kafrelshiekh University	*Theories And Tech. of Metal Forming*
Faculty of Engineering	*Third Year*
Mech. Design & prod.Eng. Dept.	*Time:3 hours*
Final First Term	*ExamDate : Jan. 13, 2019*

Answer all the Questions :-

Question No. (1)

(A)In tensile tests, the original length is L_o and the final length is L.

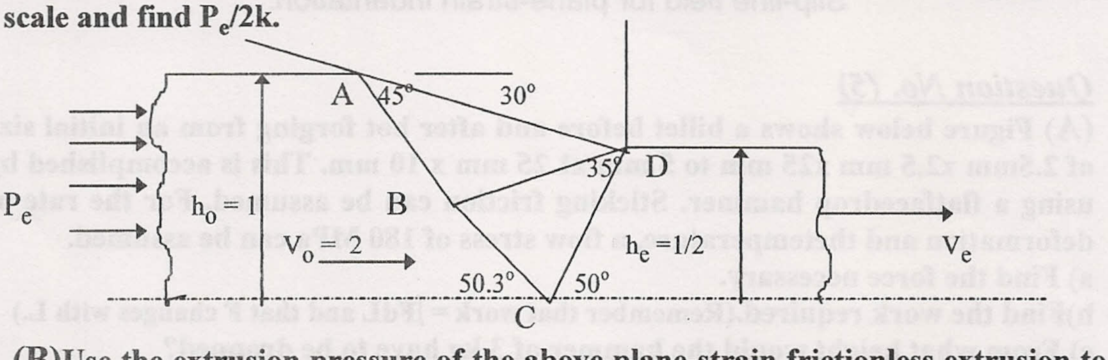
a) Show that true strain, defined as ln (L/L_o) for uniform deformation may be also expressed by any of the following : $\ln (L/L_o) = \ln (A_o/A) = 2 \ln (D_o/D) = \ln [1 / (1-r)]$ where L_o , A_o and D_o are initial values of length, area, and diameter; L, A, and D are instantaneous values; and r is the reduction of area defined as r = (Ao-A)/Ao .

b) Express the relationship between engineering strain and true strain.

(B)Show that at the onset of tensile instability, assuming that plastic behavior is described by $\overline{\sigma} = k\overline{\varepsilon}^n$, the true strain at the ultimate load, ε_u ,equals the strain-hardening exponent, n.

Question No. (2)

(A)Plane strain frictionless extrusion is to be analyzed using the upper-bound field shown in the sketch; only the top half is indicated. Draw a hodograph to scale and find $P_e/2k$.



(B)Use the extrusion pressure of the above plane-strain frictionless extrusion to predict how the ratio of actual work to ideal work: w_a/w_i, depends on α and ε_h. Describe (in words) how w_a/w_i changes with αand ε_h .

Question No. (3)

(A) A plate of steel is forged between two dies. Consider the forging in condition of plane strain. Determine the maximum pressure and its position along the plate length with coulomb friction, sticking and mixed frictional conditions between the plate and dies. Illustrate the pressure distribution diagram of the entire plate for the above friction conditions. Take thickness (h) =15 mm, length (L) =50 mm and Y=300 MPa.

(B) A sheet metal having an initial thickness of 2.5 mm and width of 30 mm is to be drawn through straight sides dies having an included angle of 30°. If the average of the yield shear stress is 120 MPa and an average value of the

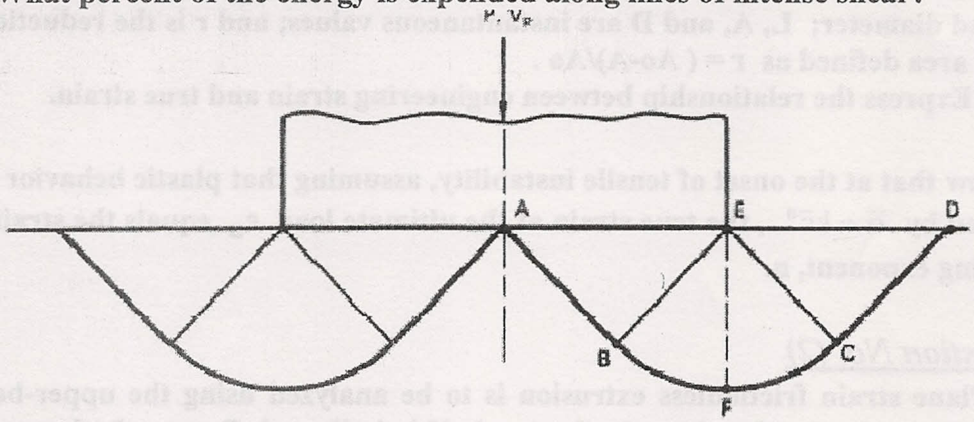
coefficient of friction is 0.08, Calculate the force needed to complete this operation for a reduction 10 %.

Question No. (4)

(A) For state of plane strain show that Von Mises condition becoms identical to Tresca condition.

(B) Using the slip-line field in Figure 9.8 for frictionless indentation it was found that $P_s/2k = 2.57$. Figure shows an alternate field for the same problem proposed by Hill.

(a) Find $P_s/2k$ for this field.
(b) Construct the hodograph.
(c) What percent of the energy is expended along lines of intense shear?

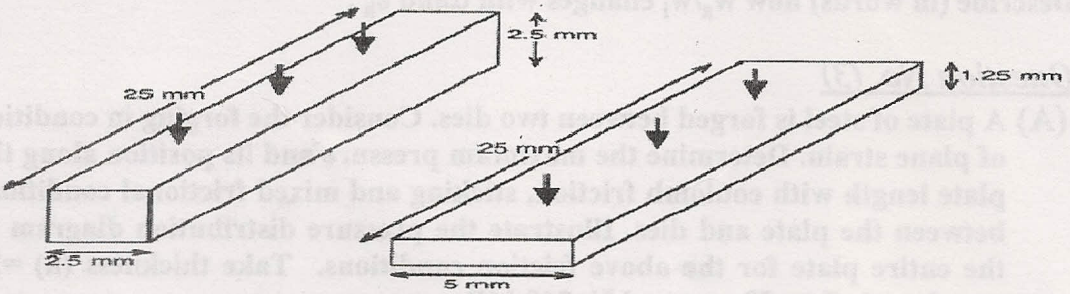


Slip-line field for plane-strain indentation.

Question No. (5)

(A) Figure below shows a billet before and after hot forging from an initial size of 2.5mm x2.5 mm x25 mm to 5 mm x1.25 mm x 10 mm. This is accomplished by using a flatfacedrop hammer. Sticking friction can be assumed. For the rate of deformation and thetemperature, a flow stress of 180 MPa can be assumed.

a) Find the force necessary.
b) Find the work required.(Remember that work = ∫FdL and that F changes with L.)
c) From what height would the hammer of 3 kg have to be dropped?
d) Compute the efficiency, η



(A) a. Explain how to product Aircraft frames, rail and corner section propulsion and ducting systems?

b. **Defects such as edge cracks, center cracks, and wavy edges, are all common with metal rolling, Explain.**

Useful information :

$$\frac{\sigma_d}{2k} = \frac{1+B}{B}\left[1-\exp^{(-B\varepsilon_h)}\right] \text{where } B = \mu\cot\alpha$$

$$\sigma_t = 2k\frac{2(1+\alpha)\sin\alpha}{1+2\sin\alpha}$$

$$p_s = 2k\frac{1+\alpha}{1+2\sin\alpha}$$

where $r = 1-\frac{a}{b} = \frac{2\sin\alpha}{1+2\sin\alpha}$

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