

SEAT NO: _____

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[86]

SARDAR PATEL UNIVERSITY

M.Sc.Semester-III: (Physical Chemistry) Examination (CBCS)-2019

Monday, 25th November, 2019

02:00 p.m. to 05:00 p.m.

PS03EPHC22, Advanced Characterization Techniques

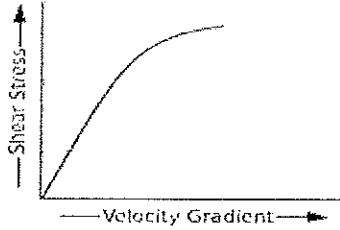
- N.B.:*
- Attempt all questions.
 - Figures to right indicate full marks.
 - Unless otherwise mentioned, symbols and notations have their usual standard meanings.
 - Neat sketches are to be drawn to illustrate answers, wherever required.
 - Assume suitable data, if necessary and indicate the same clearly.

- Q.1** The question i) to viii) contain Multiple Choice Questions (MCQs). Each question has four alternative responses marked [A], [B] [C] [D] out of which *only one* is the correct response. Please tick mark correct response i e [A], [B] [C] [D]. **[08]**
- The percentage elongation and the percentage reduction in area depends upon:
[A] Tensile strength of the material [B] Ductility of the material
[C] Toughness of the material [D] None of these
 - Every material obeys the Hooke's law within
[A] Elastic limit [B] Plastic limit
[C] Limit of proportionality [D] None of these
 - A series connection between a Hookean spring and a Newtonian dashpot results in to _____ model.
[A] Maxwell [B] Kelvin-Voigt
[C] Standard linear solid model [D] Prony series
 - Stress relaxation _____
[A] is the ability to return to its original shape, ability to store energy
[B] if the stress is held constant, the strain increases with time
[C] is the gradual decrease of stress when the material is held at constant strain
[D] if the strain is held constant, the stress decreases with time
 - In TG Experiment, the choice of material of furnace working in the temperature range 1100-1500° C is
[A] Kanthal or Nichrome wire or ribbon [B] Platinum or any alloy
[C] Tungsten of molybdenum [D] Platinum -Rhodium alloy
 - Decomposition temperature of CaCO₃ in thermogravimetric analysis will be highest in dynamic atmosphere of
[A] nitrogen [B] synthetic gas
[C] 1:1 mixture of O₂ and CO [D] water gas

①

(P.T.O.)

- vii) **Statement 1:** In $\mu_a = \tau/\dot{\gamma} = K\dot{\gamma}^{(n-1)}$, n = consistency index and K is the flow behavior index.
Statement 2: $n = 1$ for Newtonian fluids, $n < 1$ for dilatant fluids and $n > 1$ for pseudo plastic fluids. Which of the following is correct?
 [A] True, False [B] True, True [C] False, False [D] False, True
- viii) The diagram below is a graph of change in shear stress with respect to velocity gradient in a fluid. What is the type of the fluid?



- [A] Newtonian [B] Non Newtonian [C] Ideal [D] Dilated

Q.2 Answer the following questions as directed (**ANY SEVEN**). [14]

- To understand mechanical properties of polymer, how average molecular mass and molecular mass distributions are useful.
- Explain with suitable illustration the generalized Hooke's law.
- Discuss Affine deformation in relation to the molecular theory of rubber elasticity.
- Why in natural rubber, the increase in tensile stress occurs due to strain induced crystallization?
- List out application of DTA in Inorganic chemistry.
- Discuss Sample Shape factor affecting DSC Curve.
- Elucidate the terms: (I) Shear stress (II) Shear rate in relation to rheology.
- How viscosity changes in respect to the amount of shear or stress applied to the pseudoplastic?
- Discuss the Boltzmann Superposition principle in brief.

Q.3 a) Explain how chemical and steric isomerism are useful to recognize mechanical properties of polymers. [06]

b) Converse components of stress. Provide component of stress in the form of stress tensor, σ_{ij} . [06]

OR

b) (i) Describe succinctly strain energy function. [03]

(ii) Define: Shear modulus (G) and Poisson's ratio (ν) [03]

Q.4 a) What are Dynamic mechanical measurements? Define (using Phasor diagram) Complex modulus G^* and Complex compliance J^* . [06]

b) Express Maxwell model and derive the expression: [06]

$\sigma = \sigma_0 \exp(-\frac{t}{\tau})$ where τ is the relaxation time. Also write limitations of Maxwell model.

OR

- b) (i) Explain the creep for single step loading of a stress σ_0 at time $t=0$ by using Boltzmann Superposition principle. [03]
 (ii) Write down simplifying assumptions of the Statistical theory of rubber elasticity. [03]

- Q.5 a) Explain working principle, instrumentation and applications of Thermomechanical Analysis (TMA). [06]
 b)
 i) Discuss about the furnace and thermocouples components in DTA apparatus. [03]
 ii) Write a note on Instrumental factors affecting the DTA curve. [03]

OR

- b) Describe about the Balance; temperature measurements and recorder as basic units in a thermobalance of TG equipment. [06]
 Q.6 a) Define following terms in connection with viscoelastic measurements: [06]
 (I) Storage Modulus (II) Loss tangent and (III) Phase angle (δ)
 b) Discuss *vis-à-vis* Newtonian fluids and non-Newtonian fluids. [06]

OR

- b)
 (i) Explain Stress relaxation modulus of an uncrosslinked melt graph in different zone. [03]
 (ii) Explain: Pitch drop experiment. [03]

