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Impulse Momentum Equation and its Applications Formulas

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List of 41 Impulse Momentum Equation and its Applications Formulas

Impulse Momentum Equation and its Applications

Angular Momentum Principles

1) Change in Rate of Flow given Torque Exerted on Fluid

Open Calculator

fx $$q_{flow} = \frac{\tau}{r2 \cdot V_2 - r1 \cdot V_1} \cdot \Delta$$

ex $$24.13728 m^3/s = \frac{91 N*m}{6.3 m \cdot 61.45 m/s - 2 m \cdot 101.2 m/s} \cdot 49 m$$

2) Radial Distance r1 given Torque Exerted on Fluid

Open Calculator

fx $$r1 = \frac{(r2 \cdot V_2 \cdot q_{flow}) - (\tau \cdot \Delta)}{q_{flow} \cdot V_1}$$

ex $$1.989559 m = \frac{(6.3 m \cdot 61.45 m/s \cdot 24 m^3/s) - (91 N*m \cdot 49 m)}{24 m^3/s \cdot 101.2 m/s}$$

3) Radial Distance r2 given Torque Exerted on Fluid

Open Calculator

fx $$r2 = \frac{\left(\frac{\tau}{q_{flow}} \cdot \Delta\right) + r1 \cdot V_1}{V_2}$$

ex $$6.317196\text{m} = \frac{\left(\frac{91\text{N*m}}{24\text{m}^3/\text{s}} \cdot 49\text{m}\right) + 2\text{m} \cdot 101.2\text{m/s}}{61.45\text{m/s}}$$

4) Torque Exerted on Fluid

Open Calculator

fx $$\tau = \left(\frac{q_{flow}}{\Delta}\right) \cdot (r2 \cdot V_2 - r1 \cdot V_1)$$

ex $$90.48245\text{N*m} = \left(\frac{24\text{m}^3/\text{s}}{49\text{m}}\right) \cdot (6.3\text{m} \cdot 61.45\text{m/s} - 2\text{m} \cdot 101.2\text{m/s})$$

5) Velocity at Radial Distance r1 given Torque Exerted on Fluid

Open Calculator

fx $$V_1 = \frac{q_{flow} \cdot r2 \cdot V_2 - (\tau \cdot \Delta)}{r1 \cdot q_{flow}}$$

ex $$100.6717\text{m/s} = \frac{24\text{m}^3/\text{s} \cdot 6.3\text{m} \cdot 61.45\text{m/s} - (91\text{N*m} \cdot 49\text{m})}{2\text{m} \cdot 24\text{m}^3/\text{s}}$$

6) Velocity at Radial Distance r2 given Torque Exerted on Fluid

Open Calculator

fx $$V_2 = \frac{q_{flow} \cdot r1 \cdot V_1 + (\tau \cdot \Delta)}{q_{flow} \cdot r2}$$

ex $$61.61772\text{m/s} = \frac{24\text{m}^3/\text{s} \cdot 2\text{m} \cdot 101.2\text{m/s} + (91\text{N*m} \cdot 49\text{m})}{24\text{m}^3/\text{s} \cdot 6.3\text{m}}$$

Jet Propulsion - Reaction of Jet

Jet Propulsion of Orifice Tank

7) Actual Velocity given Force exerted on Tank due to Jet

Open Calculator

fx $$v = \sqrt{\frac{F \cdot [g]}{\gamma_f \cdot A_{Jet}}}$$

ex $$14.13972\text{m/s} = \sqrt{\frac{240\text{N} \cdot [g]}{9.81\text{kN/m}^3 \cdot 1.2\text{m}^2}}$$

8) Area of Hole given Coefficient of Velocity for Jet

Open Calculator

fx $$A_{Jet} = \frac{0.5 \cdot F}{\gamma_f \cdot h \cdot C_v^2}$$

ex $$1.193418\text{m}^2 = \frac{0.5 \cdot 240\text{N}}{9.81\text{kN/m}^3 \cdot 12.11\text{m} \cdot (0.92)^2}$$

9) Area of Jet given Force exerted on Tank due to Jet

Open Calculator

fx $$A_{Jet} = \frac{F}{\gamma_f \cdot \frac{v^2}{[g]}}$$

ex $$1.20677\text{m}^2 = \frac{240\text{N}}{9.81\text{kN/m}^3 \cdot \frac{(14.1\text{m/s})^2}{[g]}}$$

10) Force exerted on Tank due to Jet

Open Calculator

fx $$F = \gamma_f \cdot A_{Jet} \cdot \frac{v^2}{[g]}$$

ex $$238.6535\text{N} = 9.81\text{kN/m}^3 \cdot 1.2\text{m}^2 \cdot \frac{(14.1\text{m/s})^2}{[g]}$$

