National Examinations – May 2015

07-Mec-A4, Design and Manufacture of Machine Elements

3 Hours Duration

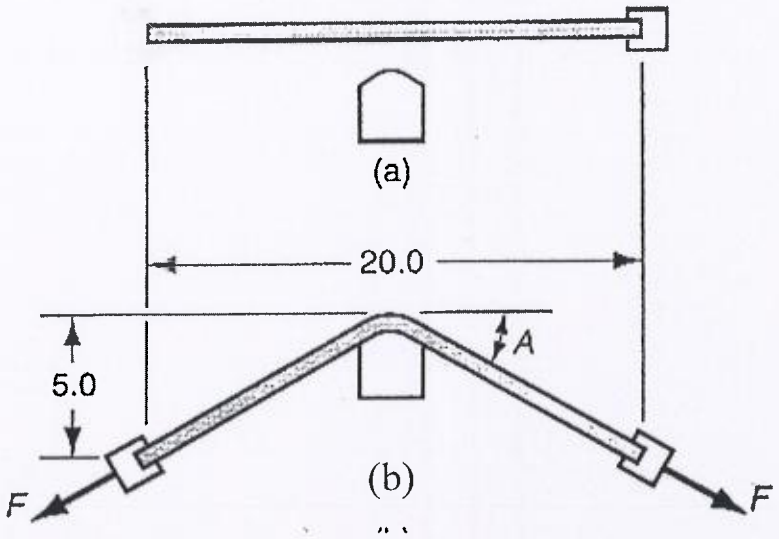
Notes, please read carefully:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an open book examination. Candidates may use any non-communicating calculator.
3. There are 6 questions on the following pages, divided into **Part A** and **Part B**. Answer **two (2) questions from Part A** and **two (2) questions from Part B**. 4 (four) questions constitute a complete paper. Only the first four questions, as they appear in your answer book, will be marked. Clearly cross off any question you do not want marked.
4. All questions are of equal mark value (25%).

PART A: Choose any two (2) questions from part A.

Q1

A 20 inch long sheetmetal workpiece is stretched in a stretch forming operation to the dimensions shown in Figure (a). The thickness of the beginning stock t = 0.125 inch and the width = 10 inches. The metal has a flow curve defined by K = 70,000 lb/in2 and n = 0.25. (a) Find the stretching force F required near the beginning of the operation when yielding first occurs. Determine: (b) true strain experienced by the metal, (c) stretching force F, and (d) die force Fdie at the very end when the part is formed as indicated in Figure (b).



Q2

i) A part fails in the course of deep drawing.
(a)Fracture occurs toward the end of draw; identify a likely source of the problem and suggest a possible remedy.
(b)Fracture occurs earlier; identify a likely source of the problem and suggest as many possible remedies as you can.

ii) It is suggested that, for highest reduction in deep drawing, the punch and die radii should be as large as possible. Subject this suggestion to a critique, using a sketch to support your argument.

iii) Someone asserts that a blankholder is always needed in deep drawing. (a) Do you agree? (b) If not, state (qualitatively) the defining conditions.

Q3

In a surface grinding operation, the grade of the only available grinding wheel is "T" (hard). During grinding, the workpiece surface shows discoloration indicating the burning of the surface. The shop foreman suggest using a softer wheel.

(a) Is this a sound advice? Why?

It turns out no other grinding wheels are available. The same foreman states that the wheel can be made to behave softer if cutting conditions are changed.

(b) Is the foreman right? If yes which cutting condition and how?

PART B: Choose any two(2) questions from part B.

