Unit 14 - Week 12

Course outline

Week 0 - Pre-requisites

Week 1

Week 2

Week 3

Week 4

Week 5

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

- Problems during rheometry - example of cone and plate
- Problems during rheometry - example of cone and plate 2
- Strain, convected derivatives, non-linear models
- Strain, convected derivates, non-linear models 2
- Rheometer demonstration
- Microscopic modeling of rheology
- Microscopic modeling of rheology 2
- Quiz : Assignment 12
- Week 12 Feedback : Rheology of Complex Materials
- Assignment 12 solutions

DOWNLOAD VIDEOS

Interaction Session

MATLAB: Introduction

MATLAB: Vector and Matrix Operations

MATLAB: Advanced Topics

Assignment 12

The due date for submitting this assignment has passed. Due on 2018-04-18, 23:59 IST.

Submitted assignment

1) Following is the strain tensor for planar extension

$$\mathbf{E}^{\tau} = \frac{1}{2}\begin{bmatrix} \lambda_x^{-2}-1 & 0 & 0 \\ 0 & \lambda_y^{-2}-1 & 0 \\ 0 & 0 & \lambda_z^{-2}-1 \end{bmatrix} \text{ with } \lambda_x = e^{\epsilon} \quad \lambda_y = 1 \quad \lambda_z = e^{-\epsilon}$$

The infinitesimal strain tensor for this flow is given by

$$\begin{bmatrix} \mathscr{A}\epsilon & 0 & 0 \\ 0 & \mathscr{B}\epsilon & 0 \\ 0 & 0 & \mathscr{C}\epsilon \end{bmatrix}$$

The value of $\mathscr{A}$ is _____ . (to one decimal place)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) -1.0

2 points

2) The value of $\mathscr{B}$ is _____ . (to one decimal place)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 0.0

2 points

3) The value of $\mathscr{C}$ is _____ . (to one decimal place)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 1.0

2 points

4) The governing equation for Giesekus model for steady simple shear is

$$\tau_{yx} + \mathscr{A}\lambda_1\frac{\partial \tau_{yx}}{\partial t} - \mathscr{B}\lambda_1\tau_{yy}\frac{\partial v_x}{\partial y} + \mathscr{C}a\frac{\lambda_1}{\eta}\tau_{yx}\left(\tau_{xx}+\tau_{yy}\right) - \mathscr{D}a\lambda_2\left(D_{yx}\tau_{xx}+\tau_{yy}D_{yx}\right) = \mathscr{E}\eta D_{yx} + \mathscr{F}\eta\lambda_2\frac{\partial D_{yx}}{\partial t}$$

The value of $\mathscr{A}$ is _____ . (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:

(Type: Numeric) 0

1 point

5) The value of $\mathscr{B}$ is _____ . (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 1

1 point

6) The value of $\mathscr{C}$ is _____ . (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 1

1 point

7) The value of $\mathscr{D}$ is _____ . (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 2

1 point

8) The value of $\mathscr{E}$ is _____ . (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 2

1 point

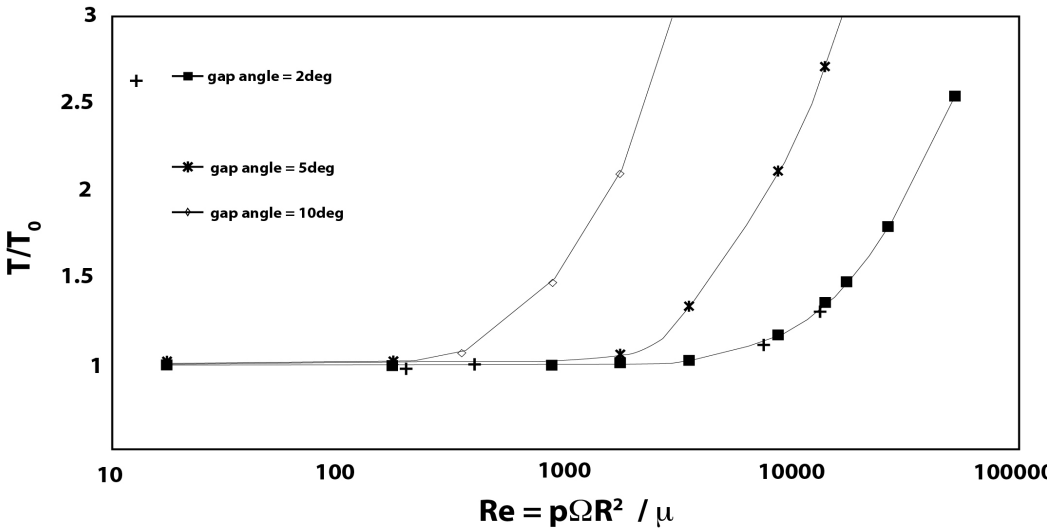
9) The value of $\mathscr{F}$ is _____ . (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 0

1 point

10) The following graph shows variation of torque in a cone and plate device for different cone angles [Bataineh, Computers and Fluids, 2014]. T is the cone torque observed at different Reynolds numbers (Ω is the rotational rate), and T_0 is the cone torque if flow is assumed to be one-dimensional. When T/T_0 is 1, there are no secondary flows. Whenever, secondary flows cannot be neglected T/T_0 is not equal to 1.



The following extracts highlight the conclusions from the above mentioned paper:

> *The effects of the secondary flow on the torque and viscosity measurement of Newtonian fluids sheared between cone-and-plate viscometers have been determined. When Reynolds number is less than 1, the secondary flow effect can be generally be neglected. At high Reynolds numbers, the results are incompatible with the theoretical primary formula and the secondary flow effect cannot be ignored. The secondary flow effect increases as Reynolds number increases. The torque values on the plates are different from those on the cone surface. This is due to the existence of the secondary flow. Higher values of the cone torque are observed due to the secondary flow effect. On the other hand, a decrease in the plate torque values is observed due to the secondary flow.*

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.40,1.00

2 points

11) If measurements are to be made with a cone of 10° cone with $R = 50$ mm, rotation rate of 1.0 1/s, the minimum value of viscosity that can be measured without correcting for secondary flows is _____ Pa s. (to nearest integer)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 10,25

2 points

1 point

12) State True/False.
The critical Reynolds number beyond which secondary flows are important, is higher for larger cone angle.

- True
- False

No, the answer is incorrect.
Score: 0

Accepted Answers:
False

13) *1 point*

State True/False.

When flow is one-dimensional in a cone and plate geometry, the torque on the rotating cone is the same as the torque on the stationary plate.

- True
- False

No, the answer is incorrect.
Score: 0

Accepted Answers:
True

14) *1 point*

For violating the assumption of one-dimensional flow in a rheometer geometry, Which one of the following is not a factor,

- Machining defect
- Lack of alignment in geome-try
- Slip
- Turbulence

No, the answer is incorrect.
Score: 0

Accepted Answers:
Slip

15) *1 point*

Non-isothermal effects during rheology could arise due to

- Viscous disspation
- Secondary flow
- Improper heating
- Slip

No, the answer is incorrect.
Score: 0

Accepted Answers:
Viscous disspation
Improper heating

Previous Page End