Unit 3 - Week 1

Assignment 1

The due date for submitting this assignment has passed. Due on 2019-08-14, 23:59 IST.
As per our records you have not submitted this assignment.

1) In the Lagrangian description, the position of a fluid particle in a flow field is given by

$$x = x_0 e^{kt}$$
$$y = y_0 e^{-kt}$$
$$z = z_0$$

where (x_0, y_0, z_0) is the initial position of the fluid particle at time $t = 0$ and k is a known dimensional constant. This flow field is

(A) steady and uniform
(B) steady but non-uniform
(C) unsteady but uniform
(D) unsteady and non-uniform

1 point

a
b
c
d

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

2) For a two-dimensional velocity field, $\vec{V} = u(x,y)\,\hat{i} + v(x,y)\,\hat{j}$, the slope of a streamline is given by

(A) $\left(\frac{dy}{dx}\right)_{\text{streamline}} = \frac{u}{v}$
(B) $\left(\frac{dy}{dx}\right)_{\text{streamline}} = -\frac{u}{v}$
(C) $\left(\frac{dy}{dx}\right)_{\text{streamline}} = \frac{v}{u}$
(D) $\left(\frac{dy}{dx}\right)_{\text{streamline}} = -\frac{v}{u}$

1 point

a
b
c
d

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

3) Streamlines, streaklines and pathlines are always identical for a

(A) steady flow
(B) uniform flow
(C) incompressible flow
(D) They are never identical for any flow field

1 point

a
b
c
d

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

4) Which among the following is the MOST GENERAL expression for the acceleration of a fluid particle in a flow field where $\vec{V}(x,y,z,t)$ represents the velocity field in the Eulerian description?

(A) $\frac{\partial \vec{V}}{\partial t}$
(B) $\frac{\partial \vec{V}}{\partial t} + \vec{V}\left(\nabla \cdot \vec{V}\right)$
(C) $\frac{\partial \vec{V}}{\partial t} + \left(\vec{V} \cdot \nabla\right)\vec{V}$
(D) $\frac{\partial \vec{V}}{\partial t} + \nabla\left(\vec{V} \cdot \vec{V}\right)$

1 point

a
b
c
d

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

5) Consider a two-dimensional velocity field:

$$\vec{V} = \frac{x}{1+t}\,\hat{i} + \frac{2y}{1+2t}\,\hat{j}$$

The acceleration of a fluid particle located at the point (4,9) at time $t = 1$ s is

(A) $-\hat{i} - 4\hat{j}$
(B) $-2\hat{i} - 8\hat{j}$
(C) $\hat{i} + 4\hat{j}$
(D) $\vec{0}$

1 point

a
b
c
d

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

6) The material acceleration is always zero for a/an

(A) steady and uniform flow
(B) steady and non-uniform flow
(C) unsteady and uniform flow
(D) unsteady and non-uniform flow

1 point

a
b
c
d

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

7) Consider the flow represented by the velocity field, $\vec{V} = (Ay + B)\hat{i} - A\hat{x}\hat{j}$, where $A = 10\ s^{-1}$ and $B = 3$ m/s and the coordinates are measured in meters. The circulation about the "curve" bounded by $y = 0$, $x = 1$, $y = 1$ and $x = 0$ is

(A) 10 m^2/s
(B) 20 m^2/s
(C) -20 m^2/s
(D) 0

1 point

a
b
c
d

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

8) Which among the following velocity fields represents a rigid body motion?

(A) $u = x + 2y + 3z$; $v = 2x + y - z$; $w = 3x - y - 2z$
(B) $u = x + 2y + 3z$; $v = -2x + y + z$; $w = -3x - y - 2z$
(C) $u = 2y + 3z$; $v = 2x - z$; $w = 3x - y$
(D) $u = 2y + 3z$; $v = -2x + z$; $w = -3x - y$

1 point

a
b
c
d

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

9) Consider two-dimensional, steady, incompressible flow through the plane converging channel as shown in figure below. The velocity on the horizontal centerline (x-axis) is given by

$$\vec{V} = V_0\left(1 + \frac{x}{L}\right)\hat{i}$$

The time taken by a fluid particle on the horizontal axis to travel from $x = 0$ to $x = L$ is

(A) $\frac{2L}{3V_0}$
(B) $\frac{L}{V_0}\ln(2)$
(C) $\frac{L}{2V_0}$
(D) $\frac{L}{2V_0}\ln(2)$

1 point

a
b
c
d

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

10) A two-dimensional velocity field is given by

$$\vec{V} = xy\,\hat{i} + \frac{1}{2}\left(x^2 - y^2\right)\hat{j}$$

The flow field represents

(A) an incompressible, irrotational flow
(B) an incompressible, rotational flow
(C) a compressible, irrotational flow
(D) a compressible, rotational flow

1 point

a
b
c
d

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

11) A two-dimensional velocity field is given by

$$\vec{V} = 2xy\,\hat{i} + \left(2y^2 - x^2\right)\hat{j}$$

The rate of angular deformation of a fluid element ($\dot{\gamma}_{xy}$) and vorticity of the flow field (Ω_z) respectively are

(A) $\dot{\gamma}_{xy} = 0$ and $\Omega_z = 0$
(B) $\dot{\gamma}_{xy} = 0$ and $\Omega_z = 4x$
(C) $\dot{\gamma}_{xy} = -4x$ and $\Omega_z = 0$
(D) $\dot{\gamma}_{xy} = 0$ and $\Omega_z = -4x$

1 point

a
b
c
d

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

12) The stream function of a flow field is $\psi = Ax^2y - By^3$, where $A = 1$ (with appropriate dimensions). The value of B for which the flow becomes irrotational is

(A) $-\frac{1}{3}$
(B) $\frac{1}{3}$
(C) 3
(D) -3

1 point

a
b
c
d

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