

PROJECT LEAD THE WAY

PLTW

**Introduction to Engineering
Design™
Final Examination**

**Part C
College Credit Performance**

Student Name: _____

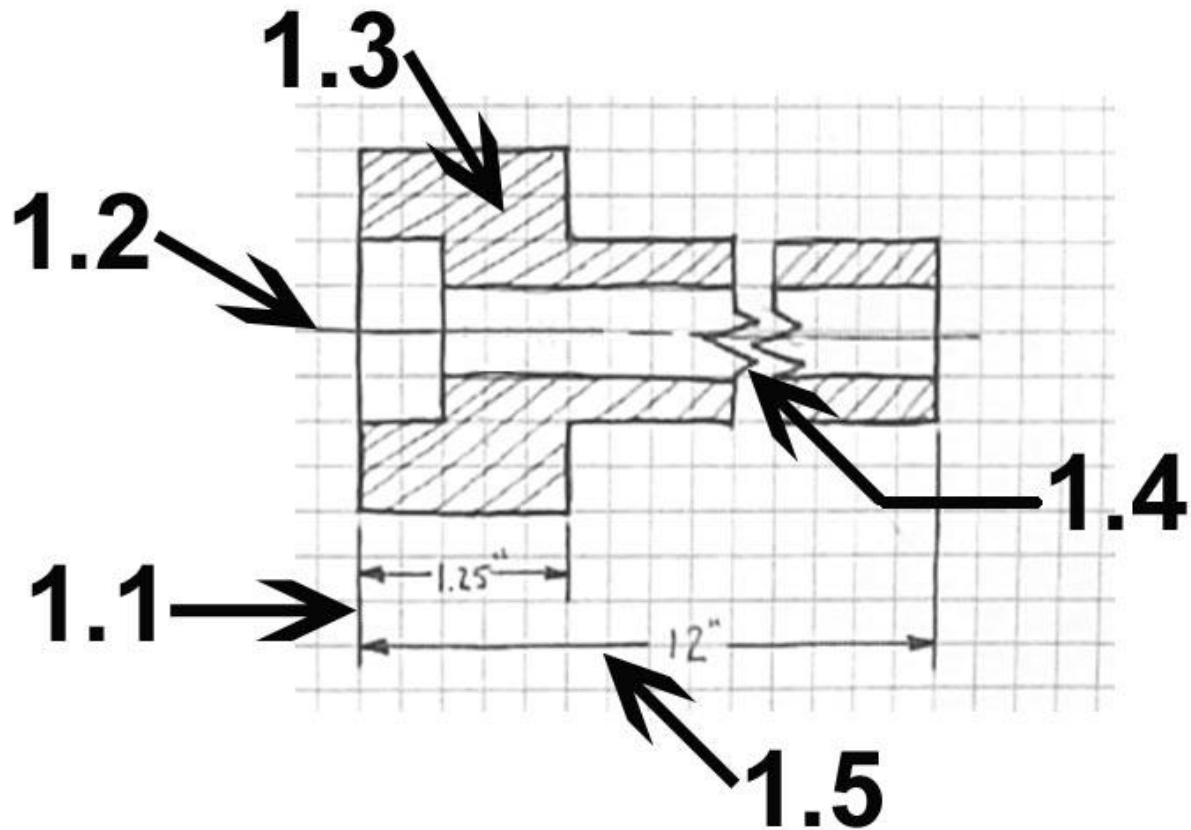
Date: _____

Class Period: _____

Total Points: _____/50

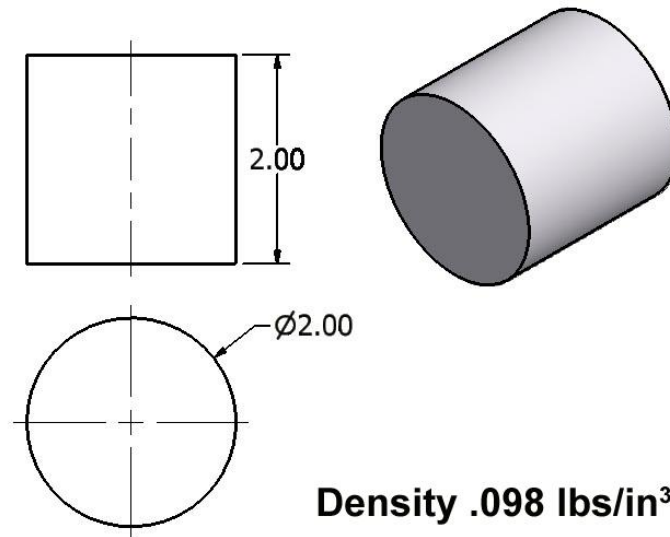
DIRECTIONS: Complete each of the following 10 exercises. Record your answers directly on the separate PART B Recording Sheet.

