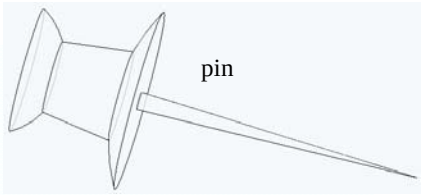
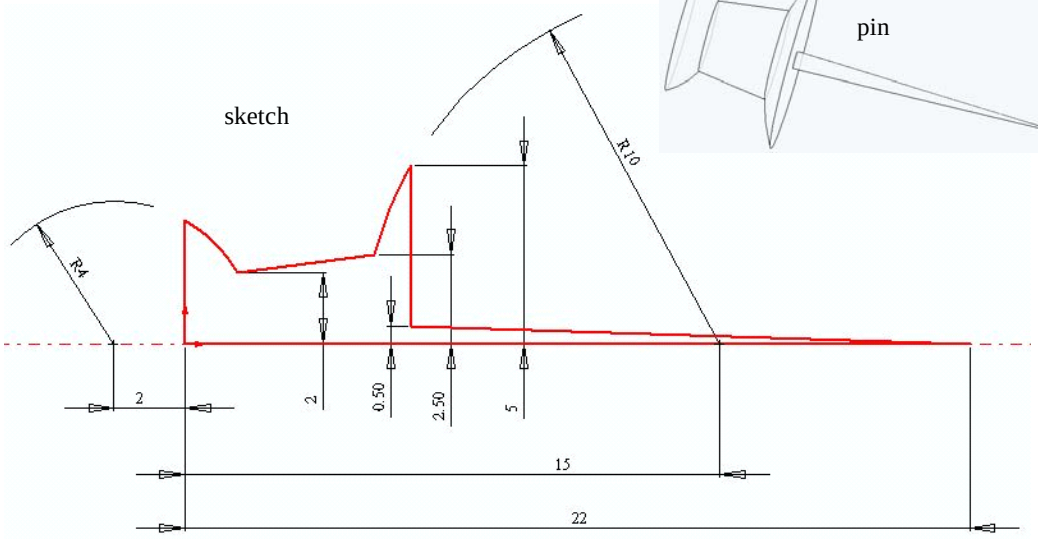
IEEM 317 Product Design and Development **Name**
Fall 2004, Exam II
Max Time 2 Hours, Max Score: 50 **SID**

Question 1. Constructive Solid Geometry **[6+10]**

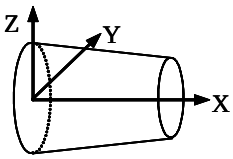
(a) The figure below shows a model of a pin used to stick notes to a soft board. Sketch a CSG tree to construct this part, using only the CSG primitives given below.
Your answer must contain the *CSG tree*, and, for each node, the *primitive*, the *parameter values*, and the *transformation(s)*.
[HINT: The sketch shows all dimensions on a section view of the part; you may imagine that the part is made by revolving this section by 360°]

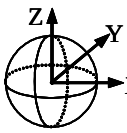




CSG primitives

cone(*radius1, radius2, length*)

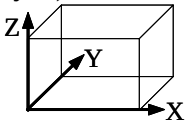




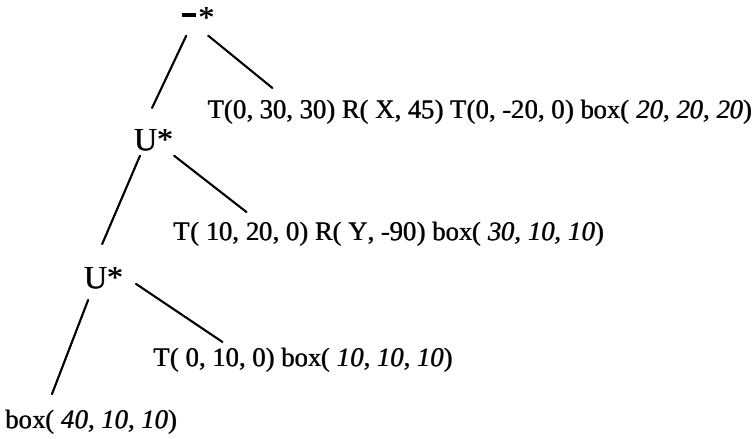
sphere(*radius*)

(b) Consider the following three CSG trees. Do they represent the same shape (give reason, including a sketch of each part)? The only primitive used is a rectangular solid, as shown below. In the tree, rotation is denoted by R(axis, angle), and translation by T(x, y, z).