11) Head over Jet Hole given Force exerted on Tank due to Jet

Open Calculator

fx $$h = \frac{0.5 \cdot F}{\left(C_v^2\right) \cdot \gamma_f \cdot A_{Jet}}$$

ex $$12.04357\text{m} = \frac{0.5 \cdot 240\text{N}}{\left((0.92)^2\right) \cdot 9.81\text{kN/m}^3 \cdot 1.2\text{m}^2}$$

12) Specific Weight of Liquid given Coefficient of Velocity for Jet

Open Calculator

fx $$\gamma_f = \frac{0.5 \cdot F}{A_{Jet} \cdot h \cdot C_v^2}$$

ex $$9.756189 \text{kN/m}^3 = \frac{0.5 \cdot 240\text{N}}{1.2\text{m}^2 \cdot 12.11\text{m} \cdot (0.92)^2}$$

13) Specific Weight of Liquid given Force exerted on Tank due to Jet

Open Calculator

fx $$\gamma_f = \left(\frac{F \cdot [g]}{A_{Jet} \cdot (v)^2}\right)$$

ex $$9.865349 \text{kN/m}^3 = \left(\frac{240\text{N} \cdot [g]}{1.2\text{m}^2 \cdot (14.1\text{m/s})^2}\right)$$

Jet Propulsion of Ships

14) Absolute Velocity of Issuing jet given Propelling Force

Open Calculator

fx $$V = [g] \cdot \frac{F}{W_{Water}}$$

ex $$2.353596 \text{m/s} = [g] \cdot \frac{240\text{N}}{1000\text{kg}}$$

15) Absolute Velocity of Issuing Jet given Relative Velocity

Open Calculator

fx $$V = V_r - u$$

ex $$6\text{m/s} = 10.1\text{m/s} - 4.1\text{m/s}$$

16) Area of Issuing Jet given Weight of Water

Open Calculator

fx $$A_{Jet} = \frac{W_{Water}}{\gamma_f \cdot V_r}$$

ex $$10.09275\text{m}^2 = \frac{1000\text{kg}}{9.81\text{kN/m}^3 \cdot 10.1\text{m/s}}$$

17) Area of Issuing Jet given Work done by Jet on Ship

Open Calculator

fx $$A_{Jet} = \frac{W \cdot [g]}{V \cdot u \cdot \gamma_f}$$

ex $$6.095479\text{m}^2 = \frac{150\text{J} \cdot [g]}{6\text{m/s} \cdot 4.1\text{m/s} \cdot 9.81\text{kN/m}^3}$$

18) Efficiency of Propulsion

Open Calculator

fx $$\eta = 2 \cdot V \cdot \frac{u}{(V + u)^2}$$

ex $$0.482306 = 2 \cdot 6\text{m/s} \cdot \frac{4.1\text{m/s}}{(6\text{m/s} + 4.1\text{m/s})^2}$$

19) Efficiency of Propulsion given Head Loss due to Friction

Open Calculator

fx $$\eta = 2 \cdot V \cdot \frac{u}{(V+u)^2 + 2 \cdot [g] \cdot h}$$

ex $$0.144907 = 2 \cdot 6\text{m/s} \cdot \frac{4.1\text{m/s}}{(6\text{m/s} + 4.1\text{m/s})^2 + 2 \cdot [g] \cdot 12.11\text{m}}$$

20) Kinetic Energy of Water

Open Calculator

fx $$KE = W_{Water} \cdot \frac{V_f^2}{2 \cdot [g]}$$

ex $$1274.645\text{J} = 1000\text{kg} \cdot \frac{(5\text{m/s})^2}{2 \cdot [g]}$$

21) Propelling Force

Open Calculator

fx $$F = W_{Water} \cdot \frac{V}{[g]}$$

ex $$611.8297\text{N} = 1000\text{kg} \cdot \frac{6\text{m/s}}{[g]}$$

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22) Velocity of Jet Relative to Motion of Ship given Kinetic Energy

