University of Saskatchewan
College of Engineering
Dept. of Mech. Engineering
ME 330.3 Final Exams
April 2007

Time: 2 Hours **Instructors: Chris Zhang**
Open Book Exam.

Name: _____

Student Number: _____

This exam question set consists of **two** parts. Part I consists of **14** questions. Part II consists of **3** questions.

Attempt all questions**.**

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Part I (48 marks)

Question I.1
In the phase diagram (element A and element B), if a particular composition of the material which consists of A and B is given, can you determine the phase of the material with this composition? Why?

Question I.2
Is there any use of the phase diagram for heat treatment? How and why?

Question I.3
What are the carbon contents for the steel and cast iron, respectively? Why is the steel generally more ductile than the cast iron?

Question I.4
Quenching is a kind of heat treatment to make the material hard and strong. What is the mechanism underlying the quenching process for the steel? Whether is this mechanism applied to Aluminum and Why?

Question I.5
What is the difference between hardenability and hardness? What is the mechanism that alloying could increase the hardenability?

Question I.6
Fig. 1 shows a casting product. The small hole is **not** as a design feature; it is made with consideration of something related to the casting process. What is the purpose of this hole and why?

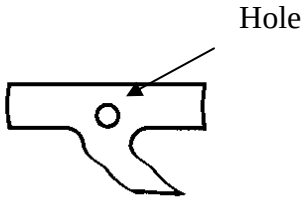

Fig. 1

Question I.7
What is the nature of rapid prototyping (RP) technology? Why does the RP technology usually make use of plastic materials? What is about the strength of the RP product and why so?

Question I.8
List two conflicting goals when determining the tolerance and explain why they are conflicting.

Question I.9
Are the tolerance and clearance the same thing? Why?

Question I.10
What is the main mechanics cause for die swell?

Question I.11
Here is a specification of fit between a hole and a shaft: 50 G7 /h8. Suppose that we increase 50 to 100 and we then have a specification denoted as 100 G7 /h8. Would you expect that the tolerance for the basic size 100 be larger than the tolerance for the basic size 50? why? (b) Suppose that we change the specification from 50 G7 / h8 to 50 G7 / h5. Do you think that we would change the nature of the fit and why?

Question I.12

Equation (1) is related to the rolling process, while Equation (2) is related to the drawing process.

$$\varepsilon = \ln \frac{t_0}{t_f} \quad (1)$$

$$\varepsilon = \ln \frac{A_0}{A_f} \quad (2)$$

Please explain how these two equations come from.

Question I.13

In casting system design, what is called pouring temperature? How can the phase diagram help in determining the pouring temperature and why?

Question I.14

Fig. 2 shows a sketch of a cavity for casting. Suppose that the cavity can be divided into two regions which are defined by the volume-to-surface ratio (V/A). Where should a riser be located (right or left) if $(V/A)_1<(V/A)_2$? Why?

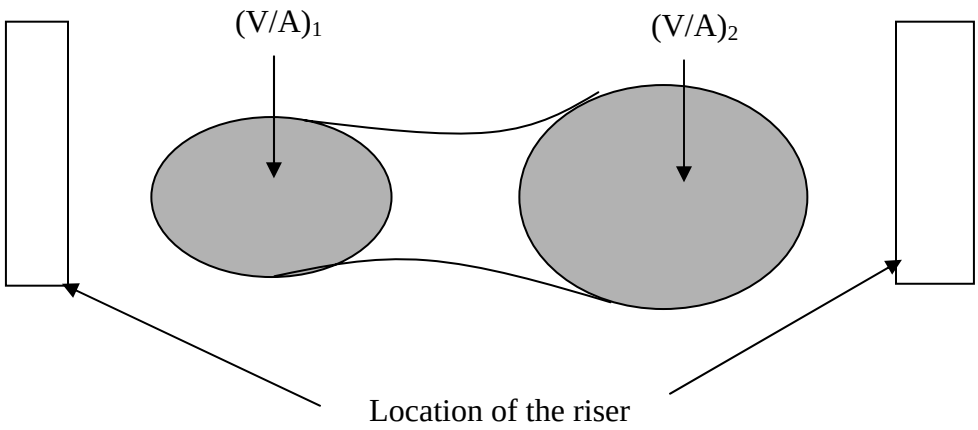

Fig. 2

Part II (52 marks)

Question II.1 (20 marks)

There is a casting product with the following geometry: rectangular plate with 2 in. by 4 in. by 6 in (see Fig. 3). We concern to design a riser for this casting product. We place the riser on the top of the plate. The riser has a cylindrical form. We assume that following information is known: (1) The total solidification time of the casting product (T_{cast})=1.6 minutes, and (2) The total solidification time of the riser (T_{riser}) is 25% longer than T_{cast}.

Please do the following:

(a) State the desired or optimal riser design;
(b) Write the equation to express the desired riser design;
(c) Determine what should be the relationship between the diameter and the height of the riser following the desired or optimal riser design concept;
(d) Determine the dimension of the optimal or desired riser and validate it.

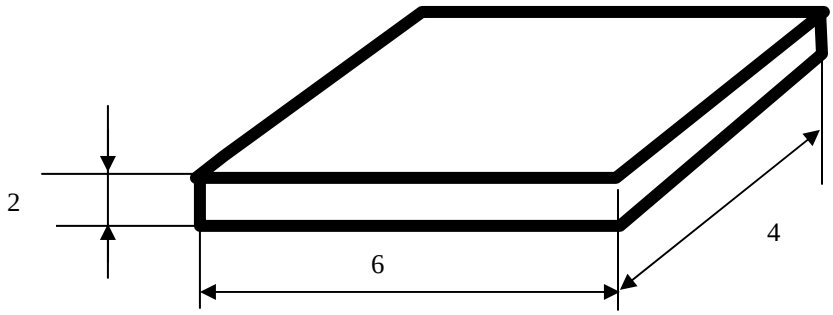

Fig. 3

Question II.2 (20 marks)

An extruder has a barrel diameter=5.0 in. and length=12 ft. The extruder screw rotates at 50 rev/min; it has channel depth=0.30 in. and flight angle=17.7^{o}. The plastic melt has a shear viscosity=100 x 10^{-4} lb-sec/in^{2}. The head pressure at the end of the barrel p=1000 lb/in.^{2}. Please do the following:

(a) Find the extruder characteristic,
(b) Determine the operating point,
(c) Determine the die characteristic, and
(d) Explain the variable or parameter to measure the productivity of the extrusion process in general and to discuss two ways to increase the productivity for this particular extrusion process (i.e., their pros and cons).

Question II.3 (12 marks)

The capacity of the drawing process is limited. Please do the following:

(a) Explain what those limiting factors are for the drawing process.
(b) Derive Equation (3) (e: natural logarithm) and state the assumptions behind your derivation.

$$\frac{A_0}{A_f} = e \qquad (3)$$

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