Unit 10 - Week 8: Vorticity-Stream Function Formulation

Course outline

Assignment 8

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-03-25, 23:59 IST.

1) For a 2D steady Newtonian incompressible flow, the equation for stream function is *1 point*

- $\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=-\omega_x$
- $\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=-\omega_y$
- $\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=-\omega_z$
- $\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=0$

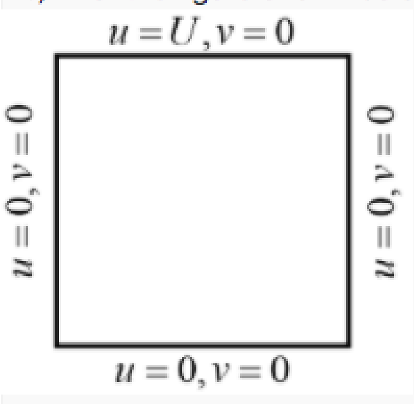
No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=-\omega_z$

2) For a 2D steady Newtonian incompressible flow, the equation for vorticity is *1 point*

- $u\frac{\partial \omega}{\partial x}+v\frac{\partial \omega}{\partial y}=\mu\left(\frac{\partial^2 \omega}{\partial x^2}+\frac{\partial^2 \omega}{\partial y^2}\right)$
- $u\frac{\partial \omega}{\partial x}+v\frac{\partial \omega}{\partial y}=\nu\left(\frac{\partial^2 \omega}{\partial x^2}+\frac{\partial^2 \omega}{\partial y^2}\right)$
- $v\frac{\partial \omega}{\partial x}+u\frac{\partial \omega}{\partial y}=\mu\left(\frac{\partial^2 \omega}{\partial x^2}+\frac{\partial^2 \omega}{\partial y^2}\right)$
- $v\frac{\partial \omega}{\partial x}+u\frac{\partial \omega}{\partial y}=\nu\left(\frac{\partial^2 \omega}{\partial x^2}+\frac{\partial^2 \omega}{\partial y^2}\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$u\frac{\partial \omega}{\partial x}+v\frac{\partial \omega}{\partial y}=\nu\left(\frac{\partial^2 \omega}{\partial x^2}+\frac{\partial^2 \omega}{\partial y^2}\right)$

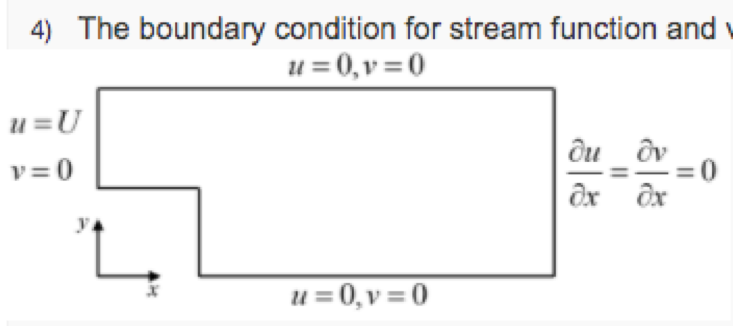
3) For the figure shown below, the discretized equation at the top wall is given as *1 point*



- $\omega_{i,N}=-\frac{2}{\Delta x^2}\left(\psi_{i,N}-\psi_{i,N-1}+U\Delta x\right)$
- $\omega_{i,N}=-\frac{2}{\Delta y^2}\left(\psi_{i,N}-\psi_{i,N-1}+U\Delta y\right)$
- $\omega_{i,N}=-\frac{2}{\Delta x^2}\left(\psi_{i,N-1}-\psi_{i,N}+U\Delta x\right)$
- $\omega_{i,N}=-\frac{2}{\Delta y^2}\left(\psi_{i,N-1}-\psi_{i,N}+U\Delta y\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\omega_{i,N}=-\frac{2}{\Delta y^2}\left(\psi_{i,N-1}-\psi_{i,N}+U\Delta y\right)$

