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NPTEL

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Courses » **Rheology of Complex Materials**

Announcements **Course** Ask a Question Progress Mentor

Unit 6 - Week 4

Course outline

Assignment 4

The due date for submitting this assignment has passed. **Due on 2018-02-21, 23:59 IST.**

Submitted assignment

1) Pick the statements which are valid for a Newtonian viscous fluid *2 points*

- [ ] The current state of stress is related to the current state of strain rate.
- [ ] The current state of stress does not depend upon past history of deformation.
- [ ] The overall response is only dissipative.
- [ ] In extensional flow, when a constant strain rate is applied, a steady state of stress is not reached.

No, the answer is incorrect.
Score: 0

Accepted Answers:
The current state of stress is related to the current state of strain rate.
The current state of stress does not depend upon past history of deformation.
The overall response is only dissipative.

2) In a rotational rheometer with a parallel plate geometry, the important conponents of stress and strain rate are *1 point*

- τ_{zr} or τ_{rz}; D_{zr} or D_{rz}
- $\tau_{r\theta}$ or $\tau_{\theta r}$; $D_{r\theta}$ or $D_{\theta r}$
- $\tau_{z\theta}$ or $\tau_{\theta z}$; $D_{z\theta}$ or $D_{\theta z}$
- τ_{rr} or τ_{zz}; D_{rr} or D_{zz}

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\tau_{z\theta}$ or $\tau_{\theta z}$; $D_{z\theta}$ or $D_{\theta z}$

3) Newtonian fluid is a linear viscous fluid due to following reasons: *1 point*

- Viscous because current stress is only related to current strain rate; linear because stress and strain rate are linearly related to each other.
- Viscous because stress is only related to current and past strain rate; linear because stress increases linearly with time.
- Viscous because strain rate is only related to current and past stress; linear because strain rate increases linearly with time.
- Viscous because current stress is only related to current strain; linear because stress and strain are linearly related to each other.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Viscous because current stress is only related to current strain rate; linear because stress and strain rate are linearly related to each other.

4) For a Newtonian fluid in simple shear, normal stress components $\sigma_{xx}, \sigma_{yy}, \sigma_{zz}$ are *1 point*

- $=0, =0, =0$
- $=T_{xx}, =T_{yy}, =T_{zz},$
- $=T_{yx}, =0, =0$
- $=-p, =-p, =-p$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$= -p, = -p, = -p$

5) *2 points*

Match the geometry with the definition of material function viscosity:

Geometry	Definition of viscosity η
I. Parallel plate	a. $\frac{\tau_{z\theta}}{\dot{\gamma}^0_{z\theta}}$
II. Rotational parallel plate	b. $\frac{\tau_{yx}}{\dot{\gamma}^0_{yx}}$
III. Cone and plate	c. $\frac{\tau_{r\theta}}{\dot{\gamma}^0_{r\theta}}$
IV. Concentric cylinder	d. $\frac{\tau_{\theta\phi}}{\dot{\gamma}^0_{\theta\phi}}$

- I-b,II-c,III-d,IV-a
- I-d,II-b,III-c,IV-a
- I-c,II-d,III-a,IV-b
- I-b,II-a,III-d,IV-c

No, the answer is incorrect.
Score: 0

Accepted Answers:
I-b,II-a,III-d,IV-c

6) For a generalized Newtonian fluid, the ratio of extensional viscosity to viscosity is __________.

(to 1 decimal place)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 3.0

2 points

7) Carreau Yasuda model can describe *2 points*

- Shear thinning
- Constant viscosity at very high shear rates
- Zero shear viscosity
- Yield stress

No, the answer is incorrect.
Score: 0

Accepted Answers:
Shear thinning
Constant viscosity at very high shear rates
Zero shear viscosity

8) *2 points*

As discussed during the lecture, mechanical analog can be used to unders the derivation of viscoelastic models. Consider a model, which is a series bination of a spring $\tau^e_{yx} = G\gamma^e_{yx}$ and a dashpot $\tau^v_{yx} = \eta\frac{\partial\gamma^v_{yx}}{\partial t}$. Where, the e v superscripts denote stress and strain in spring and dashpot respectivel relationship has to be derived between the total stress applied τ_{yx} and the strain γ_{yx}. Given that the stress will be the same for a series combinatio can state that $\tau^e_{yx} = \tau^v_{yx} = \tau_{yx}$.

