

## Faculty of Engineering Prince of Songkla University

การสอบกลางภาคการศึกษาที่ 2

ปีการศึกษา 2552

วันจันทร์ที่ 21 ธันวาคม 2552

เวลา 13:30 – 16:30 น

วิชา 237-302 Metal Forming

ห้องหัวหูน

ผู้ออกข้อสอบ ผศ.ดร. เจษฎา วรรณสินธุ์

### คำสั่ง

- (1) เขียนคำตอบให้สมบูรณ์ทุกข้อเพื่อให้ได้คะแนนเต็ม
- (2) ไม่อนุญาตให้นำเอกสารทุกชนิดเข้าสอบ เว้นแต่ กระดาษ A4 1 แผ่น เครื่องคิดเลข และ Dictionary เข้าสอบได้
- (3) ให้ตรวจสอบข้อสอบให้เรียบร้อยก่อนสอบ หากมีข้อสงสัย ให้ถามอาจารย์คุมสอบได้
- (4) ข้อที่มีการคำนวณ ใช้ข้อมูลที่ให้ไว้ในหน้านี้

**ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริตและพักการศึกษา 1 ภาคการศึกษา**

Question No.	Point	Result
1	15	
2	15	
3	20	
4	10	
5	20	
6	20	
	Total	

- Heat transfer coefficient (steel/liquid aluminium) = 2,000 W/m<sup>2</sup>/°C
- Heat transfer coefficient (brass/liquid aluminium) = 10,000 W/m<sup>2</sup>/°C
- Density of pure aluminium = 2,700 kg/m<sup>3</sup>
- 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

Name: \_\_\_\_\_ Student ID No: \_\_\_\_\_

**1. Melting Furnaces (15 points)**

a) For melting zinc alloys, which furnace is the most suitable: crucible furnace, cupola furnace, or arc furnace? Explain your reason clearly.

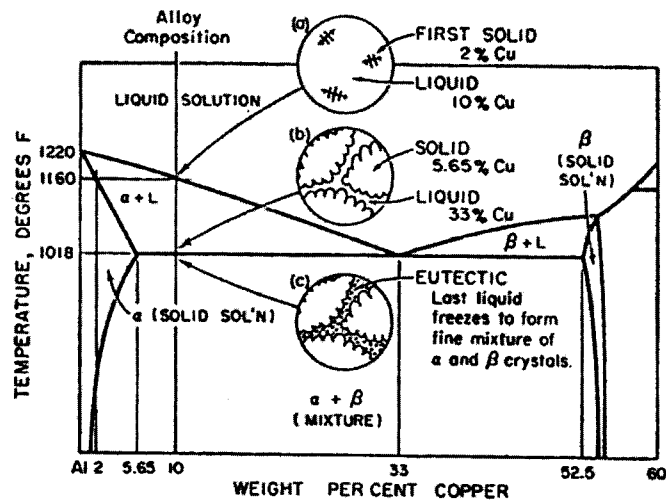
b) Explain the key advantages of hot chamber die casting when compared with cold chamber die casting.

**2. Defects (15 points).**

a) What is microsegregation defect? Also explain how to solve it.

b) What is hot tearing defect? Also explain how to solve it.

**3. Fundamentals (20 points).**

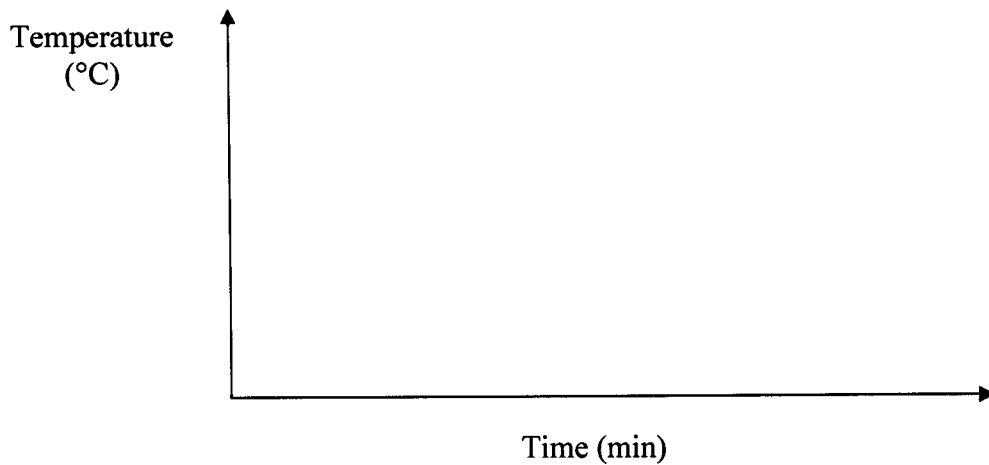


- Draw the final microstructure of an Al-1%Cu alloy solidified in a sand mold. Explain all the phases. (5 points)
- For an Al-20%Cu alloy solidified very slowly, draw the final microstructure (5 points)
- For an Al-20%Cu alloy solidified very slowly, approximately how much alpha phase is in the microstructure.
- For an Al-20%Cu alloy solidified very slowly, approximately how much copper (wt%) is at the middle of the alpha phase? (5 points)