Open Calculator

fx $$V_r = \sqrt{KE \cdot 2 \cdot \frac{[g]}{W_{body}}}$$

ex $$20.41237 m/s = \sqrt{1274.64 J \cdot 2 \cdot \frac{[g]}{60 N}}$$

23) Velocity of Moving Ship given Relative Velocity

Open Calculator

fx $$u = V_r - V$$

ex $$4.1 m/s = 10.1 m/s - 6 m/s$$

Momentum Theory of Propellers

24) Diameter of Propeller given Thrust on Propeller

Open Calculator

fx $$D = \sqrt{\left(\frac{4}{\pi}\right) \cdot \frac{Ft}{dP}}$$

ex $$14.56731 m = \sqrt{\left(\frac{4}{\pi}\right) \cdot \frac{0.5 kN}{3 Pa}}$$

25) Flow Velocity given Power Lost

Open Calculator

fx $$V_f = V - \sqrt{\left(\frac{P_{loss}}{\rho_{Fluid} \cdot q_{flow} \cdot 0.5}\right)}$$

ex $$4.382389\text{m/s} = 6\text{m/s} - \sqrt{\left(\frac{15.7\text{W}}{0.5\text{kg/m}^3 \cdot 24\text{m}^3/\text{s} \cdot 0.5}\right)}$$

26) Flow Velocity given Rate of Flow through Propeller

Open Calculator

fx $$V_f = \left(8 \cdot \frac{q_{flow}}{\pi \cdot D^2}\right) - V$$

ex $$-5.711711\text{m/s} = \left(8 \cdot \frac{24\text{m}^3/\text{s}}{\pi \cdot (14.56\text{m})^2}\right) - 6\text{m/s}$$

27) Flow Velocity given Theoretical Propulsive efficiency

Open Calculator

fx $$V_f = \frac{V}{\frac{2}{\eta} - 1}$$

ex $$4\text{m/s} = \frac{6\text{m/s}}{\frac{2}{0.80} - 1}$$

28) Flow Velocity given Thrust on Propeller

Open Calculator

fx $$V_f = -\left(\frac{Ft}{\rho_{Water} \cdot q_{flow}}\right) + V$$

ex $$5.979167\text{m/s} = -\left(\frac{0.5\text{kN}}{1000\text{kg/m}^3 \cdot 24\text{m}^3/\text{s}}\right) + 6\text{m/s}$$

29) Input Power

Open Calculator

fx $$P_i = P_{out} + P_{loss}$$

ex $$52\text{J/s} = 36.3\text{W} + 15.7\text{W}$$

30) Output Power given Input Power

Open Calculator

fx $$P_{out} = P_i - P_{loss}$$

ex $$36.3\text{W} = 52\text{J/s} - 15.7\text{W}$$

31) Output Power given Rate of Flow through Propeller

Open Calculator

fx $$P_{out} = \rho_{Water} \cdot q_{flow} \cdot V_f \cdot (V - V_f)$$

ex $$120000\text{W} = 1000\text{kg/m}^3 \cdot 24\text{m}^3/\text{s} \cdot 5\text{m/s} \cdot (6\text{m/s} - 5\text{m/s})$$

32) Power Lost

Open Calculator

fx $$P_{loss} = \rho_{Fluid} \cdot q_{flow} \cdot 0.5 \cdot (V - V_f)^2$$

ex $$6\text{W} = 0.5\text{kg/m}^3 \cdot 24\text{m}^3/\text{s} \cdot 0.5 \cdot (6\text{m/s} - 5\text{m/s})^2$$

33) Power Lost given Input Power

Open Calculator

fx $$P_{loss} = P_i - P_{out}$$

ex $$15.7W = 52J/s - 36.3W$$

34) Rate of Flow given Power Lost

Open Calculator

fx $$q_{flow} = \frac{P_{loss}}{\rho_{Fluid}} \cdot 0.5 \cdot (V - V_f)^2$$

ex $$15.7m^3/s = \frac{15.7W}{0.5kg/m^3} \cdot 0.5 \cdot (6m/s - 5m/s)^2$$

35) Rate of Flow through Propeller

Open Calculator

fx $$Q = \left(\frac{\pi}{8}\right) \cdot (D^2) \cdot (V + V_f)$$

ex $$915.7466m^3/s = \left(\frac{\pi}{8}\right) \cdot \left((14.56m)^2\right) \cdot (6m/s + 5m/s)$$

36) Theoretical Propulsive Efficiency

Open Calculator

fx $$\eta = \frac{2}{1 + \left(\frac{V}{V_f}\right)}$$

ex $$0.909091 = \frac{2}{1 + \left(\frac{6m/s}{5m/s}\right)}$$

37) Thrust on Propeller

Open Calculator

fx $$Ft = \left(\frac{\pi}{4}\right) \cdot \left(D^2\right) \cdot dP$$

ex $$0.499498\text{kN} = \left(\frac{\pi}{4}\right) \cdot \left(\left(14.56\text{m}\right)^2\right) \cdot 3\text{Pa}$$