Which of the following describe the correct relationships:

- $\gamma^e_{yx} + \gamma^v_{yx} = \gamma_{yx}$
- $\gamma^e_{yx} \times \gamma^v_{yx} = \gamma_{yx}$

- $\gamma_{yx}^e - \gamma_{yx}^v = \gamma_{yx}$
- $\frac{1}{\gamma_{yx}^e} + \frac{1}{\gamma_{yx}^v} = \frac{1}{\gamma_{yx}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\gamma_{yx}^e + \gamma_{yx}^v = \gamma_{yx}$

9) Based on the correct answer in above question , we can write the following expression, *2 points*

- $\frac{1}{G}\frac{\partial \tau_{yx}^e}{\partial t} + \frac{1}{\eta}\tau_{yx} = \frac{\partial \gamma_{yx}^v}{\partial t}$
- $\frac{1}{G}\frac{\partial \tau_{yx}}{\partial t} + \frac{1}{\eta}\tau_{yx}^e = \frac{\partial \gamma_{yx}^v}{\partial t}$
- $\frac{1}{G}\frac{\partial \tau_{yx}^e}{\partial t} + \frac{1}{\eta}\tau_{yx}^v = \frac{\partial \gamma_{yx}}{\partial t}$
- $\frac{1}{G}\frac{\partial \tau_{yx}^v}{\partial t} + \frac{1}{\eta}\tau_{yx}^e = \frac{\partial \gamma_{yx}}{\partial t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\frac{1}{G}\frac{\partial \tau_{yx}^e}{\partial t} + \frac{1}{\eta}\tau_{yx}^v = \frac{\partial \gamma_{yx}}{\partial t}$

10)The final expression is *1 point*

- $\frac{1}{G}\frac{\partial \tau_{yx}}{\partial t} + \frac{1}{\eta}\tau_{yx} = \frac{\gamma_{yx}}{t}$
- $\eta\frac{\partial \gamma_{yx}}{\partial t} + G\gamma_{yx} = \tau_{yx}$
- $\frac{\partial \tau_{yx}}{\partial t} + \frac{\tau_{yx}}{t} = G\frac{\partial \gamma_{yx}}{\partial t}$
- $\frac{1}{G}\frac{\partial \tau_{yx}}{\partial t} + \frac{1}{\eta}\tau_{yx} = \frac{\partial \gamma_{yx}}{\partial t}$

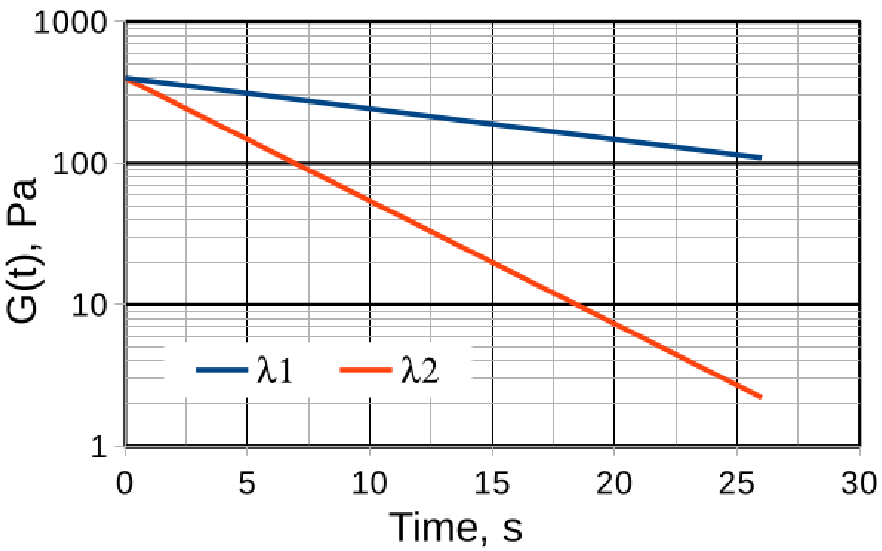
No, the answer is incorrect.
Score: 0

Accepted Answers:

$\frac{1}{G}\frac{\partial \tau_{yx}}{\partial t} + \frac{1}{\eta}\tau_{yx} = \frac{\partial \gamma_{yx}}{\partial t}$

11)

The following graph shows the relaxation modulus for two different relaxa times, λ1 and λ2.



