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NPTEL

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Courses » Rheology of Complex Materials

Announcements Course Ask a Question Progress Mentor

Unit 5 - Week 3

Course outline

Week 0 - Pre-requisites

Week 1

Week 2

Week 3

Kinematics for simple flows

Kinematics for simple flows 2

Introduction to tensors

Rheometric flows

Viscous response 1

Quiz : Assignment 3

Week 3 Feedback

Assignment 3: solutions

Week 4

Week 5

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

Assignment 3

The due date for submitting this assignment has passed. **Due on 2018-02-14, 23:59 IST.**

Submitted assignment

1) In solids, the reference configuration is usually 1 point

- Deformed configuration
- Current configuration
- Undeformed configuration
- Future configuration

No, the answer is incorrect.

Score: 0

Accepted Answers:

Undeformed configuration

2) In fluids, the reference configuration is at the present time. Therefore, the strain at the present time will be, 1 point

- Undefined
- Zero
- Non-zero Constant tensor
- Infinite

No, the answer is incorrect.

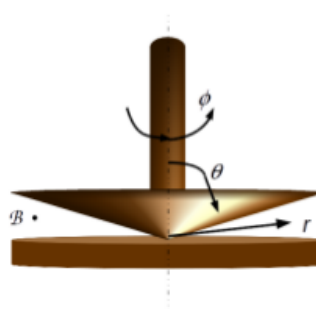
Score: 0

Accepted Answers:

Zero

3) 2 points

In cone and plate, the cone is rotated/moved, and due to this all the material points will also move. The position of material point \mathcal{B} is given by r, θ and ϕ at present time t and by r^τ, θ^τ and ϕ^τ at an arbitrary time τ . For this point,



- $r = r^\tau$; $\phi = \phi^\tau$; θ and θ^τ will be different

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VIDEOS

Interaction
Session

MATLAB:
Introduction

MATLAB: Vector
and Matrix
Operations

MATLAB:
Advanced Topics

- $\phi = \phi^\tau; \theta = \theta^\tau; r$ and r^τ will be different
- r and $r^\tau; \theta$ and $\theta^\tau; \phi$ and ϕ^τ will be different
- $r = r^\tau; \theta = \theta^\tau$ and ϕ and ϕ^τ will be different

No, the answer is incorrect.

Score: 0

Accepted Answers:

$r = r^\tau; \theta = \theta^\tau$ and ϕ and ϕ^τ will be different

4) The finite strain tensors do not reduce to infinitesimal strain tensor, when deformation is small.

1 point

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

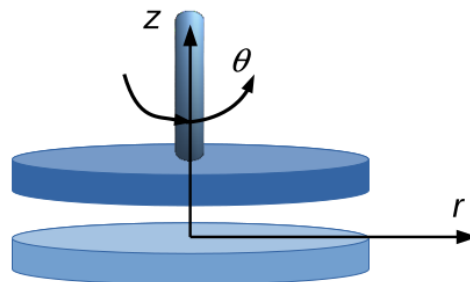
False

Based on the question 5 ,answer the following questions up to 7

- 5) For various materials such as pastes, rotational parallel plate geometry is preferred. In this geometry, the top plate is rotated/moved, and due to this all the material points also move. The position of material point is given by r, θ and z at present time t and by r^τ, θ^τ and z^τ at an arbitrary time τ . The top plate rotational motion is given by Ω , leading to velocity of Ωr at any location r on the top plate. The position at two instants of time can be related to each other, if we specify the shear rate as $\dot{\gamma}_{z\theta}$. The gap between plates is H .

2 points

$$\begin{aligned} r^\tau &= \mathcal{A}r + \mathcal{B}z\dot{\gamma}_{z\theta}(\tau - t) \\ \theta^\tau &= \mathcal{C}\theta + \mathcal{D}\left(\frac{z}{r}\right)\dot{\gamma}_{z\theta}(\tau - t) \\ z^\tau &= \mathcal{E}z + \mathcal{F}z\dot{\gamma}_{z\theta}(\tau - t) . \end{aligned}$$



Value of \mathcal{A} , \mathcal{B} and \mathcal{C} will be

- 1,1,1
- 0,1,1
- 1,0,1
- 0,0,1

No, the answer is incorrect.

Score: 0

Accepted Answers:

1,0,1

- 6) Value of \mathcal{D} , \mathcal{E} and \mathcal{F} will be

2 points

- 0,1,1
- 1,0,1
- 1,1,0
- 1,0,0

No, the answer is incorrect.

