Question 1:

A square bar is reduced in cross-section by extruding it seven times through dies of decreasing size. During each of the seven extrusion operations the reduction in the cross-sectional area is 35%. Calculate:

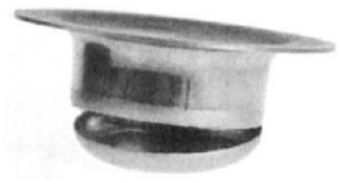
a- the total true strain applied
b- the final length of the bar, in terms of the initial length of the bar
c- the total engineering strain applied.

Question 2:

a) Estimate the limiting drawing ratio (LDR) that you would expect from a sheet metal. Knowing that stretching a sample of this sheet 20% in length decreases its thickness by 10%.

b) What materials properties determine springback? Elaborate on your answer.

c) A part fails in the course of deep drawing. Fracture occurs toward the end of draw as in the accompanied figure. Suggest possible reasons and remedies.



Question 3:

A low carbon steel container of 4.125 in height and 2.375 in internal diameter is to be made of 0.067 in thick strip material. The bottom radius is 0.375 in. Assuming that the average wall thickness of the container is equal to the sheet thickness, (a) calculate the starting blank diameter, (b) determine the draw sequence, assuming that the first draw is made with a blankholder, and (c) estimate the press force for the first draw.

Question 4:

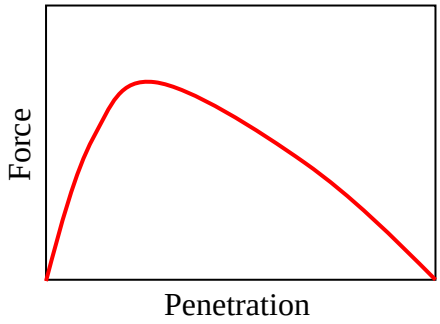
i) Circular blanks of d_o = 10 in diameter are to be cut from h = 0.125 in thick annealed 5052 aluminum alloy. What press force and energy are needed? (*hint:* TS of 5052 Al alloy is 190MPa)
ii) Mild steel plate of 5 mm thickness and 2 m width is cut in the width direction. Estimate the shearing force for cutting (a) with parallel blades and (b) in a guillotine in which the blades are given a 6° shear.

Question 5:

a) A sheet has *R* values of 1.0, 1.5 and 2.0 for the 0°, 45° and 90° directions to rolling, respectively. If a round blank is 200 mm in diameter, estimate the smallest cup diameter to which it can be drawn.
b) In question b, explain whether ears will form and why or why not?

Question 6:

(i) As a practicing engineer in manufacturing, why would you be interested in the shape of the curve in accompanied figure? Explain.



Typical punch-penetration curve in shearing.

(ii) If you had a choice whereby you could control the state of strain in a sheet-forming operation, would you rather work on the left or the right side of the forming-limit diagram? Explain.

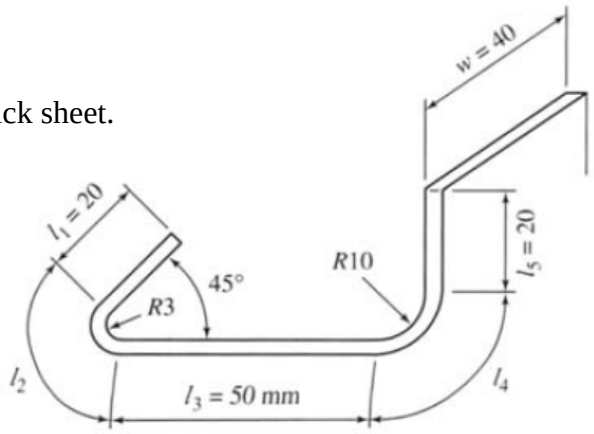
Question 7:

A cylindrical specimen 1 in. in diameter and 1 in. height is being compressed by dropping a weight of 200 lb on it from a certain height. After deformation, it is found that the temperature rise in the specimen is 300°F. Assuming no heat loss and no friction, calculate the final height of the specimen, using the following data for the material: K = 30,000 psi, n = 0.5, density = 0.1 lab/in^3, and specific heat = 0.3 BTU/lb.°F.

Question 8:

i) The part shown is to be made of 3 mm thick sheet.

Calculate the length of strip.



ii) The part shown above was originally made of annealed cartridge brass. It is now proposed that, as a weight saving measure, it should be made of one of the aluminum alloys listed below. Is one or more of these alloys suitable for this application?

	Brass	5052-34	5052-0	6061-T4
Yield Strength (MPa)	100	215	90	145
Tensile Strength (MPa)	310	260	195	240
E (GPa)	140	70	70	70
Elongation %	65	10	25	22
Reduction in Area %	75			

iii) How much is the springback in making the 90° bend of the part in question (i)?

iv) Calculate the force required for making the 90° bend in the part in question (i), assuming that the workpiece material is brass.