

Faculty of Engineering Prince of Songkla University

การสอบปลายภาคการศึกษาที่ 1

ปีการศึกษา 2554

วันที่ 10 ต.ค. 2554

เวลา 13:30-16:30 น.

วิชา 237-511 Advanced Metal Casting

ห้อง S201

คำสั่ง

- (1) เขียนคำตอบให้สมบูรณ์ทุกข้อเพื่อให้ได้คะแนนเต็ม
- (2) ให้เอา Calculator และ Dictionary เข้าห้องสอบได้
- (3) อ่านคำสั่งให้ละเอียด และตอบทุกคำถาม

| Question No. | Point | Result |
|--------------|-------|--------|
| 1 | 10 | |
| 2 | 30 | |
| 3 | 10 | |
| 4 | 10 | |
| 5 | 10 | |
| 6 | 10 | |
| 7 | 10 | |
| 8 | 10 | |
| | Total | |

$$\rho g H = \frac{1}{2} \rho v^2$$

$$t = \left[\frac{\pi \left(\frac{\rho_c \Delta H_f}{T_m - T_0} \right)^2 \frac{1}{k_m \rho_m c_m} \right] \left(\frac{V}{A} \right)^2$$

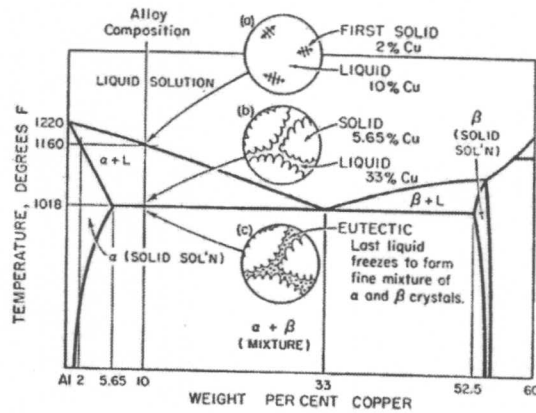
$$t = \frac{\rho_m \Delta H_f r}{h(T_m - T_0)}$$

$$Re = \frac{\rho V d}{\mu}$$

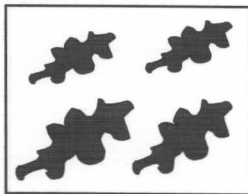
- Heat transfer coefficient (steel/liquid aluminium) = 2,000 W/m²/°C
- Heat transfer coefficient (brass/liquid aluminium) = 10,000 W/m²/°C
- Density of pure aluminium = 2,700 kg/m³
- Heat capacity of liquid aluminium = 1 kJ/kg/°C
- Heat of fusion of aluminium = 398 kJ/kg
- Heat capacity of sand = 0.6 kJ/kg/°C
- Viscosity of pure aluminium = 0.0013 Pa-s
- Heat content of LPG gas = 49.6 MJ/kg

- How much does it cost to melt 100 kg of aluminum with 100°C superheat using a crucible gas furnace [Given: Furnace efficiency = 30%; LPG gas price = 18 B/kg] (10 points)

2. Cast Metals and Solidification (30 points)



- If the microstructure contains 30% dendrite phase, how much copper is in this alloy (5 points)?

