

## National Examinations – May 2018

### 16-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 a clear statement of any assumptions made with the answer paper.
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) problems from part A.****Q1**

A square box is made by thermoforming. In straight vacuum forming the edges thin out excessively.

- (a) make a sketch of pure vacuum forming, showing typical die and polymer temperatures;
- (b) show why the corners and edges should thin out
- (c) suggest a production method for reduced thinning.

**Q2**

a) Draw sketches illustrating the principles of

- 1) compression molding
- 2) transfer molding.

Show the essential die elements for each process.

b) Indicate which of the two processes (1 or 2) gives higher material utilization.

c) Give the main reason for using the process of lower material utilization.

d) Name the metal processing techniques closest to these polymer techniques (1 and 2)

e) Make a sketch to explain the phenomenon of melt fracture.

**Q3**

a) A rectangular bar is to be extruded from a thermoplastic.

1a) Superimpose on rectangle of the die the shape of the extruded product.

2a) Suggest two possible changes to the die design to obtain the correct cross section.

b) A round thermoplastic bar emerging from an extrusion die has a surface similar to shark skin (see figure)

1b) Suggest a reason for its appearance

2b) Suggest a way of eliminating the problem.

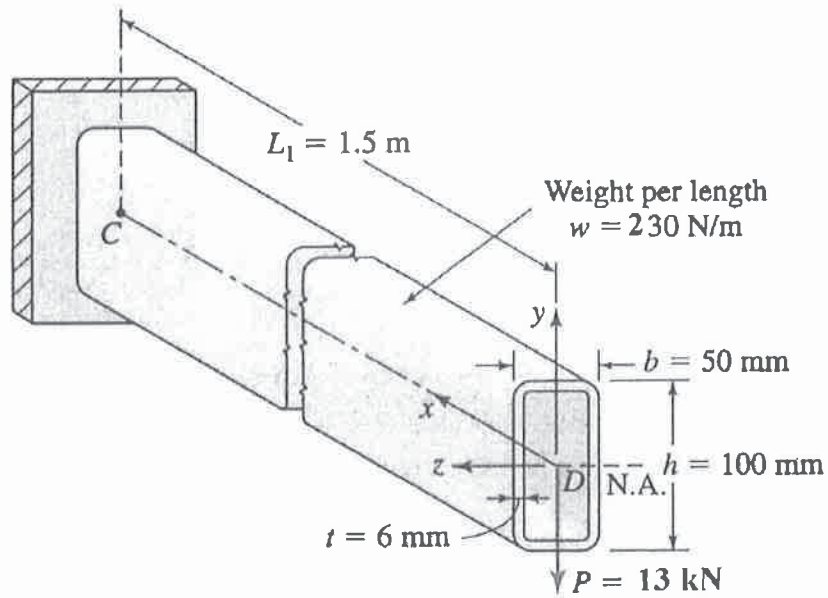


**Part B: Choose any two (2) problems from part B.**

**Q4**

For the structural member shown, determine the maximum stress and the factor of safety against yielding.

Material is ASTM-A36, Yield strength of 250MPa and Young's Modulus of E 200 GPa

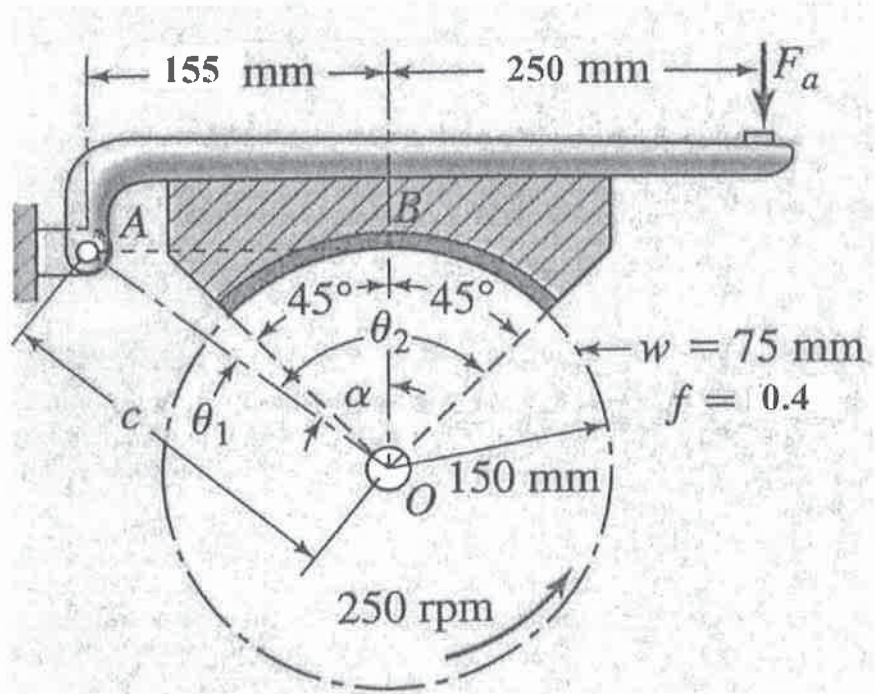


Q5

The drum brake is actuated by a mechanism that exerts a force of  $F_a = 5 \text{ kN}$ .

Determine

- (a) The maximum pressure.
- (b) The torque and power capacities.



Q6 Without bracing, a machinist can exert only about 150 lbf on a wrench or tool handle. The lever shown in the Figure has  $t = 0.6$  in and  $w = 2$  in. We wish to specify the fillet-weld size to secure the lever to the tubular part at A. Both parts are of steel, and the shear stress in the weld throat should not exceed 3000 psi. Find a safe weld size.

