

**University of Saskatchewan
College of Engineering
Dept. of Mech. Engineering
ME 330.3 Final Exams
April 2009**

**Time: 2 Hours
Open Book Exam.**

Instructors: Chris Zhang

Name: _____

Student Number: _____

This exam question set consists of two parts. Part I consists of 10 questions. Part II consists of 3 questions. Attempt all questions.

Part I (40 marks)

Question I.1

In specifying the tolerances of a pair of parts to be assembled, please make one choice from the following:

- (a) Considering the functionality of the assembly only.
- (b) Considering the cost of parts manufacturing only.
- (c) Considering both (a) & (b), as they can likely conflict to each other.
- (d) Considering both (a) & (b), as they are always consistent to each other.

Question I.2

The following are tolerance specifications for a pair of two parts that are to be assembled.

- (1) 40H7/f8, (2) 50H7/f8, (3) 50H8/f8, (4) 50G8/h7

Please choose T/F among the following statements:

- (a) 50 G8/h7 is based on the basic hole system
- (b) The tolerance of the hole in (1) is larger than that of the hole in (2)
- (c) The tolerance of the hole in (2) is larger than that of the hole in (3)
- (d) The tolerance specification in (4) is a clearance fit

(T/F)
(T/F)
(T/F)
(T/F)

Question I.3

ISO has a document called ISO 9000 and ISO 9001. Choose the most correct one (only one) among the following lists:

- (a) ISO 9000 demands a company to purchase high-end metrology instrument for quality inspection.
- (b) ISO 9000 is a standard about the quality management practice of a company.
- (c) To get the ISO 9000 certificate, you need a well-defined quality inspection laboratory.
- (d) ISO 9000 is a standard for big company.

Question I.4

In the machining operation, productivity is measured by the multiplication of three parameters, v (cutting speed), f (feed rate), and d (depth of cut), namely productivity is (v)(f)(d). Please choose T/F among the following statements:

- (a) Such a productivity formula is only applicable to the lathe machining tool
- (b) There should be also a tool life in determining the machining productivity
- (c) Such a productivity is only used in WIDIA manual
- (d) WIDIA manual can only be used for the German standard system
- (e) WIDIA only considers the situation that the tool life is 15 minutes
- (f) Material imperfection has not been considered in WIDIA manual
- (g) Machining imperfection has not been considered in WIDIA manual
- (h) The term used in WIDIA manual called "approach angle" is new to our text used

(T/F)
(T/F)
(T/F)
(T/F)
(T/F)
(T/F)
(T/F)
(T/F)

Question I.5

The following equation is related to the metal rolling process. Please derive it from the general metal forming formula such as $\epsilon = \ln \frac{L_f}{L_0}$.

$\epsilon = \ln \frac{t_0}{t_f}$ true strain.

given $\epsilon = \ln \left(\frac{l}{l_0} \right)$

$\frac{l}{l_0} = r = \frac{d}{t_0}$ when $d = t_0 - t_f$

$r = \frac{t_0 - t_f}{t_0} \Rightarrow r = 1 - \frac{t_f}{t_0} \Rightarrow$

$\epsilon = \ln(r) \Rightarrow \epsilon = \ln \left(1 - \frac{t_f}{t_0} \right)$

$\epsilon = \ln(1) - \ln \left(\frac{t_f}{t_0} \right)$

$\Rightarrow \epsilon = \ln \left(\frac{t_0}{t_f} \right)$

Question I.6

The following is the equation which describes the average flow stress over a period of deformation. Please derive it.

$$\bar{Y}_f = \frac{k\varepsilon^n}{1+n}$$

$$\bar{Y}_f = \frac{\int Y_f d\varepsilon}{\varepsilon} \Rightarrow \frac{\int_0^\varepsilon K\varepsilon^n d\varepsilon}{\varepsilon}$$

$$\bar{Y}_f = \frac{K\varepsilon^{n+1}}{\varepsilon(n+1)} \Big|_0^\varepsilon \Rightarrow \bar{Y}_f = \frac{K\varepsilon^{n+1}}{\varepsilon(n+1)}$$

Question I.7

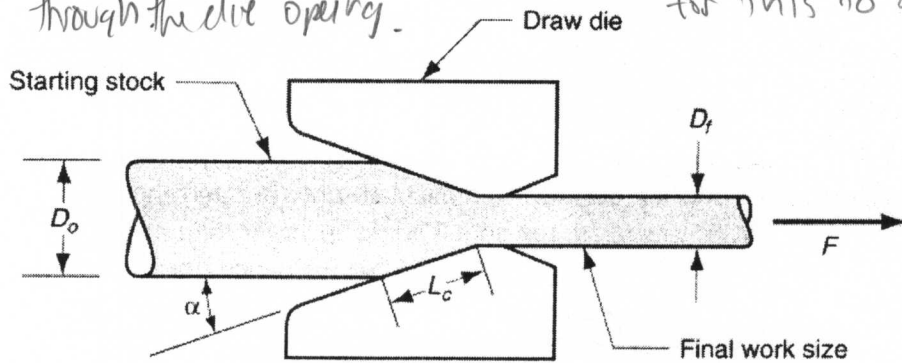
In shaping processes for plastics especially a process called extrusion. There is a concept called "die swell". Is there a similar concept in the metal forming process such as drawing process? Why Yes/No?

