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Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
(ONLINE)  
SEMESTER II  
SESSION 2020/2021**

**COURSE NAME : ENGINEERING POLYMER AND CERAMICS**

**COURSE CODE : BDB 40603**

**PROGRAMME CODE : BDD**

**EXAMINATION DATE : JULY 2021**

**DURATION : 3 HOURS**

**INSTRUCTION : ANSWERS ALL QUESTIONS**

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**THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES**

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- Q1** (a) Mr. Faisal would like to grind SiC powder with size 0.8 micron to the size of 0.3 micron. He uses alumina balls with diameter of 10 mm and 100 mm diameter ball mill for wet grinding technique. Use the gravity of  $9.81 \text{ ms}^{-2}$ .
- (i) Calculate the critical velocity for the grinding process. (4 marks)
- (ii) What is an appropriate estimation for the critical velocity if Faisal wants to use dry milling technique? (2 marks)
- (b) Analyse the similarity and differences between milling and mixing process? (4 marks)
- (c) Turbine rotor is one of the ceramic products. Gel casting has been applied as a forming technique to fabricate of the turbine rotor. Based on your knowledge in ceramic processing, arrange and explain the steps involve in the processing route of the turbine rotor. (10 marks)
- Q2** (a) Crack has been observed after drying process of a ceramic product. Examine the factors that need to be controlled in order to avoid defects on ceramic bodies during drying process. (6 marks)
- (b) Combustion chamber as shown in **Figure Q2 (b)** is a machine which injects powder into hot air and sprays it at a high temperature and a high speed through the nozzle. There is a temperature gradient of  $800^\circ\text{C}$  between the inside and outside of the device due to the cooling water that flowed on the outer circumference of the device. A dramatic increase in life expectancy of nozzles leads to reduced down time of equipment has been observed. In the past, a nozzle made of metal material was used in order to ensure thermal shock resistance. However, the nozzle degrade rapidly due to high speed operating and as a result, it need to be replaced after only 5 hours. Evaluate on how the application of advanced ceramics materials can overcome the problem of nozzle wear and degradation. Recommend the suitable advanced ceramic materials for the nozzle. (10 marks)
- (c) Mr. Faisal has decided to mill tungsten carbide (WC) powder using zirconia grinding bowl and balls. Predict the outcome of the grinding powder and give your opinion. (4 marks)
- Q3** (a) Mr. Firdaus uses uniaxial pressing method to form pellet for his testing samples. However, the pellets could not maintain its shape and broken when it is removed from the die. From your point of view, what is the cause of this problem? Suggest the actions that can be taken to overcome this problem? (5 marks)

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- (b) **Figure Q3 (b)** shows a binary phase diagram of materials A and B. A mixture has been sintered at certain temperature (refer to point X). What do you think is the type and mechanism of the sintering at point X? Support your answer with details explanation on the sintering mechanism. (10 marks)
- (c) Surface coating is one of the finishing processes for ceramic products. Select TWO (2) other techniques that can be applied for finishing process of ceramic products. (5 marks)
- Q4** (a) Styrene-butadiene rubber (SBR) is a suitable polymer material for lightweight vehicle tires. Correlate the SBR properties with the requirement characteristics of the tires application. (5 marks)
- (b) Recommend the suitable polymer materials for the fabrication of bullet proof vest that required high resistance. (5 marks)
- (c) You need to fabricate electric socket from urea formaldehyde (UF) material. Select the appropriate polymer processing method for the fabrication and explain in details. (10 marks)
- Q5** (a) Your polymer product has faced a catastrophic failure in its application. Suggest several steps that should be taken in improving the resistance of the polymer structure towards catastrophic failure. (10 marks)
- (b) Advanced polymers have been widely used in many engineering fields such as membranes for gas transport or diffusion. Correlate the membrane polymer properties or characteristics with its application in gas transport. (10 marks)

**-END OF QUESTION-**

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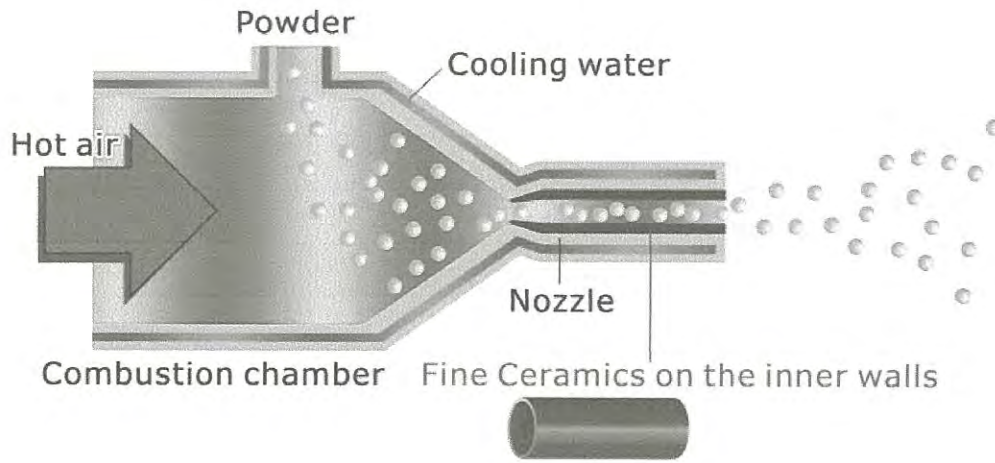
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**Figure Q2 (b)**

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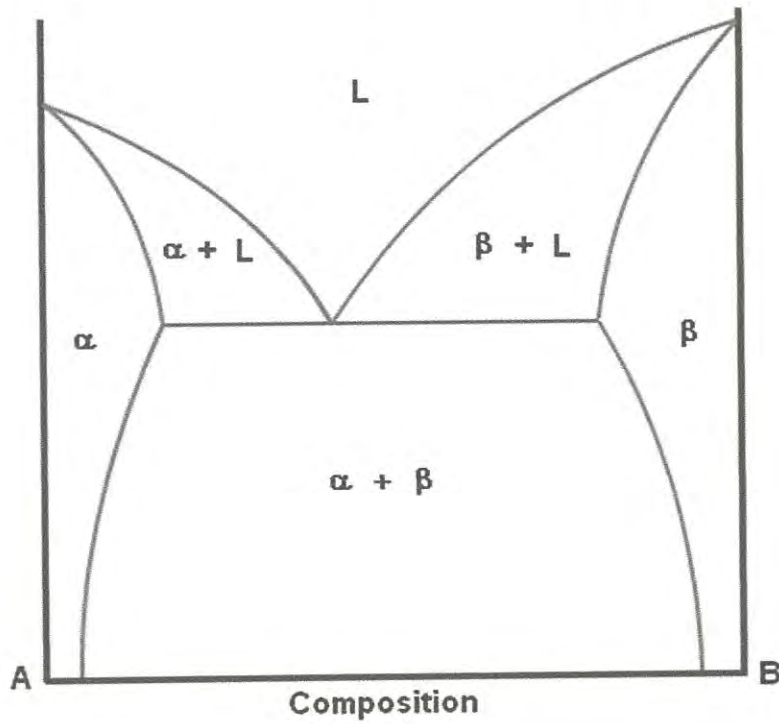


Figure Q3 (b)

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