Q4

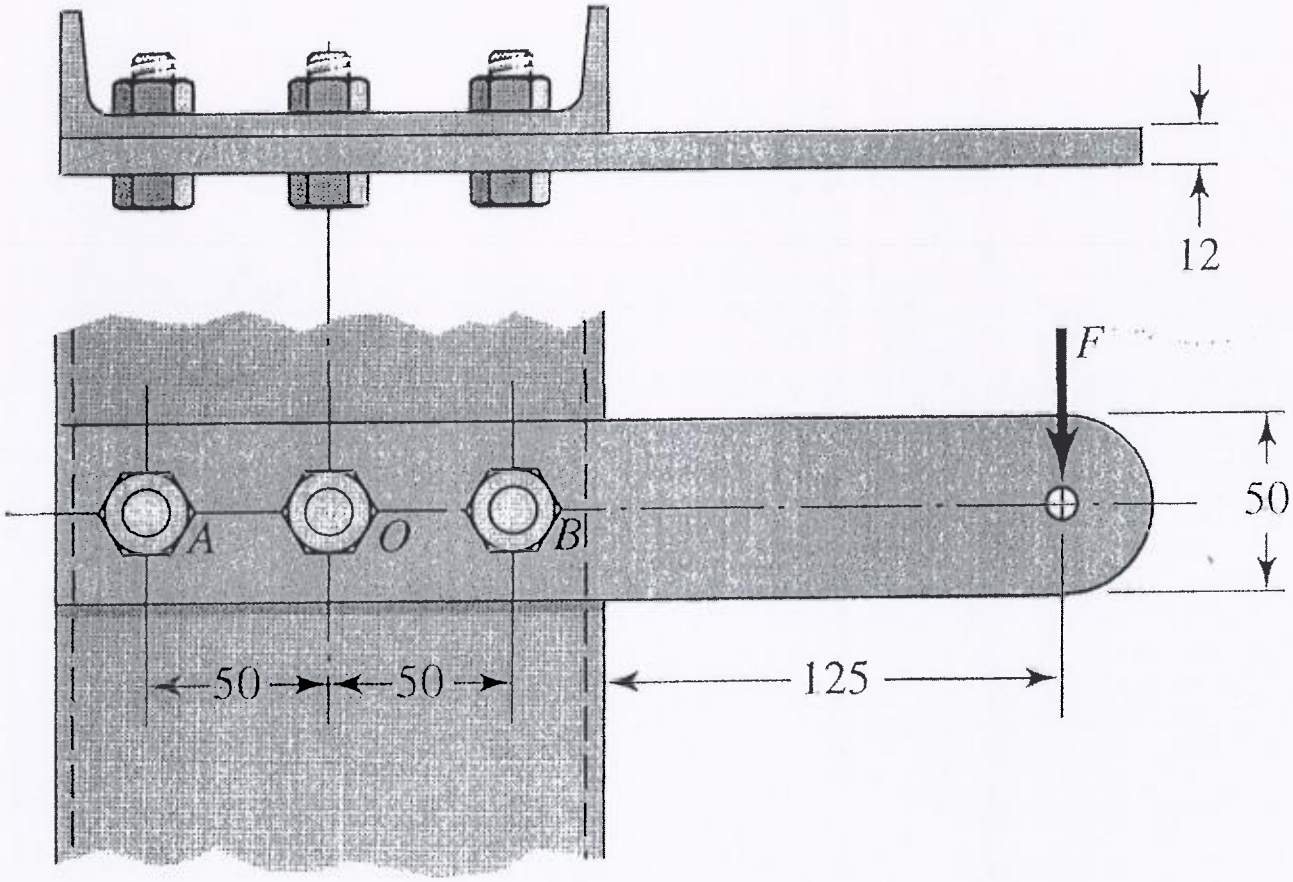
A vertical channel 152 x 76 has a cantilever beam bolted to it as shown in Figure. The channel is hot-rolled AISI 1006 steel. The bar is of hot-rolled AISI 1015 steel. The shoulder bolts are M12 x 1.75 ISO 5.8. For a design factor of 2.8, find the safe force F that can be applied to the cantilever.

Use the following information:

Bolts; Sp= 380 Mpa, Sy=420 Mpa

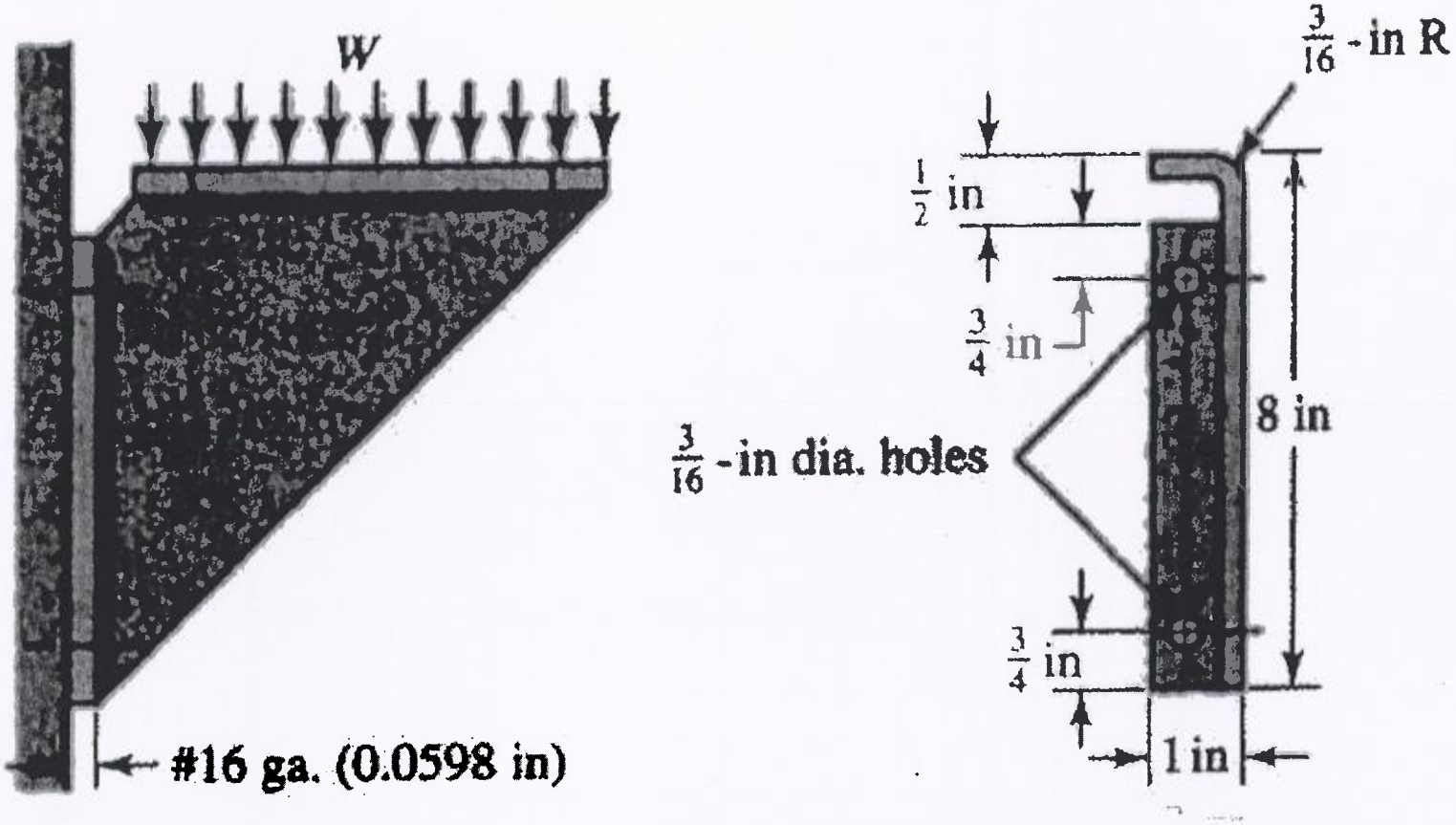
Channel: t = 6.4 mm, Sy=170 Mpa

Cantilever: Sy= 190 MPa



Q5

The figure shows a formed sheet-steel bracket. Instead of securing it to the support with machine screws, welding has been proposed. If the combined stress in the weld metal is limited to 900 psi, estimate the total load W the bracket will support. The dimensions of the top flange are the same as the mounting flange



Q6 The shoes on the brake depicted in the Figure subtend a 90° arc on the drum of this external pivoted-shoe brake. The actuation force P is applied to the lever. The rotation direction of the drum is counterclockwise, and the coefficient of friction is 0.30.

(a) What should the dimension e be?

(b) Draw the free-body diagrams of the handle lever and both shoe levers, with forces expressed in terms of the actuation force P.

(c) Does the direction of rotation of the drum affect the braking torque?