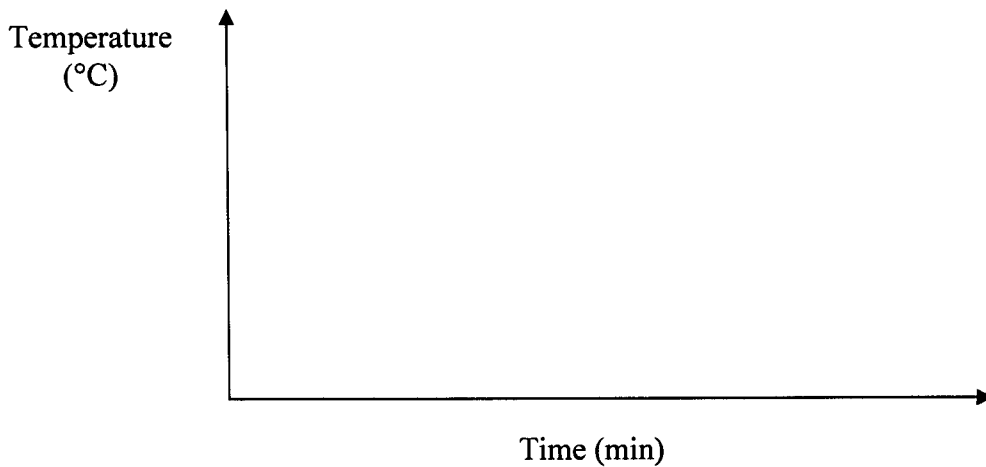
Name: \_\_\_\_\_ Student ID No: \_\_\_\_\_

**4. Cast Metals (10 points)**

a) Draw a cooling curve of a pure aluminum metal solidifying slowly in a graphite crucible. Include as much detail as possible such as the melting point. (Note: There is a 10°C undercooling) (5 points).

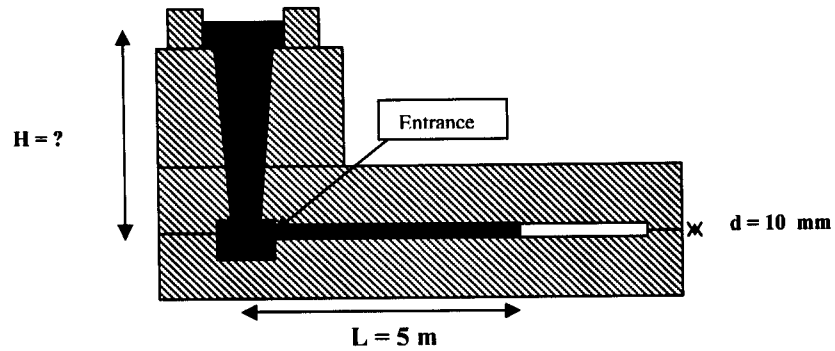


b) Draw a cooling curve of Al-20%Cu alloy solidifying slowly in a graphite crucible. Include as much detail as possible such as the liquidus, solidus, or eutectic temperatures. (Note: There is a 10°C undercooling) (5 points).



**5. Fluidity (20 points).**

This mold is made of steel and it is at  $200^{\circ}\text{C}$ . The metal is pure aluminum. Answer the following questions:



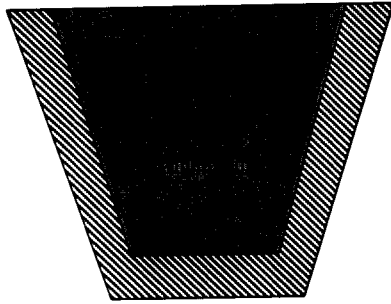
- i) If we pour the metal with the temperature of  $700^{\circ}\text{C}$  and the metal flows for the length of  $0.5\text{ m}$  before stopping. How much the metal head must be ( $H = ?$ ) (5 points)?
- ii) At the "Entrance," is the flow of the liquid metal laminar or turbulent? Explain your answer clearly (5 points).

Name: \_\_\_\_\_ Student ID No: \_\_\_\_\_

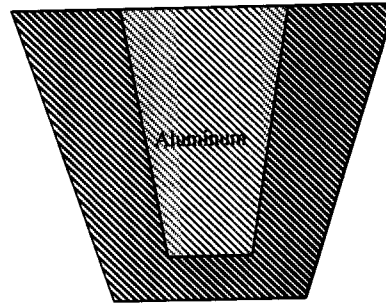
**6. Others (20 points).**

- (a) Which case (A or B) of the sample will give better tensile properties? Explain clearly why. (10 points)

Conditions: aluminum alloy is poured at the same temperature of 700°C. The metal mold is at the same temperature of 200°C



(A)



(B)

- b) Explain clearly 3 methods to reduce hot spots in a casting. (10 points)