Sardar Patel University
M. Sc. (Sem. III) Physical Chemistry Examination, January 2021
PS03EPHC 22, Advanced Characterization Techniques
Tuesday, 5th January 2021
10.00 a.m. 12.00 noon
N. B. Attempt all questions
(Figures to the right indicate marks)

08

1. A . Multiple Choice Questions (Tick (√) the right choice)

i) Which of the following are characteristics of thermosetting polymers?
a) Linear slightly branched long chain molecules
b) Become fusible on molding so cannot be reused.
c) Heavily branched cross linked polymers.
d) Soften on heating and harden on cooling, can be reused

ii) The percentage elongation and the percentage reduction in area depends upon:
a) Ductility of the material   **b)** Tensile strength of the material
c) Toughness of the material   **d)** None of these

iii) Which of the following is true for Viscoelasticity:
a) It is the ability to returns to its original shape (usually refereeing to solids); ability to store energy
b) It is of an object following an impact is less than 100%
c) It is the gradual decrease of stress when the material is held at constant strain
d) It is a combination of Viscous and Elastic properties

iv) The stress-strain curve can be articulated linearly by the use of _____

a) Cauchy's principle **b)** Fourier series **c)** Taylor's series **d)** D'Alembert theorem

v) Which of the following is not a complex fluid?
a) Foam   **b)** Gel   **c)** Melt   **d)** Oil

vi) Shear Modulus is given as:

a) τ / γ　b) $\tau / \dot{\gamma}$　c) γ / τ　d) $\dot{\gamma} / \tau$

vii) Suppose a sample is heated to a constant mass at each of a series of Increasing temperatures, then the test mode is:

a) Isothermal TGA　b) Quasielastic TGA　c) Dynamic TGA d) Incremental TGA

viii) A differential scanning calorimeter measures:

a) Heat of the sample relative to reference
b) Heat flow into or out of the sample
c) Endothermicity or exothermicity of a phase transition
d) All the three above

1. B Objective questions (One mark each or otherwise stated)

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i) Match the following:

I	II
A) Pa. s	a) DTA
B) Pa	b) DSC
C) s^{-1}	c) TGA
D) Dimensionless quantity	d) Shear stress
E) E_a / R	e) Shear rate
F) Purity of a sample	f) Viscosity
G) ΔT	g) Strain
H) Gain in mass	h) Arrhenius equation

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ii) The permanent type of deformation of a material is recognized as

_____

iii) The capability of materials to change a typical behavior under frequent loading is known as _____

iv) The skill of a material to resist plastic distortion is termed as _____

v) The maximum load a wire can withstand without breaking, when its length is reduced to half of its original length, then it will _____

Define:

vi) Isotropy, **vii)** Hardness, **viii)** Storage modulus G_1

ix) _____ affects the mechanical properties of a material under applied load.

2. Short answer questions (Any Seven)

i) Define: Shear modulus (G) and Bulk Modulus (K).

ii) Distinguish: normal strain and shear strain.

iii) How extension and retraction differs in natural & synthetic rubber?

iv) Draw force-extension curve for a rubber under Hookean behavior.

v) Give two disadvantages of DTA

vi) $\ln(T_p/\beta) = -(E_a/RT) + C$ – identify the terms on left hand

vii) Define thixotropy.

viii) What is amplitude sweep?

ix) Name two phase transitions that are endothermic in nature.

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3. a) Discuss engineering components and present components of strain.

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b) Describe: Young Modulus (E) and Poison's ratio (υ)

OR

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3. For the finite deformation of an isotropic, incompressible solid called neo-Hookean, derive the equation: $F = 2\,C_1\{1 + e - (1 - 2e)\} = 6\,C_1$

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4. a) Characterize the Glassy and Viscoelastic, Rubbery behavior by plotting the logarithm of stress relaxation modulus G(t) against the logarithm of time (t).

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b) Define: Creep and Creep compliance $J(t)$.

OR

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4. Discuss in detail the Multi-Element Model.

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5. a) Explain how shear thickening and thinning differ from each other ?

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b) Colloidal gel shows a non-Newtonian behavior - *Justify*

OR

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5. Depict the elastic and sliding components of the displacement caused by shear stress, define strain, strain rate and stress.

6. a) Calculate the fraction of crystallinity of polyethylene sample which shows a T_m of 133° C from DSC measurements. The ΔH_f for the sample and 100 % crystalline polymer are 54.5 and 68.4 cal/g respectively.

b) Suppose the DSC of a polymer sample upon melting and cold crystallization, display T_m at 247°C, T_{c-c} at 101°C, ΔH_m and ΔH_{c-c} of 165 and 46.5 J/g, calculate the % crystallinity of the sample, by assigning ΔH_m of 140.1 J/g to a 100% crystalline polymer.

OR

6. Explain the principle involved and working of DSC along with detailed applications.

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