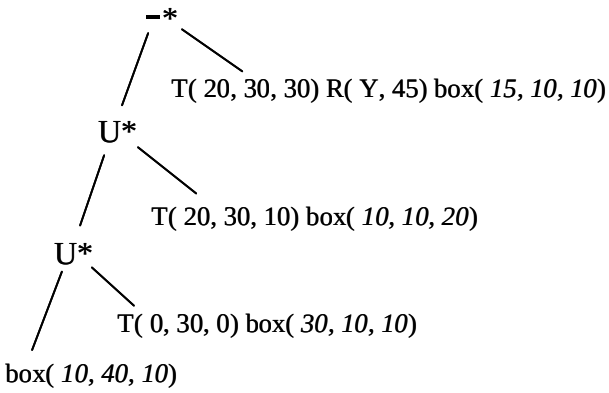
box(*x_length, y_length, z_length*)



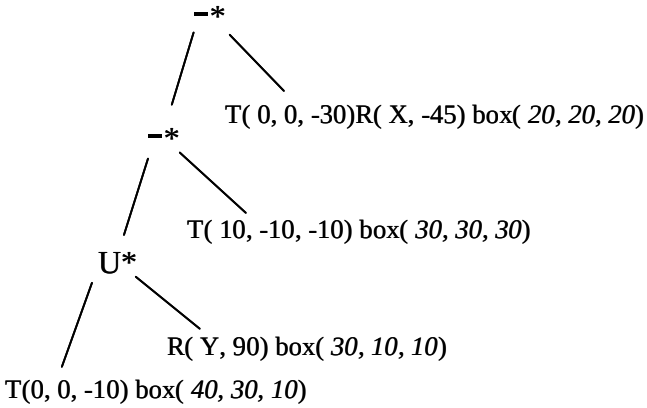
(A)



(B)

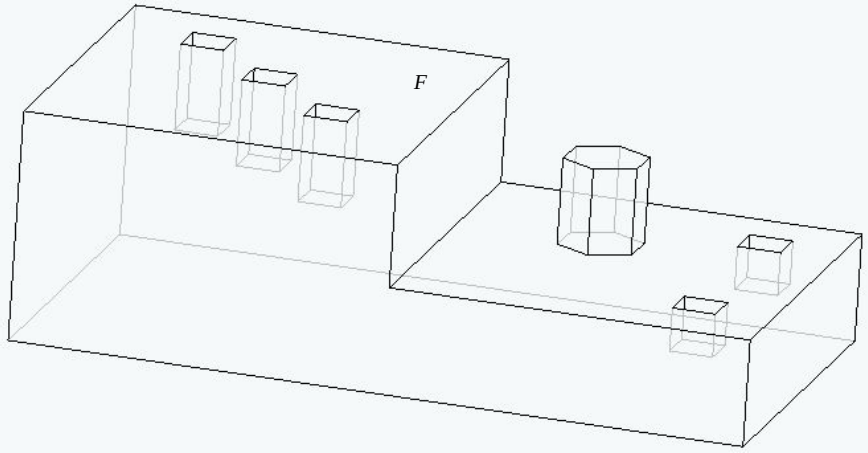


(C)



