Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS / B.TECH (CT) / SEM-5 / CT-502 / 2010-11

2010-11

GLASS-I

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words

as far as practicable.

GROUP – A

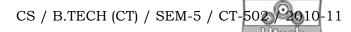### (Multiple Choice Type Questions)

1.   Choose the correct alternatives for the following : $10 \times 1 = 10$

   i)   Which of the following oxides is a good glass former ?

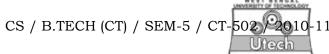   a) P_2O_5 b) Na_2O
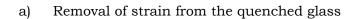
      c)   PbO   d) TeO_2.

ii) To favour heterogeneous nucleation the contact angle should be

   a) $\theta \leq 90°$ b) $\theta \leq 180°$

   c) $\theta \geq 180°$ d)   None of these.

iii) Which of the following glasses is not transparent ?

   a)   Borosilicate glass   b)   Aluminosilicate glass

   c)   Sodalime silica glass   d)   Se glass.

iv) For a good glass network former, the single bond strength should be

   a)   > 80 kcal/mol   b)   < 60 kcal/mol

   c)   < 40 kcal/mol   d)   none of these.

v) Refining of glass means

    a) Removal of strain from the quenched glass

    b) Dissolution batch particle during meeting

    c) Removal of glass bubbles from the glass melt

    d) None of these.

vi) The critical radius for nucleation is

    a) $\dfrac{3\gamma}{\Delta G}$ b) $\dfrac{2\pi\gamma}{\Delta G}$

    c) $\dfrac{\Delta G}{3\gamma}$ d) $\dfrac{2\gamma}{\Delta G}$.

vii) Splat cooling is essential for

    a) Silica glass preparation

    b) Organic glass preparation

    c) Metal glass preparation

    d) None of these.

viii) Which statement is incorrect ?
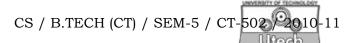
    a)   A slow rate of change of viscosity with temperature below T_m favours glass formation

    b)   Greater is the overlap between U vs T & I vs T curves, the easier is the glass formation

    c)   Cu is intentionally added in ruby red coloured glass ceramics

    d)   Any melt can be bought to a glass state by a more rapid cooling.

ix)   Which equation for critical cooling rate is correct ?

    a) $\left(\dfrac{dT}{dt}\right)_C = \dfrac{\Delta T}{t_m}$ b) $\left(\dfrac{dT}{dt}\right)_C = \dfrac{\Delta T}{t}$

    c) $\left(\dfrac{dT}{dt}\right)_C = \dfrac{\Delta T}{t_n}$ d)   none of these.

x) To increase brilliancy in Tableware which of the following oxides is added ?

    a)   BaO   b) Na_2O

    c) K_2O d)   PbO.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. Give the modern definition of glass. How does glassy state differ from crystalline solid and liquid ?   2 + 3

3. What is HMFG ? How is it prepared ?   2 + 3

4. What is critical cooling rate for glass formation ? Why are glass metals generally made in the form of tape or fibre ?

                                          3 + 2

5. Deduce the relation $\Delta G_x = \Delta T.\Delta H_f / T_m$, $\Delta G_x =$ free energy of capitalization, $\Delta H_f =$ heat of fusion, $T_m =$ melting temperature, $\Delta T = T - T_m$.

6. What is Boron anomaly ? Briefly describe how it is important in alkali borate glasses.　　　2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.　　3 × 15 = 45

7. What is kinetic theory of glass formation ? Calculate the critical radius (r^*) for nucleation with diagram of the energy change with radius (spherical nucleus). Draw the nucleation rate (I) *vs* temperature plot and explain the nature. How does viscosity under T_m control the nucleation rate & favour the glass formation ?　　3 + 6 + 3 + 3

8. Briefly describe the structural theory of glass formation based on Zachariesen's, Seen's & Rawson's hypotheses along with discripancies.　　3 × 5

9. Draw and describe the viscosity as a function of temperature plot of a sodalime silica glass melt and locate the strain point, working point & softening point. What are the significances of working range, annealing range in commercial glass production ? Define upper and lower annealing points in thermal expansion *vs* temperature plot of well annealed glass. Briefly describe rational viscometer.

6 + 3 + 3 + 3

10. Describe the structure of vitreous silica and borate glass in brief. Why does alkali oxide addition increase the thermal expansion and density of alkali silicate glass ? What is the role of alkaline earth oxides in the alkali silicate glass ? Calculate briefly bridging oxygen (BO) per tetrahedra in $20Na_2O.\ 80\ SiO_2$ (mol%) glass. $(2 \times 3) + 3 + 2 + 4$

11. Briefly describe the density and thermal expansion coefficient of glass sample. Mention the compositional effect, thermal history and phase separation / crystallization effect on the density of glass. $(3 \times 2) + 3 \times 3$

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