The relaxation time λ1 is ______. (to 1 decimal place)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 17.0,23.0

2 points

12)**The relaxation time λ2 is _______ . (to 1 decimal place)**

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 4.0,6.0

2 points

13)Assume that λ1 and λ2 correspond to the relaxation times of the same material, but at two different temperatures T 1 and T 2, respectively. Fill in the following blank with **greater / lesser.**
T 1 is ________ than T 2.

Hint

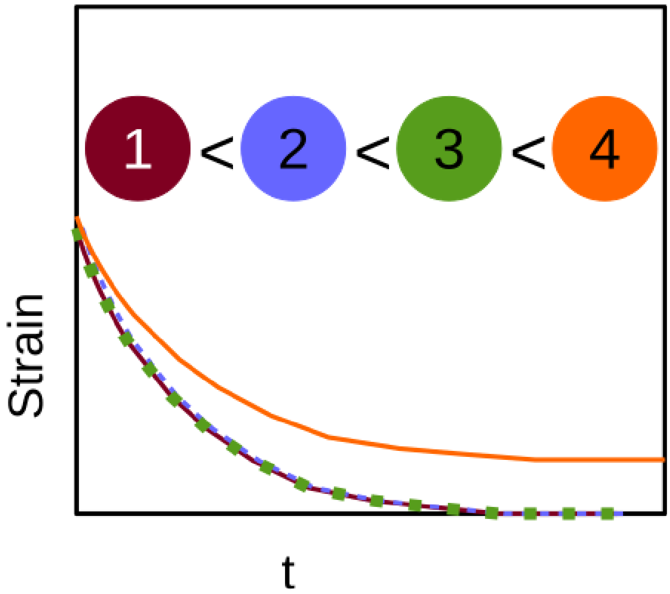
No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: String) lesser

1 point

14)

The following graph shows relaxation modulus $G(t)$ for 4 strains (show numbers in increasing strains). The largest strain for which linear viscoel response is observed is ______ . (enter integer value in 1-4)

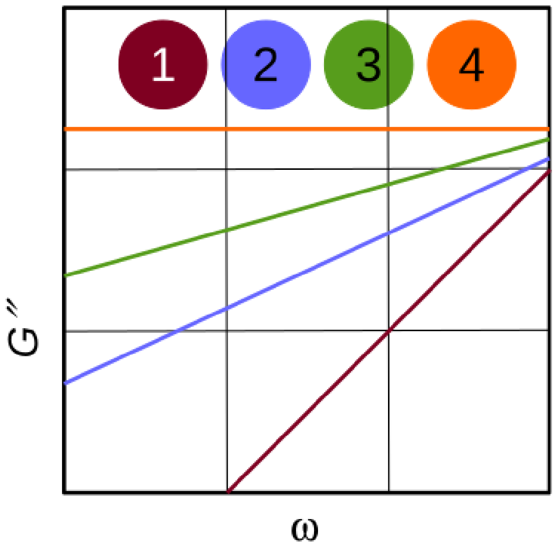


No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 3

2 points

15)**In the following graph, loss modulus Vs frequency are shown in a log-log plot.** *2 points*



Match the behaviour of 4 materials with the type:

Material	Type
1	a. Material with crosslinked network
2	b. Terminal viscous response
3	c. Material with partial interactions leading to weak network
4	

- 1-a,2-b,3-c,4-c
- 1-b,2-c-3-c,4-a
- 1-b,2-a,3-c,4-c
- 1-a,2-c-3-c,4-b

No, the answer is incorrect.
Score: 0

Accepted Answers:
1-b,2-c-3-c,4-a

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