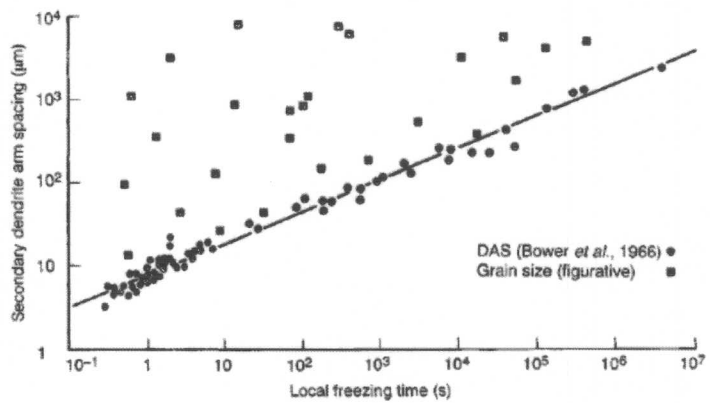
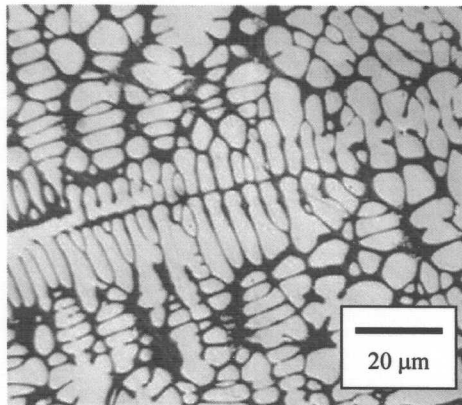


Name: _____

Student ID No: _____

b) Draw the cast microstructure for Al-25%Cu and also determine the % of dendrite phase (5 points).

c) Given below are a micrograph of an aluminum alloy and a DAS plot. Estimate the cooling rate of this sample assuming it is Al-10%Cu. [Hint: Use the given phase diagram] (5 points)



Name: _____

Student ID No: _____

- d) Given below, the schematics show the growth of a solid particle from a sphere to a dendrite. Use your knowledge to explain how this growth occurs. [Hint: It involves *solute*...] (5 points)



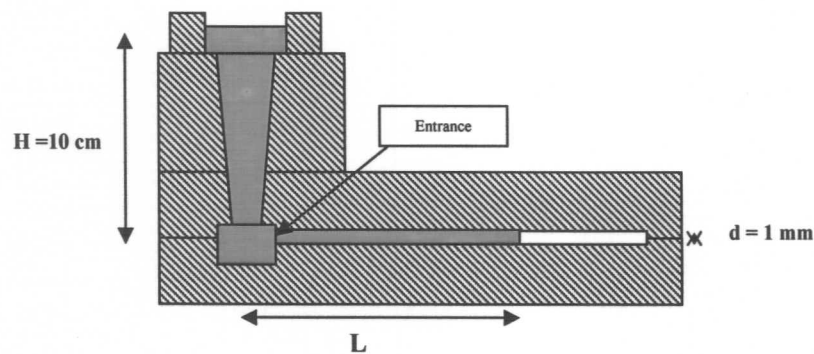
- e) Given below, the schematics show the growth of a solid particle from a dendrite to a sphere. Use your knowledge to explain how this growth occurs. [Hint: It involves *solute*...] (5 points)



- f) Clearly explain the following nucleation mechanism (5 points).
a. Dynamic nucleation

3. Fluid Flow (10 points)

- a) This mold is made of steel and it is at 200°C . The metal is pure aluminum. Answer the following questions:



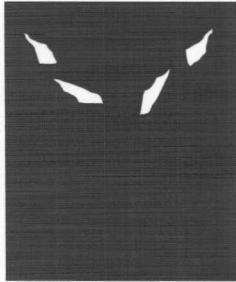
- i) At the "Entrance," is the flow of the liquid metal laminar or turbulent? Explain your answer clearly (5 points).

- ii) If we pour the metal with the temperature of 720°C , how far the metal will flow ($L = ?$) (5 points)?

Name: _____

Student ID No: _____

4. Some porosity is found in a casting as shown below. Explain methods to solve the porosity (10 points).



5. Explain 5 (five) ways oxide films are incorporated into castings? (10 points).

Name: _____

Student ID No: _____

6. Explain the reasons why fine dendrites are preferred over coarse dendrites? (10 points).

7. Explain how inclusions such as oxide films or sludge have effects on the mechanical properties such as yield strength, tensile strength, ductility, fracture toughness, and fatigue. (10 points)

Name: _____

Student ID No: _____

8. Identify 5 bad designs, also explain why they are bad and recommend the modifications.
(10 points)

