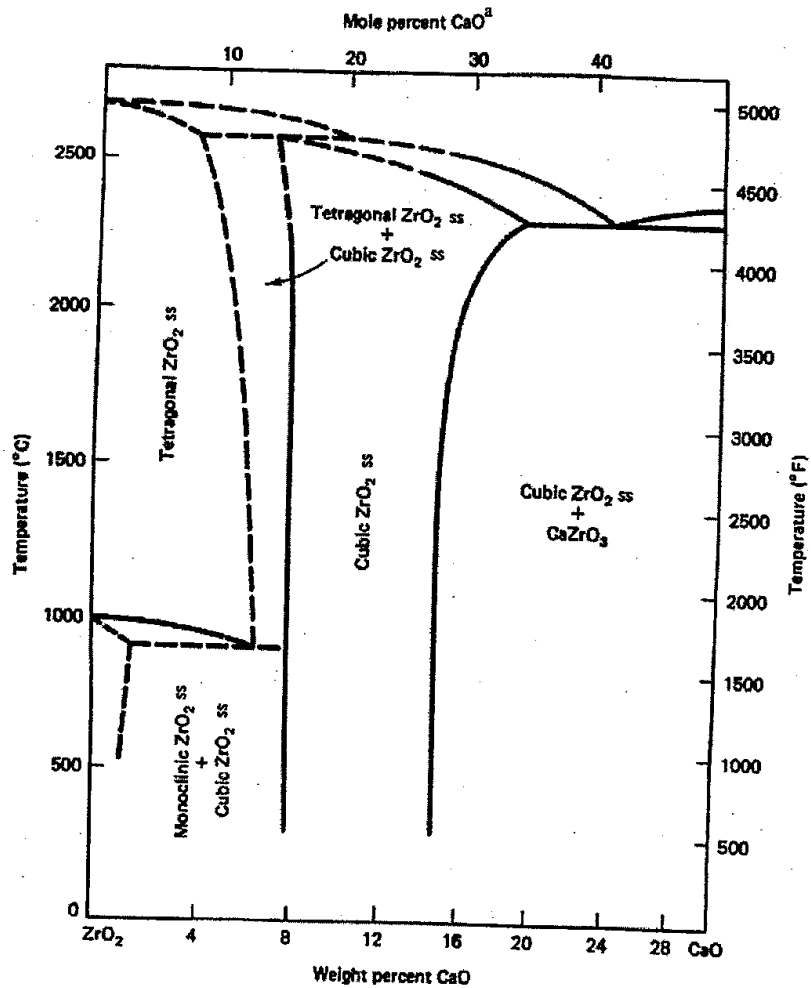


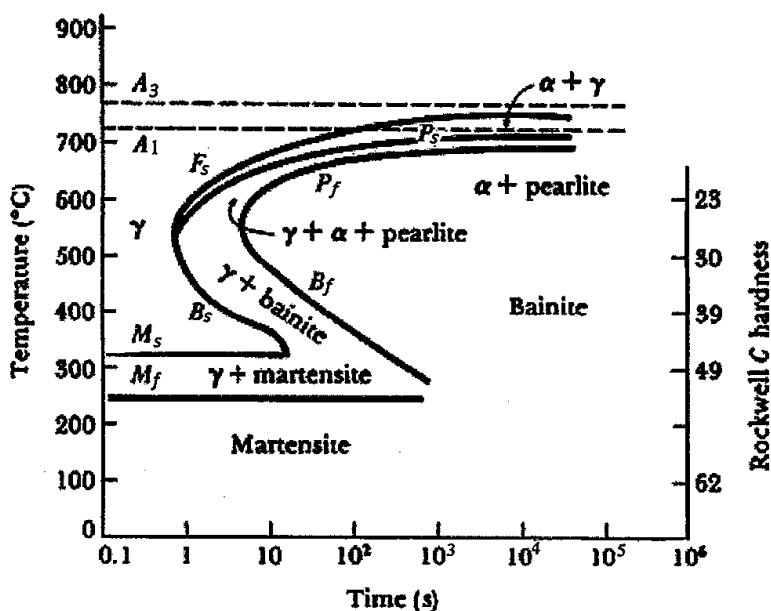
※ 注意：請於試卷上「非選擇題作答區」標明大題及小題題號，並依序作答。

1. For pure copper, one vacancy exists for roughly 1600 atoms at about 1080 °C (just below the melting temperature of copper). Say if you have a 100% pure copper coin of a diameter 19 mm. Determine the approximate number of vacancies in a (100) plane parallel to the coin faces at 1080 °C. (15%)  
(The atomic radius of copper is 0.1278 nm.)
  
2. The phase diagram of the CaO-ZrO<sub>2</sub> system is shown below. (20%)
  - (i) Identify where the peritectic reaction occurs and the solid phase(s) involved in the peritectic reaction.
  - (ii) Identify where the eutectoid reaction occurs and the solid phase(s) involved in the eutectoid reaction.



見背面

- Using the phase diagram of CaO-ZrO<sub>2</sub> shown above as an example, explain the toughening mechanism of partial stabilized ZrO<sub>2</sub> (PSZ). (15%)
- A 1050 steel is held at 800 °C for 1 h, quenched to 700 °C and held for 50 s, quenched to 400 °C and held for 20 s, and finally quenched to room temperature. What is the final microstructure of this steel? The TTT diagram for a 1050 steel is shown below. (15%)



- Draw the structure of polyisoprene (natural rubber). A stress of 6.9 MPa is required to stretch polyisoprene around a set of books. After 6 weeks, the stress acting on the rubber is only 6.75 MPa. How much stress will remain after one year? Explain the reason why the stress decreases over time. (20%)
- How many carriers are required to give a conductivity of 10<sup>4</sup> Ω<sup>-1</sup>·m<sup>-1</sup> in the exhaustion region of silicon? How many antimony (Sb) atoms would have to be added to silicon to produce such number of carriers? (15%)  
(The lattice parameter of diamond cubic silicon is 5.4307 × 10<sup>-10</sup> m.)