

※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

1. What is the Hall effect? What is its major application in materials science? (5%)

- 2.(1) Which method(s) can increase the glass transition temperature (T_g) of polymer in general? (5%)
 - (a) Increase the molecular weight;
 - (b) Reduce the crosslinks;
 - (c) Add benzene;
 - (d) Increase the freedoms of motion of polymer chain.
 - (2) Which method(s) can increase the melting temperature (T_m) of polymer in general? (5%)
 - (a) Increase the molecular weight;
 - (b) Reduce the branching;
 - (c) Add benzene;
 - (d) Increase the freedoms of motion of polymer chain.

3. There is an interesting idea to make kitchen knife by zirconium oxide (ZrO_2), instead of steels. What are the benefits of ZrO_2 knife, compared with steel one? (10%)

4. Explain (including mechanisms) the temperature dependence of conductivity in metal and semiconductor materials, respectively. (6%)

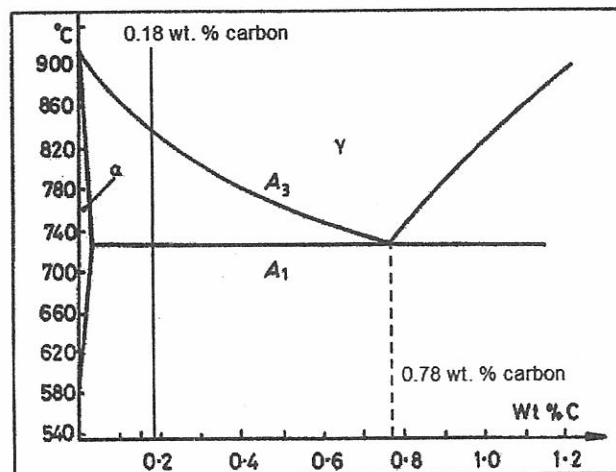
5. For the body-centered cubic (BCC) structure:
 - (1) Calculate its atomic packing factor (5%)
 - (2) Within a BCC unit cell, sketch and index one close-packed plane and one close-packed direction. (5%)
 - (3) What are the slip systems in BCC crystal? (5%)
 - (4) Why does BCC crystal have the ductile-to-brittle-transition temperature? (5%)

6. Write the chemical names and sketch the corresponding repeat unit structures for following polymers:
 - (1) PET (3%)
 - (2) PMMA (3%)
 - (3) PC (3%)

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7. The true stress-strain curve is meaningless after the ultimate tensile strength. Please comment the above statement (true or false & the reason). (5%)

8. Please clearly and logically describe an approach to obtain dual phase steel with 70 wt. % ferrite and 30 wt. % martensite in a Fe-0.18C (in wt. %) steel. Also, you will need to draw the microstructure evolution step by step. Please refer to the following phase diagram. (15%)



9. Briefly describe the characteristics of fracture surfaces for brittle fracture and ductile fracture in metals and alloys. (5%)

10. Explain why TiB₂ nanowire (r~20 nm) has much higher fracture stress than bulk TiB₂. (10%)

11. What is toughness? (5%)