight of Fluid given Angular Momentum at Inlet

$$fx \quad w_f = \frac{L \cdot G}{v_f \cdot r}$$

Open Calculator 

$$ex \quad 20.83333N = \frac{250kg \cdot m^2/s \cdot 10}{40m/s \cdot 3m}$$

62) Weight of Fluid given Angular Momentum at Outlet

$$fx \quad w_f = \frac{T_m \cdot G}{v \cdot r_O}$$

Open Calculator 

$$ex \quad 91.97884N = \frac{38.5kg \cdot m/s \cdot 10}{9.69m/s \cdot 12m}$$

63) Weight of Fluid given Mass of Fluid Striking Vane per Second

$$fx \quad w_f = m_f \cdot G$$

Open Calculator 

$$ex \quad 9N = 0.9kg \cdot 10$$



64) Weight of Fluid given Power Delivered to Wheel [Open Calculator](#) 

$$\text{fx } w_f = \frac{P_{dc} \cdot G}{v_f \cdot u + v \cdot v_f}$$

$$\text{ex } 12.35735\text{N} = \frac{2209\text{W} \cdot 10}{40\text{m/s} \cdot 35\text{m/s} + 9.69\text{m/s} \cdot 40\text{m/s}}$$

65) Weight of Fluid given Tangential Momentum of Fluid Striking Vanes at Inlet [Open Calculator](#) 

$$\text{fx } w_f = \frac{T_m \cdot G}{v_f}$$

$$\text{ex } 9.625\text{N} = \frac{38.5\text{kg} \cdot \text{m/s} \cdot 10}{40\text{m/s}}$$

66) Weight of Fluid given Work Done if Jet leaves in Motion of Wheel [Open Calculator](#) 

$$\text{fx } w_f = \frac{w \cdot G}{v_f \cdot u - v \cdot v_f}$$

$$\text{ex } 38.52232\text{N} = \frac{3.9\text{KJ} \cdot 10}{40\text{m/s} \cdot 35\text{m/s} - 9.69\text{m/s} \cdot 40\text{m/s}}$$



67) Weight of Fluid when Work Done at Vane Angle is 90 and Velocity is Zero

$$\text{fx } w_f = \frac{w \cdot G}{v_f \cdot u}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 27.85714\text{N} = \frac{3.9\text{KJ} \cdot 10}{40\text{m/s} \cdot 35\text{m/s}}$$

Work Done

68) Work Done for Radial Discharge at Vane Angle is 90 and Velocity is Zero

$$\text{fx } w = \left(\frac{w_f}{G} \right) \cdot (v_f \cdot u)$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

$$\text{ex } 1.7304\text{KJ} = \left(\frac{12.36\text{N}}{10} \right) \cdot (40\text{m/s} \cdot 35\text{m/s})$$

69) Work Done if Jet leaves in Direction as that of Motion of Wheel

$$\text{fx } w = \left(\frac{w_f}{G} \right) \cdot (v_f \cdot u - v \cdot v_f)$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

$$\text{ex } 1.251326\text{KJ} = \left(\frac{12.36\text{N}}{10} \right) \cdot (40\text{m/s} \cdot 35\text{m/s} - 9.69\text{m/s} \cdot 40\text{m/s})$$



70) Work Done if there is no Loss of Energy

$$fx \quad w = \left(\frac{w_f}{2} \cdot G \right) \cdot (v_f^2 - v^2)$$

Open Calculator 

$$ex \quad 0.093077KJ = \left(\frac{12.36N}{2} \cdot 10 \right) \cdot \left((40m/s)^2 - (9.69m/s)^2 \right)$$

71) Work Done on Wheel per Second

$$fx \quad w = \left(\frac{w_f}{G} \right) \cdot (v_f \cdot r + v \cdot r_O) \cdot \omega$$

Open Calculator 

$$ex \quad 3.796547KJ = \left(\frac{12.36N}{10} \right) \cdot (40m/s \cdot 3m + 9.69m/s \cdot 12m) \cdot 13rad/s$$



Variables Used

- **A** Area (Square Meter)
- **A_{cs}** Cross-Sectional Area (Square Meter)
- **G** Specific Gravity of Fluid
- **L** Angular Momentum (Kilogram Square Meter per Second)
- **m_f** Fluid Mass (Kilogram)
- **P_{dc}** Power Delivered (Watt)
- **Q** Discharge of Fluid (Cubic Meter per Second)
- **r** Radius of wheel (Meter)
- **r_O** Radius of Outlet (Meter)
- **T_m** Tangential Momentum (Kilogram Meter per Second)
- **u** Component of Velocity in X Direction (Meter per Second)
- **u** Initial Velocity (Meter per Second)
- **u₀₁** Initial Velocity at Point 1 (Meter per Second)
- **u₀₂** Initial Velocity at Point 2 (Meter per Second)
- **u_{Fluid}** Fluid Velocity (Meter per Second)
- **v** Component of Velocity in Y Direction (Meter per Second)
- **v** Velocity of Jet (Meter per Second)
- **V₂** Velocity of Fluid at 2 (Meter per Second)
- **v_f** Final Velocity (Meter per Second)
- **V_{Negativesurges}** Velocity of Fluid at Negative Surges (Meter per Second)
- **v_{tangential}** Tangential Velocity (Meter per Second)
- **w** Work Done (Kilojoule)



- **W_f** Weight of Fluid (Newton)
- **Γ** Circulation (Square Meter per Second)
- **η** Efficiency of Jet
- **θ** Slope of Streamline
- **ρ_1** Density of Liquid 1 (Kilogram per Cubic Meter)
- **ρ_2** Density of Liquid 2 (Kilogram per Cubic Meter)
- **T** Torque Exerted on Wheel (Newton Meter)
- **Φ** Slope of Equipotential Line
- **ω** Angular Velocity (Radian per Second)
- **Ω** Vorticity (1 per Second)
- **Ω** Angular Speed (Revolution per Second)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **arctan**, arctan(Number)
Inverse trigonometric tangent function
- **Function:** **ctan**, ctan(Angle)
Trigonometric cotangent function
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Function:** **tan**, tan(Angle)
Trigonometric tangent function
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Energy** in Kilojoule (KJ)
Energy Unit Conversion 
- **Measurement:** **Power** in Watt (W)
Power Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
Volumetric Flow Rate Unit Conversion 



- **Measurement: Angular Velocity** in Radian per Second (rad/s), Revolution per Second (rev/s)
Angular Velocity Unit Conversion 
- **Measurement: Density** in Kilogram per Cubic Meter (kg/m³)
Density Unit Conversion 
- **Measurement: Torque** in Newton Meter (N*m)
Torque Unit Conversion 
- **Measurement: Angular Momentum** in Kilogram Square Meter per Second (kg*m²/s)
Angular Momentum Unit Conversion 
- **Measurement: Momentum** in Kilogram Meter per Second (kg*m/s)
Momentum Unit Conversion 
- **Measurement: Momentum Diffusivity** in Square Meter per Second (m²/s)
Momentum Diffusivity Unit Conversion 
- **Measurement: Vorticity** in 1 per Second (1/s)
Vorticity Unit Conversion 



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