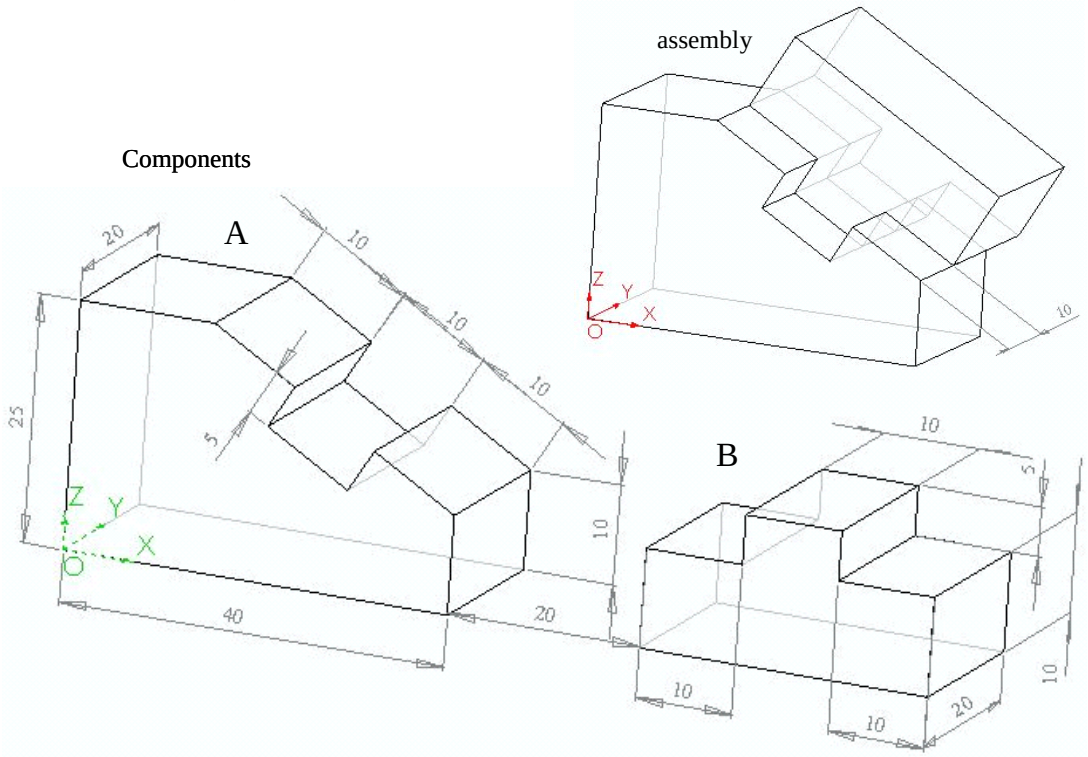
Question 2. BREP **[10]**

Write the pseudo-code of a program which finds the face with maximum number of holes. You can assume that the input to the program is the BREP of a polyhedral part.
For example, in the part below, the program will identify the face marked as *F*.



Question 3. CAD operations: transformations **[8]**

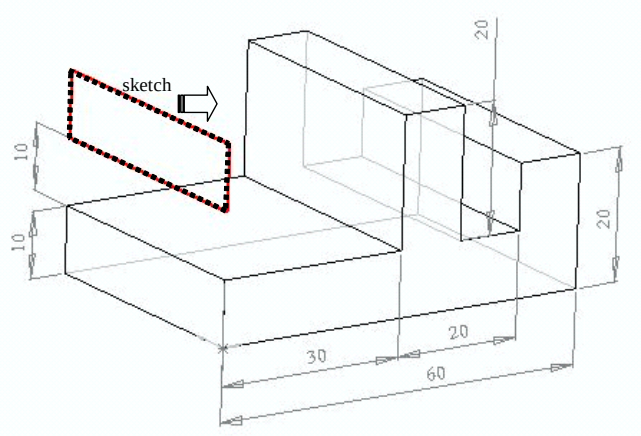
Figure 1 shows two components located in a global coordinate frame OXYZ. Derive the object transformation matrix that will move the Part B so that it is assembled onto Part A as indicated in the figure marked ‘assembly’.



