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Unit 11 - Week 9

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Assignment 9

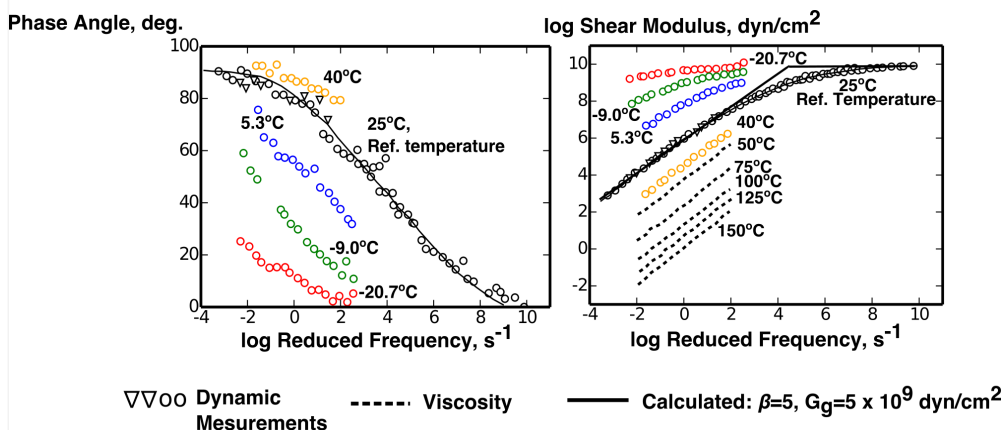
The due date for submitting this assignment has passed.

Due on 2018-03-28, 23:59 IST.

Submitted assignment

Based on the data given in the question 1, answer the following up to 7

1) The following graphs show classical data for road bitumen [Lesueur, Advances in Colloid and Interface Science, 2009] **2 points**



Match the following

Behaviour

- I. Predominantly viscous
- II. Predominantly elastic
- III. Viscoelastic

Temperature

- a. < -20°C
- b. > 60°C
- c. -20 to 60°C

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

I-b,II-a,III-c

2) Behaviour at 25 °C and 10^m to 10^n s^{-1} is equivalent to behaviour at -20 °C and 0.01 to 100 s^{-1} .

The value of m is _____ . (to nearest integer)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 5,7

MATLAB: Vector
and Matrix
Operations

MATLAB:
Advanced Topics

- 3) Behaviour at 25 °C and 10^m to 10^n s⁻¹ is equivalent to behaviour at -20 °C and 0.01 to 100 s⁻¹.

1 point

The value of n is _____. (to nearest integer)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 8,10

1 point

- 4) Above 60°C, $G^* \sim \omega^k$. The value of k is _____. (to nearest integer)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 1

2 points

5) In the given range of temperature, the overall rheological behaviour can be summarized as

2 points

- Glassy at low temperature to viscous at high temperature
- Rubbery at low temperature to viscous at high temperature
- Glassy at low temperature to rubbery at high temperature
- Glassy at high temperature to rubbery at low temperature

No, the answer is incorrect.

Score: 0

Accepted Answers:

Glassy at low temperature to viscous at high temperature

- 6) State True/False.

1 point

The shift factors for obtaining the master curve at 25°C would be based on Arrhenius equation.

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

False

- 7) Phase angle at 100°C is likely to be _____ rad . (to nearest 1 decimal place)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 1.4,1.6

2 points

- 8)

4 points

One of the following model is suggested to describe the linear viscoelastic sponse of bitumen.

$$< -40^{\circ}C \rightarrow \eta^* = \frac{\eta_0}{1+(i\omega\lambda_h)^{1-h}+(i\omega\lambda_k)^{1-k}}$$

The model reduces to Maxwell model for the following values of the parameters. The term “Any value” indicates any number greater than 1

- $\lambda_h = \text{Any value}, h = 0, \lambda_k = 0, k = \text{Any value}$
- $\lambda_h = \text{Any value}, h = \text{Any value}, \lambda_k = 0, k = \text{Any value}$
- $\lambda_h = 0, h = \text{Any value}, \lambda_k = \text{Any value}, k = \text{Any value}$
- $\lambda_h = 0, h = \text{Any value}, \lambda_k = \text{Any value}, k = 0$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\lambda_h = \text{Any value}, h = 0, \lambda_k = 0, k = \text{Any value}$

$\lambda_h = 0, h = \text{Any value}, \lambda_k = \text{Any value}, k = 0$

Based on the data given in the question 9, answer the following up to 11

- 9) Bitumen can be thought of as a mixture of insoluble fraction called **asphaltenes** and soluble fraction called **maltenes**. 2 points

Extracts from the above paper that connect microstructure to the rheology:

When temperature is lowered below 60 °C, the bitumen relaxation at which viscoelastic effects start to appear is associated to the Brownian motion of the asphaltene micelles and the associated relaxation time is proportional to the bitumen viscosity and the cube of the asphaltene micelle size. The maltene phase is however also directly involved in the phenomenon through the bitumen viscosity and there is therefore a strong coupling between the two phases.

Transition from the viscoelastic to the elastic regime, is a consequence of the vitrification of the maltene phase and the higher the glass transition temperature, the higher the modulus. The asphaltene still have an influence on the relaxation function, and the higher the asphaltene content, the smaller the relaxation rate. Thus, just like for the viscoelastic to viscous transition, there is again a coupling between asphaltene and maltene at low temperature as well.

The dominant mechanisms of defining viscoelasticity just below 60 °C will be,

- Cagelike confinement of asphaltene, Brownian force
- Clustering and breaking of asphaltene
- Percolated network of asphaltene
- Brownian force, drag between asphaltene and maltene

No, the answer is incorrect.

Score: 0

Accepted Answers:

Brownian force, drag between asphaltene and maltene

10) State True/False. 1 point

At low temperatures, since the maltene freeze, asphaltene become irrelevant in determining the rheological response.

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

False

11) Pick the correct statement/s.

2 points

At low temperature, relaxation rate is higher with smaller asphaltene content

At low temperature, relaxation rate is higher with larger asphaltene content

At high temperature, relaxation rate is higher with higher bitumen viscosity

At high temperature, relaxation rate is higher with lower bitumen viscosity

No, the answer is incorrect.

Score: 0

Accepted Answers:

At low temperature, relaxation rate is higher with smaller asphaltene content

At high temperature, relaxation rate is higher with lower bitumen viscosity

12) When present configuration is used as a basis for defining kinematic measures, at present time

The displacement is _____. (to nearest integer)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 0

1 point

13) When present configuration is used as a basis for defining kinematic measures, at present time

The relative displacement is _____. (to nearest integer)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 0

1 point

14) In rigid body rotation,

2 points

Deformation gradient zero; relative displacement unity

Relative displacement zero; deformation gradient unity

Deformation gradient non-zero; relative displacement non-unity

Relative displacement non-zero; deformation gradient non-unity

No, the answer is incorrect.

Score: 0

Accepted Answers:

Relative displacement non-zero; deformation gradient non-unity

1 point

15) State True/False.

Convected coordinates are labels of material particles, therefore the convected coordinates do not change when the material particles move.

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

True

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