

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

## Faculty of Engineering Prince of Songkla University

การสอบกลางภาคการศึกษาที่ 2

ปีการศึกษา 2551

วันจันทร์ที่ 22 ธันวาคม 2551

เวลา 13:30 – 16:30 น

วิชา 237-302 Metal Forming

ห้อง A201

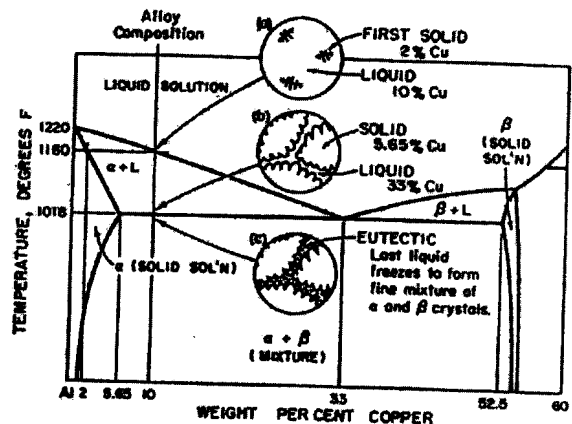
ผู้ออกข้อสอบ ดร. เจษฎา วรรณสินธุ์

### คำสั่ง

- (1) เขียนคำตอบให้สมบูรณ์ทุกข้อเพื่อให้ได้คะแนนเต็ม
- (2) ไม่อนุญาตให้นำเอกสารทุกชนิดเข้าสอบ แต่ นำเครื่องคิดเลข และ Dictionary เข้าสอบได้
- (3) ข้อที่มีการคำนวณ ให้ข้อมูลที่ให้ไว้ในหน้านี้

**ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริตและพักการศึกษา 1 ภาคการศึกษา**

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

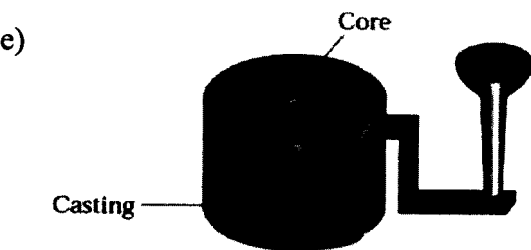
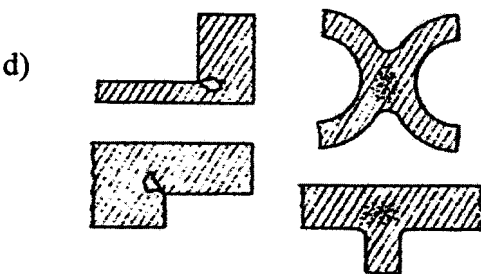
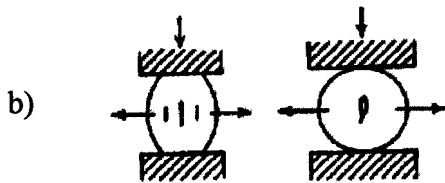
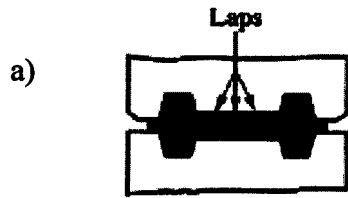


### Useful Equations and Data:

<p>Conservation of Energy:</p> $\rho g H = \frac{1}{2} \rho v^2$ <p>Solidification time in sand mold:</p> $t = \left[ \frac{\pi \left( \frac{\rho_c \Delta H_f}{T_m - T_0} \right)^2 \frac{1}{k_m \rho_m c_m}}{A} \right] V^2$ <p>Solidification time in steel mold:</p> $t = \frac{\rho_m \Delta H_f r}{h(T_m - T_0)}$	<ul style="list-style-type: none"> <li>■ Thermal conductivity of steel = 20 W/m°C</li> <li>■ Heat capacity of steel = 0.5 kJ/kg°C</li> <li>■ Heat transfer coefficient (steel/liquid aluminium) = 5,000 W/m²°C</li> <li>■ Cost of energy = 0.01 baht/kJ</li> <li>■ Density of pure aluminium = 2,700 kg/m³</li> <li>■ Heat capacity of liquid aluminium = 1 kJ/kg°C</li> <li>■ Heat of fusion of aluminium = 398 kJ/kg</li> </ul>
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1. **Defects (20 points).**

Explain the causes of the defects and how to solve the problems.



