Name:_____Student ID No:_____

Faculty of Engineering
Prince of Songkla University

การสอบกลางภาคการศึกษาที่ 2   ปีการศึกษา 2549

วันเสาร์ที่ 16 ธันวาคม 2549   เวลา 13:30 – 16:30 น

วิชา 237-302   ห้อง A201

ผู้ออกข้อสอบ ดร. เจษฎา วรรณสินธุ์

คำสั่ง

  (1) เขียนคำตอบให้สมบูรณ์ทุกข้อเพื่อให้ได้คะแนนเต็ม

  (2) ไม่อนุญาตให้นำเอกสารทุกชนิดเข้าสอบ ยกเว้นเครื่องคิดเลข และ Dictionary

  (3) ให้ตรวจสอบข้อสอบให้เรียบร้อยก่อนสอบ

  (4) ข้อที่มีการคำนวณ ใช้ข้อมูลที่ให้ไว้ในหน้านี้

<u>ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริตและพักการศึกษา 1 ภาคการศึกษา</u>

Question No.	Point	Result
1	13	
2	17	
3	25	
4	10	
5	10	
6	25	
	Total	

Useful Equations and Data:

$$A_1V_1 = A_2V_2$$

$$\rho gH = \tfrac{1}{2}\rho v^2$$

$$t = \left[\frac{\pi}{4}\left(\frac{\rho_c \Delta H_f}{T_m - T_0}\right)^2 \frac{1}{k_m \rho_m c_m}\right]\left(\frac{V}{A}\right)^2$$

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

$$F = Y_f \pi r^2 \left(1 + \frac{2\mu r}{3h}\right),$$

- Thermal conductivity of steel = 20 W/m/°C
- Heat capacity of steel = 0.5 kJ/kg/°C
- Heat transfer coefficient (steel/liquid aluminium) = 3,000 W/m^2/°C
- Cost of energy = 0.01 baht/kJ
- Density of pure aluminum = 2,700 kg/m^3
- Heat capacity of liquid aluminum = 1 kJ/kg/°C
- Heat of fusion of aluminium = 398 kJ/kg
- Heat capacity of sand = 0.6 kJ/kg/°C
- Density of sand = 2,000 kg/m^3
- Thermal conductivity of sand = 1 W/m/°C

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1. **Explain the following terms (13 points):**

a) **Arc-Melting (3)**

b) **Segregation (4)**

c) **Pin hole (3)**

d) **Flash (3)**

2. **Answer the following questions (17):**

(a) Explain 2 ways to get fine grain size in casting processes. (2 points)

(b) Explain how to eliminate microsegregation from casting parts. (3 points)

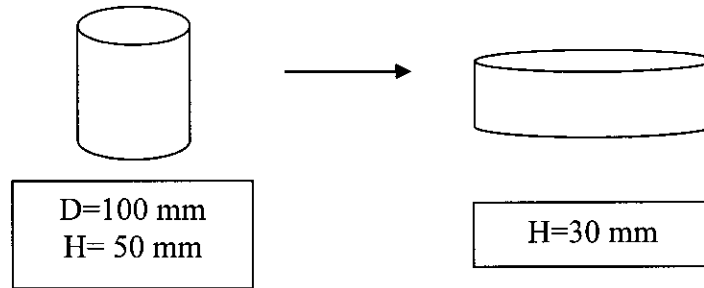(c) Draw a picture showing "Fillet Radii" and "Corner Radii." Also identify these radii. (2 points)

(d) In die casting dies, why do we need ribs or fins? (3 points)

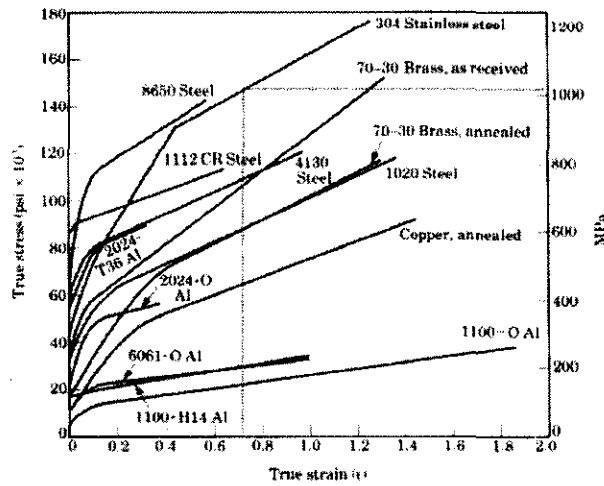(e) Give 2 defects that reduce ultimate tensile strengths of casting parts (2 points)

(f) Give 3 casting defects that radiography or x-ray can detect. (3 points)

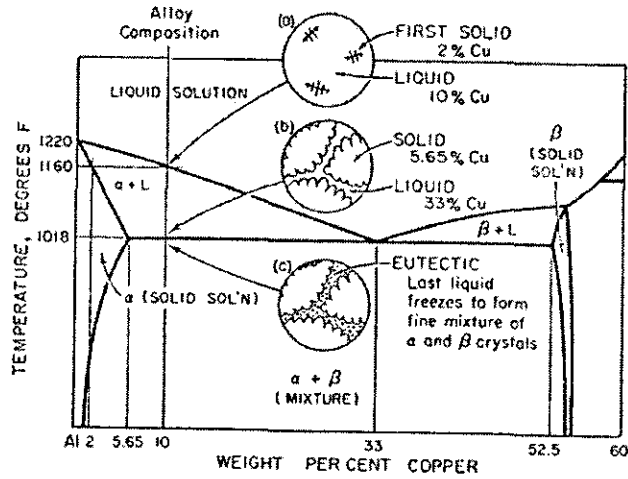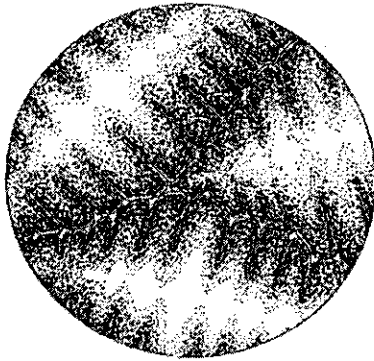(g) Give 2 benefits of **fine** dendrite arm spacing. (2 points)

3. **At your company, there is a hydraulic forging machine with the maximum load of about 350 Tons. Your company needs to forge cylindrical parts to reduce the height as shown below:**

D=100 mm
H= 50 mm

H=30 mm

With the machine you have and the friction coefficient of 0.1, your manager wants to know what are the metals that can be forged. Using the given plot below, list the metals that can be forged. Give your reasons by showing the calculations. (25 points)

True strain (ε)

4. Given is the microstructure of an Al-10%Cu alloy solidified in an iron mold and the phase diagram. Answer the following equations: (10 points)

i) What is approximately the amount of copper near the center of the dendrite? (5 points)

ii) What is approximately the amount of copper outside the dendrite? (5 points)

5. To get good mechanical properties, it is recommended that metal mold is used as the mold materials instead of sand mold. Explain clearly why? (10 points)

6. **Calculate how far the metal can flow before it solidifies in this <u>sand mold</u>. (25 points)**

(Given: the sand mold is at 25°C. The metal is pure aluminum poured at its melting point.)