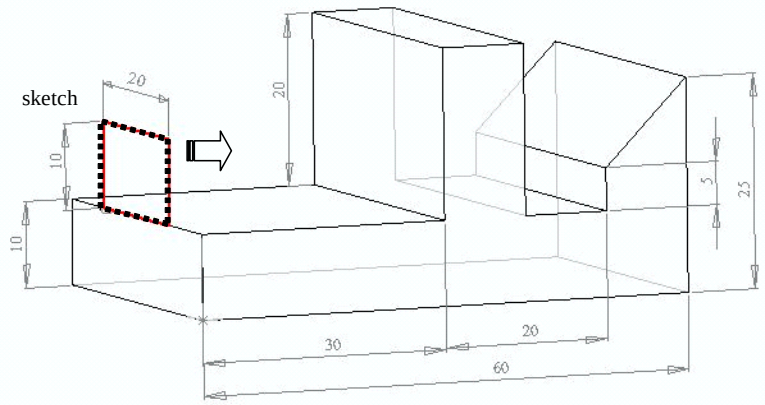
Question 4. CAD Operations fundamentals **[10]**

(a) In each case, write down for what range of values of the specified parameter will the operation fail, giving reason.

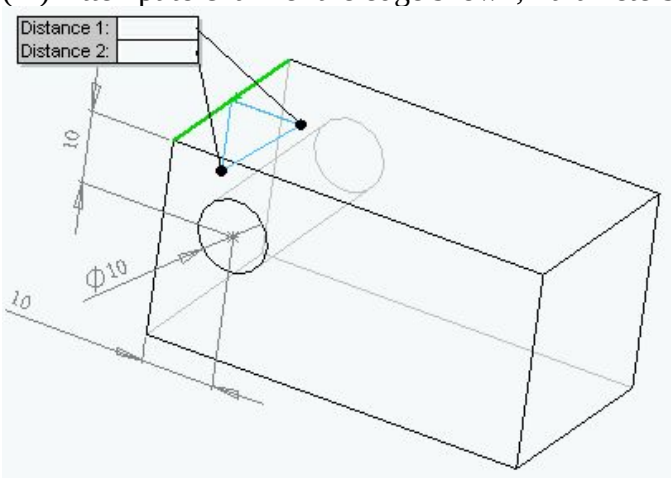
(i) We wish to extrude the sketch (dashed rectangle) in the direction of the arrow. The parameter is the extrude distance.



(ii) We wish to extrude-cut the sketch (dashed rectangle) in the direction of the arrow. The parameter is the length of the extrude-cut.



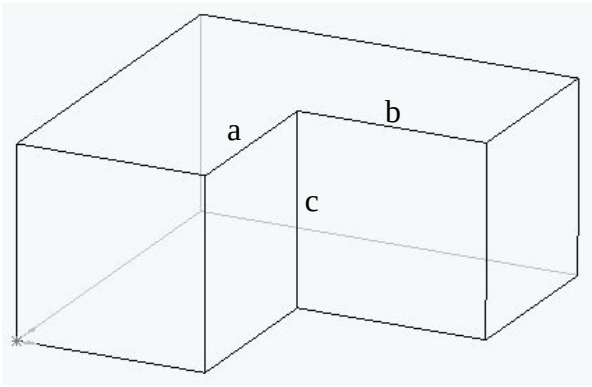
(iii) Attempt to chamfer the edge shown; Parameters: ‘Distance 1’ and ‘Distance 2’



(b) Suppose that in the following part, we will apply the following two operations:

OP1: round edges ‘a’ and ‘b’

OP2: fillet edge ‘c’



If we apply these operations in sequence OP1 → OP2, or in the sequence OP2 → OP1, will the resulting geometry be the same [give reason] ? Which sequence is preferred, if any?

Question 5. Rapid Prototyping **[2+2+2]**

State TRUE or FALSE, with reason (draw sketches if necessary)

(a) Other factors remaining the same, if you increase the thickness of each deposition layer, then the surface finish of the part will be worse.

(b) Other factors remaining the same, if the same part is constructed in a different orientation, the total time to build it will remain the same.

(c) Other factors remaining the same, if the part is constructed in a different orientation, then the surface finish of each surface will remain the same.