Jet Velocity

38) Jet Velocity given Output Power

Open Calculator

fx $$V = \left(\frac{P_{out}}{\rho_{Water} \cdot q_{flow} \cdot V_f}\right) + V_f$$

ex $$5.000302\text{m/s} = \left(\frac{36.3\text{W}}{1000\text{kg/m}^3 \cdot 24\text{m}^3\text{/s} \cdot 5\text{m/s}}\right) + 5\text{m/s}$$

39) Jet Velocity given Power Lost

Open Calculator

fx $$V = \sqrt{\left(\frac{P_{loss}}{\rho_{Fluid} \cdot q_{flow} \cdot 0.5}\right)} + V_f$$

ex $$6.617611\text{m/s} = \sqrt{\left(\frac{15.7\text{W}}{0.5\text{kg/m}^3 \cdot 24\text{m}^3\text{/s} \cdot 0.5}\right)} + 5\text{m/s}$$

40) Jet Velocity given Theoretical Propulsive Efficiency

Open Calculator

fx $$V = \left(\frac{2}{\eta} - 1\right) \cdot V_f$$

ex $$7.5\text{m/s} = \left(\frac{2}{0.80} - 1\right) \cdot 5\text{m/s}$$

41) Jet Velocity given Thrust on Propeller

Open Calculator

fx $$V = \left(\frac{Ft}{\rho_{Water} \cdot q_{flow}}\right) + V_f$$

ex $$5.020833\text{m/s} = \left(\frac{0.5\text{kN}}{1000\text{kg/m}^3 \cdot 24\text{m}^3/\text{s}}\right) + 5\text{m/s}$$

Variables Used

- **A_{Jet}** Cross Sectional Area of Jet *(Square Meter)*
- **C_v** Coefficient of Velocity
- **D** Diameter of Turbine *(Meter)*
- **dP** Change in Pressure *(Pascal)*
- **F** Force of Fluid *(Newton)*
- **Ft** Thrust Force *(Kilonewton)*
- **h** Impulse Height *(Meter)*
- **KE** Kinetic Energy *(Joule)*
- **P_i** Total Input Power *(Joule per Second)*
- **P_{loss}** Power Loss *(Watt)*
- **P_{out}** Output Power *(Watt)*
- **Q** Rate of Flow through Propeller *(Cubic Meter per Second)*
- **q_{flow}** Rate of Flow *(Cubic Meter per Second)*
- **r1** Radial Distance 1 *(Meter)*
- **r2** Radial Distance 2 *(Meter)*
- **u** Velocity of Ship *(Meter per Second)*
- **v** Actual Velocity *(Meter per Second)*
- **V** Absolute Velocity of Issuing Jet *(Meter per Second)*
- **V_1** Velocity at Point 1 *(Meter per Second)*
- **V_2** Velocity at Point 2 *(Meter per Second)*
- **V_f** Flow Velocity *(Meter per Second)*
- **V_r** Relative Velocity *(Meter per Second)*

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- **W** Work done *(Joule)*
- **W_{body}** Weight of Body *(Newton)*
- **W_{Water}** Weight of Water *(Kilogram)*
- **γ_f** Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- **Δ** Delta Length *(Meter)*
- **η** Efficiency of Jet
- **ρ_{Fluid}** Density of Fluid *(Kilogram per Cubic Meter)*
- **ρ_{Water}** Water Density *(Kilogram per Cubic Meter)*
- **τ** Torque Exerted on Fluid *(Newton Meter)*

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Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[g]**, 9.80665 Meter/Second²
  Gravitational acceleration on Earth
- Function: **sqrt**, sqrt(Number)
  Square root 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: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Power** in Watt (W), Joule per Second (J/s)
  Power Unit Conversion
- Measurement: **Force** in Newton (N), Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate 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: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion

Check other formula lists

- Buoyancy And Floatation Formulas
- Culverts Formulas
- Equations of Motion and Energy Equation Formulas
- Flow of Compressible Fluids Formulas
- Flow Over Notches and Weirs Formulas
- Fluid Pressure and Its Measurement Formulas
- Fundamentals of Fluid Flow Formulas
- Hydroelectric Power Generation Formulas
- Hydrostatic Forces on Surfaces Formulas
- Impact of Free Jets Formulas
- Impulse Momentum Equation and its Applications Formulas
- Liquids in Relative Equilibrium Formulas
- Most Economical or Most Efficient Section of Channel Formulas
- Non-uniform Flow in Channels Formulas
- Properties of Fluid Formulas
- Thermal Expansion of Pipe and Pipe Stresses Formulas
- Uniform Flow in Channels Formulas
- Water Power Engineering Formulas

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