Multiple Choice Questions – Lecture 1

Only one answer per question is correct!!

1. Mention three network modifiers of oxide glasses:
   a. Na_2O, CaO, B_2O_3
   b. K_2O, Al_2O_3, Li_2O
   c. K_2O, CaO, Na_2O
   d. B_2O_3, Na_2O, SiO_2

2. The color of a glass is mainly determined by:
   a. The network modifying ions in the glass
   b. Multivalent ions in the glass, which have specific absorption bands in the visible spectrum. The glass has the same color as the absorbed light
   c. Multivalent ions in the glass, which have specific absorption bands in the visible spectrum. The glass color corresponds to the complementary wavelengths, not absorbed by the glass

3. The presence of the following ions have a large effect on the color of glass
   a. Na^+ ions
   b. Ca^{2+} ions
   c. Fe^{2+}ions
   d. K^+ ions

4. Which physical property of the raw material powders should be controlled in particular for obtaining an homogeneous batch, after mixing and transport to the furnace
   a. Density of the powder particles
   b. Grain size distribution of the powders
   c. Surface roughness of the particles
   d. Shape of the powder particles

5. The weight percentage of external cullet in raw materials batches
   a. May never exceed 50%
   b. Can be as high as 90%
   c. Is very high in float glass and glass wool production
   d. Is very low in container glass production

6. A LCD glass producer must select a type of boron raw material for its production. Which type of raw material should he select among:
   a. Boric Acid (H_3BO_3)
   b. Borax ($Na_2B_4O_7$-$10H_2O$)

7. The amber color of beer bottles (amber glass) is caused by:
   a. Cokes dissolved in the glass
   b. Reduced iron species in the glass (Fe^0 and Fe^{2+})
   c. Presence of sulfide (S^{2-}) and ferric iron (Fe^{3+}) in the glass
   d. Colloidal coloring by very small gold particles dispersed in the glass?

8. Why is a temperature above 35.4°C preferred for preparing (mixing) a soda-lime-silica raw material batch:
    a. Below this temperature, the soda is chemically very reactive and corrosive
    b. Below this temperature, the batch shows a too high apparent viscosity (batch is difficult to transport)
    c. Below this temperature, the batch will absorb CO_2 from the ambient atmosphere;
    d. Below this temperature, soda will absorb water from the batch and forms hydrated soda and starts to form lumps

9. The redox state of the glass is mainly determined by:
    a. Temperature of the furnace;
    b. Presence of organic materials in the raw material batch
    c. Amount of sand in raw material batch
    d. Amount of soda in raw material batch;
    e. Type of furnace
    f. Residence time in furnace

10. What type of sand is generally preferred in container or float glass production:
    a. A very fine sand, because it will decrease the required melting time';
    b. A very coarse sand, it will prevent carry-over and dusting;
    c. A sand with wide sand grain size distribution to have advantages of fine sand and coarse sand;
    d. A sand with a narrow sand grain size distribution, no very fine and no coarse sand grains.

<u>Extra exercise</u>: Calculation of a batch

A glass producer wants to produce a sulfate-fined borosilicate glass, using the dry raw materials with the oxide contents described below (composition given in mass %, or wt%).

% oxide (wt%)	SiO_2	B_2O_3	Na_2O	K_2O	CaO	MgO	Al_2O_3	SO_3	Fe_2O_3
Sand	99.95								0.05
Boric acid*		56.3							
Soda Ash (Na_2CO_3)*			58.5						
Dolomite* ($xCaCO_3.yMgCO_3$)					30.5	21.5			
Alumina							100		
Sodium sulfate (Na_2SO_4)			43.7					56.3	
Potash (K_2CO_3)*				68.0					

* the remainder to 100 wt% corresponds to melting losses (CO_2 or water)

The quantities of each raw material used by the producer to prepare his industrial batch are the following (NB: this batch recipe does not correspond to an actual composition used in the industry, it was randomly chosen for this exercise):

- Sand: 1000 Kg
- Boric Acid: 200 Kg
- Soda Ash: 120 Kg
- Dolomite: 200 Kg
- Potash: 20 Kg
- Alumina: 20 Kg
- Sodium sulfate: 7 Kg

Assuming that the sulfur retention in the glass melt is 50% (50% of the sulfur is lost during the fining process), calculate the composition of the glass obtained after melting of this batch.