Score: 0

Accepted Answers:

1,1,0

7) The strain rate $\dot{\gamma}_{z\theta} = \frac{\partial v_\theta}{\partial z}$ will be

1 point

- $\frac{\Omega r}{H}$
- Ω
- $\frac{\Omega z}{H}$
-

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\frac{\Omega r}{H}$

Based on the question given in 8 , answer the following question up to 10

8)

2 points

In a rotational rheometer, torque (T , in N m) and angular position or rate of change of angular position (W , in rad/s) are measured. For a cone and plate geometry (Radius $R = 12.5$ mm, angle $\theta_0 = 2^\circ$ or 0.0349 rad), following are some rheometry related expressions:

$$\text{shear stress } \tau_{\theta\phi} = \frac{3T}{2\pi R^3}$$

$$\text{shear rate } \dot{\gamma}_{\theta\phi} = \frac{W}{\theta_0}$$

$$\text{viscosity } \mu = \frac{3T\theta_0}{2\pi R^3 W}$$

If the lowest limit of torque measurement on a rheometer is 1×10^{-6} N m, which of the following measurements cannot be made on the rheometer:

- A fluid with viscosity of 0.01 Pa s at shear rate of 100 1/s
- A fluid with viscosity of 0.01 Pa s at shear rate of 10 1/s
- A fluid with viscosity of 3 Pa s at shear rate of 0.05 1/s
- A fluid with viscosity of 3 Pa s at shear rate of 10 1/s

No, the answer is incorrect.

Score: 0

Accepted Answers:

A fluid with viscosity of 0.01 Pa s at shear rate of 10 1/s

A fluid with viscosity of 3 Pa s at shear rate of 0.05 1/s

9) If angular displacement is by ϕ_0 , the shear strain is

1 point

- $\frac{\phi_0}{\cos \theta_0}$
-
- $\frac{\theta_0}{\phi_0}$
-

No, the answer is incorrect.

Score: 0

Accepted Answers:

10)

If minimum angular displacement that can be measured in the rheometer is 1×10^{-4} rad, the minimum shear strain that can be measured is _____ . (to nearest 3 decimal places)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 0.0020,0.0040

2 points

11) When fluid is stretched and made to flow in z direction, it necessarily flows in x and y directions due to

1 point

- Incompressibility
- Non-Newtonian nature
- Compressibility
- Newtonian nature

No, the answer is incorrect.

Score: 0

Accepted Answers:

Incompressibility

12) For a planar shear flow $v_x(y)$,

2 points

- D_{yx} , D_{xx} and D_{yy} will be non-zero
- D_{yx} will be non-zero D_{xx} and D_{yy} will be zero
- D_{yx} will be zero D_{xx} and D_{yy} will be non-zero
- D_{yx} , D_{xx} and D_{yy} will be zero

No, the answer is incorrect.

Score: 0

Accepted Answers:

D_{yx} will be non-zero D_{xx} and D_{yy} will be zero

13) For a Newtonian fluid, if D_{xx} is zero τ_{xx} is also necessarily zero.

1 point

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

True

14) Generalized coordinates need to be orthogonal, similar to the rectangular and cylindrical coordinate systems.

1 point

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:*False*

15) Optical reader in a rheometer is used for the measurement of

1 point

- Strain only
 Stress only
 Strain and strain rate
 Stress and stress rate

No, the answer is incorrect.**Score: 0****Accepted Answers:***Strain and strain rate*

16 Given that the velocity components in lubricated squeeze flow $v_z(z) = kz$; $v_r(r) = -\frac{k}{2}r$, the governing equations for position of a material particle are given by $\frac{\partial z}{\partial t} = \mathcal{A}kz + \mathcal{B}\left(-\frac{k}{2}r\right)$ and $\frac{\partial r}{\partial t} = \mathcal{C}kz + \mathcal{D}\left(-\frac{k}{2}r\right)$. The values of coefficients (to nearest integer) are: $\mathcal{A} = \underline{\hspace{2cm}}$, $\mathcal{B} = \underline{\hspace{2cm}}$, $\mathcal{C} = \underline{\hspace{2cm}}$ and $\mathcal{D} = \underline{\hspace{2cm}}$.

Hint

No, the answer is incorrect.**Score: 0****Accepted Answers:***(Type: String) 1,0,0,1***2 points**

17)

2 points

- $z_1^T = z_1 + k\Delta t z_1, z_2^T = z_2 + k\Delta t z_2, \frac{\Delta t}{t}$
 $z_1^T = z_2 + k\Delta t z_1, z_2^T = z_1 + k\Delta t z_2, k\Delta t$
 $z_1^T = z_2 + k\Delta t z_1, z_2^T = z_1 + k\Delta t z_2, \frac{\Delta t}{t}$
 $z_1^T = z_1 + k\Delta t z_1, z_2^T = z_2 + k\Delta t z_2, k\Delta t$

No, the answer is incorrect.**Score: 0****Accepted Answers:** $z_1^T = z_1 + k\Delta t z_1, z_2^T = z_2 + k\Delta t z_2, k\Delta t$

Previous Page

End



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