If refer to the viscoelasticity of the material, as it is pressed through the die it does not immediately relax, only partially. So the extruded material "remembers" some of its original size and expands back to that size.

Question I.8

In the metal drawing process (see the following figure), there is a concept which says: the maximum stress in the metal should be less than the yield stress, as otherwise the metal will be just pulled out without any need of driving force (F). But on the other hand, the drawing process is a kind of the general metal forming process which requires that the stress in the metal should be over the yield of the metal to induce permanent deformation. Is there any conflict? Why Yes/No?

if the draw stress exceeds the yield strength of the exiting material the draw wire will simply elongate instead of new material being squeezed through the die opening. for this to be successful



Maximum draw stress must be less than the yield strength of the exiting material.

Question I.9

Choose true (T) or false (F) from the following list of statements:

- (a) Aluminum is usually poor for casting process in comparison with cast iron
- (b) Casting process is generally not applied to aluminum

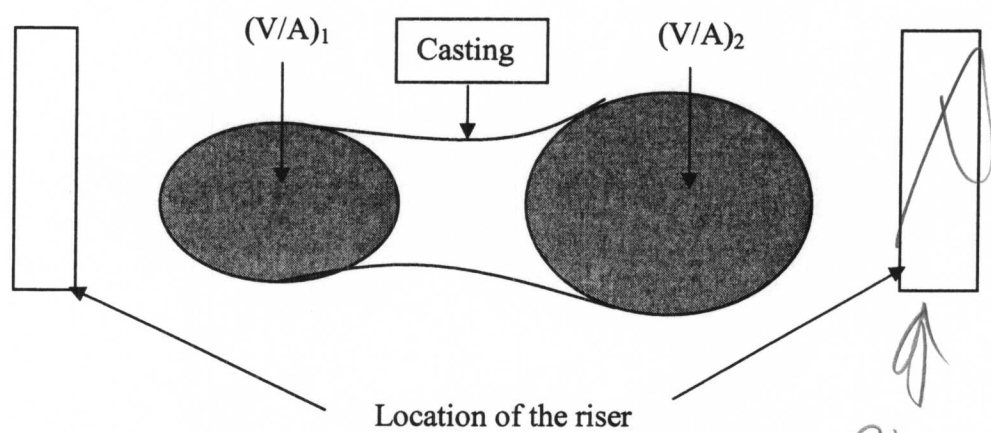
(T/F)
(T/F)

- (c) Aluminum can be strengthened based on the same principle as applied to steel
- (d) Industrial norm process for surface treatment of aluminum is painting
- (e) Powder metallurgy process can be applied to any kind of material except ceramics
- (f) Riser has a similar function as sprue in casting
- (g) Powder metallurgy process is a kind of rapid prototyping process

(T/F) analysis
 (T/F)
 (T/F) - plus
 (T/F)
 (T/F)

Question I.10

The following figure 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 Yes/No?



The riser should be placed furthest away from the smaller V/A ratio, as $(V/A)_1$ will freeze first. If the riser is placed on the left and $(V/A)_2$ freezes first there is a risk of the section not allowing flow from the riser to $(V/A)_2$ or cracking due to stresses.

Place riser here.

Part II (60 marks)

Question II.1 (20 marks)

Fig. 1 shows a casting product with the following geometry: rectangular plate with 2 in. by 4 in. by 6 in. There is a riser to be placed on the top of the casting, and the riser has a cylindrical form with H representing its height and D representing its diameter. It is desired that the volume of the riser should be designed as small as possible, as the riser will be cut as a waste after the casting is done. The following information is given: (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} . We further assume that for the riser, H is twice D . Please do the following:

- Determine the geometry of the riser for a minimum volume of the riser.
- Discuss whether the volume of the riser should increase or decrease when the riser is placed on the side of the casting instead of being on the top of the casting.

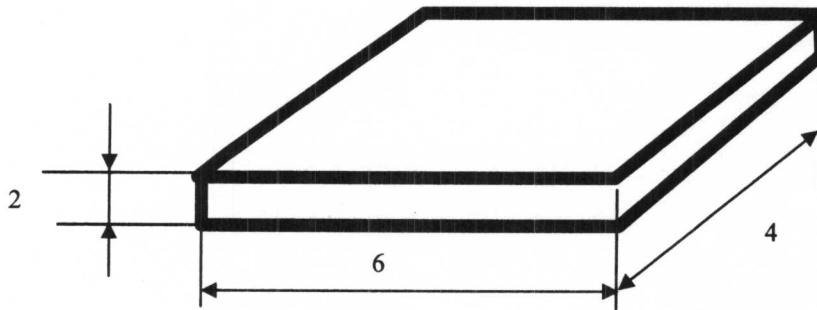


Fig. 1

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°. The plastic melt has a shear viscosity= 100×10^{-4} lb-sec/in². The head pressure is measured and found to be 1000 lb/in.². Please do the following:

- Determine the extruder characteristic.
- Determine the operating point.
- Discuss any possibility to double the flow rate.