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**2. Metal Casting Processes (20 points).**

(a) Explain how an induction furnace works. Make a sketch and explain. (5 points)

(b) Explain how an investment casting is conducted. Also, make a sketch. (5 points)

(c) How much does it cost to melt 500 kg of pure aluminium and hold the temperature at 750°C in a furnace? (10 points)

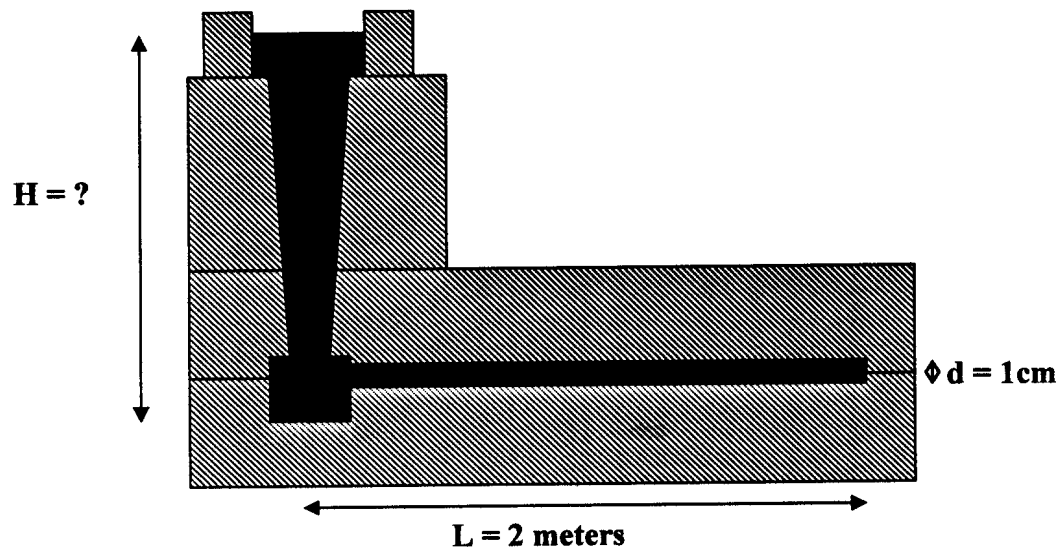
(Given: aluminium is at 25°C and the melting point is at 660°C)

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**3. Fundamentals of Metal Casting (20 points).**

Calculate how tall the metal head (H) has to be to give the metal fluidity length of 2 meters in this steel mold. (20 points)

(Given: the steel mold is at 25°C. The metal is pure aluminum poured at 700°C)



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**4. Solidification (20 points).**

- (a) What is a secondary dendrite arm spacing (SDAS)? Sketch and explain briefly. (5 points)
- (b) Explain 2 methods to get fine SDAS? (5 points)
- (c) For an Al-20%Cu alloy, what is approximately the amount of copper near the perimeter of the dendrite? (Also draw lines on the phase diagram) (5 points)
- (d) For an Al-45%Cu, what is approximately the amount of copper near the center of the dendrite? (Also draw lines on the phase diagram) (5 points)

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**5. Casting Design and Casting Testing (20 points)**

(a) What are two (2) methods to eliminate “Hot Spots” in casting (5 points)

(b) Explain clearly two (2) methods to test for internal defects (5 points)

(c) Identify 2 design problems on this drawing. Explain what the problems are and how to solve the design problems. (10 points)