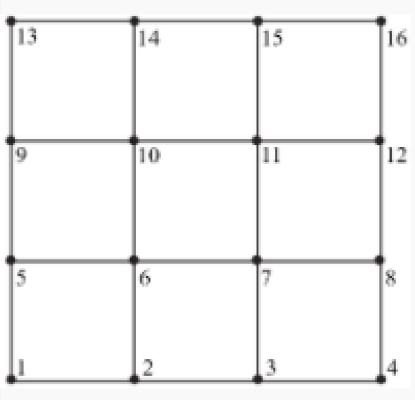
4) The boundary condition for stream function and vorticity for the bottom wall as show in the figure below is *1 point*



- $\psi=const.,\omega=\frac{\partial^2 \psi}{\partial y^2}$
- $\psi=const.,\omega=-\frac{\partial^2 \psi}{\partial y^2}$
- $\frac{\partial \psi}{\partial y}=const.,\omega=\frac{\partial^2 \psi}{\partial y^2}$
- $\frac{\partial \psi}{\partial y}=const.,\omega=0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\psi=const.,\omega=-\frac{\partial^2 \psi}{\partial y^2}$

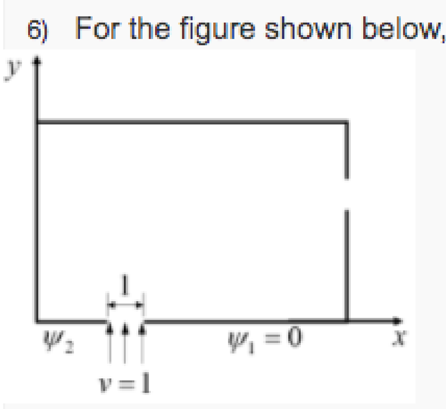
5) For a 2D steady Newtonian incompressible flow $\left(\beta=\frac{\Delta x}{\Delta y}\right)$, the discretized stream function equation at point 10 is *0 points*



- $\psi_{10}=\frac{\beta^2(\psi_{11}+\psi_9)+\psi_6+\psi_{14}+\omega_{10}\Delta y^2}{2(1+\beta^2)}$
- $\psi_{10}=\frac{\beta^2(\psi_{11}+\psi_9)+\psi_6+\psi_{14}+\omega_{10}\Delta x^2}{2(1+\beta^2)}$
- $\psi_{10}=\frac{\beta^2(\psi_6+\psi_{14})+\psi_{11}+\psi_9+\omega_{10}\Delta y^2}{2(1+\beta^2)}$
- $\psi_{10}=\frac{\beta^2(\psi_6+\psi_{14})+\psi_{11}+\psi_9+\omega_{10}\Delta x^2}{2(1+\beta^2)}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\psi_{10}=\frac{\beta^2(\psi_{11}+\psi_9)+\psi_6+\psi_{14}+\omega_{10}\Delta y^2}{2(1+\beta^2)}$

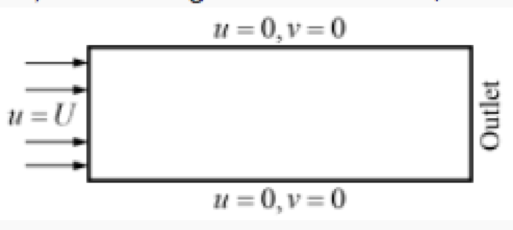
6) For the figure shown below, the value of ψ_2 is *1 point*



- $\psi_2=-1$
- $\psi_2=0$
- $\psi_2=2$
- cannot be determined

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\psi_2=-1$

7) For the figure shown below, the outlet boundary condition for vorticity is *1 point*



- $\omega_{M,j}=0$
- $\omega_{M,j}=\omega_{M+1,j}$
- $\omega_{M,j}=\omega_{M-1,j}$
- $\omega_{M-1,j}=0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\omega_{M,j}=\omega_{M-1,j}$

8) In vorticity-stream function method, the wall can be considered as a streamline. *1 point*

- True
- False

No, the answer is incorrect.
Score: 0
Accepted Answers:
True