1. Identify the five line types (1.1, 1.2, 1.3, 1.4 and 1.5) indicated on the orthographic sketch below.
[5 POINTS: 1 point each]



2. Answer the questions based on the cylinder shown below and record your answers on the separate recording sheet.

[5 POINTS – 1 point each]



2.1 What is the area of the circle?

2.2 What is the surface area of the cylinder?

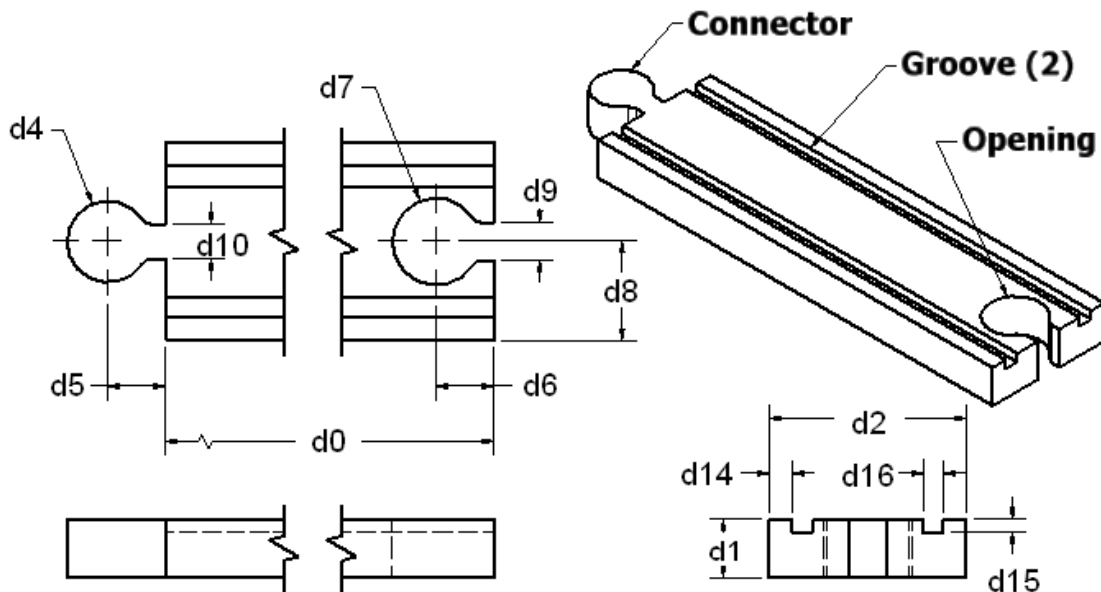
2.3 What other variable needs to be defined to calculate the weight of an object if the volume is given?

2.4 What is the volume of the cylinder?

2.5 How many of these parts could be shipped while keeping the total ship weight below 13 pounds?

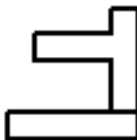
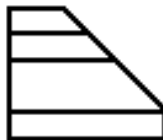
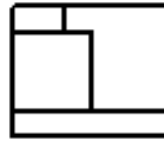
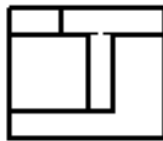
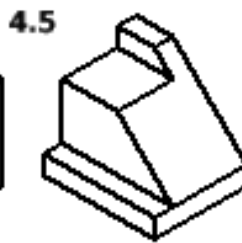
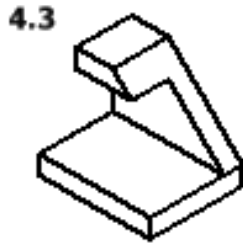
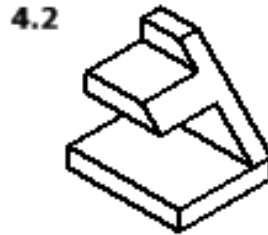
3. Directions: Write the correct parametric equation for each question on your recording sheet.

[5 POINTS – 1 point each]



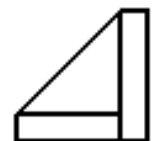
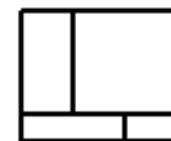
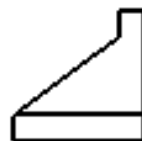
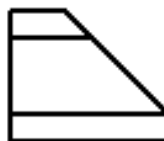
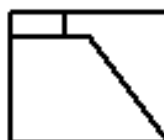
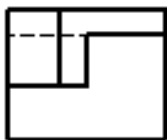
- 3.1 What is the parametric equation for dimension **d1** if the height of the track is always to be $1/12^{\text{th}}$ of **d0**?
- 3.2 What is the parametric equation for dimension **d15** if the height of the groove is always to be $1/4^{\text{th}}$ the overall height of the track?
- 3.3 What is the parametric equation for dimension **d8** if the depth of the locating dimension for the opening is always to be centered within the overall depth of the track?
- 3.4 What is the parametric equation for dimension **d7** if the radius for the opening must always be .050 inches greater than the radius for the connector of the track?
- 3.5 What is the parametric equation for **d10** if the depth of the rectangular portion of the connector must always be .050 inches less than the depth of the rectangular portion of the opening of the track?

4. Use the drawings shown below and match the Isometric Drawing (4.1- 4.5) with its proper Multiview Drawing (A-E).
 [5 POINTS – 1 point each]



A.

B.



C.

D.

E.

5. Read the narrative below. Using the Answer Bank below, select the letter of the step below that best indicates which step of the design process is being described in items 5.1 through 5.5.

[5 POINTS – 1 point each]

Narrative: *Acme Engineering* has been contracted to create a unique aquarium system inside their local mall. The engineering team has 10 months to design, test and present their final solution to mall management.

5.1 The engineering team utilizes several search engines to investigate and document 25-30 well respected aquariums worldwide.

5.2 A second meeting is scheduled between the engineering team and the mall management team to draft a design brief.

5.3 The engineering team uses several decision matrices to arrive at a final design.

5.4 Working from the set of plans developed by the CAD department, skilled fabricators construct a $\frac{1}{4}$ scale “replica” of the engineering team’s initial design idea.

5.5 The team delivers an oral presentation to mall management. The presentation includes the comments about the scale model, a slideshow, and video clips of the species that will be featured in the mall’s aquarium.

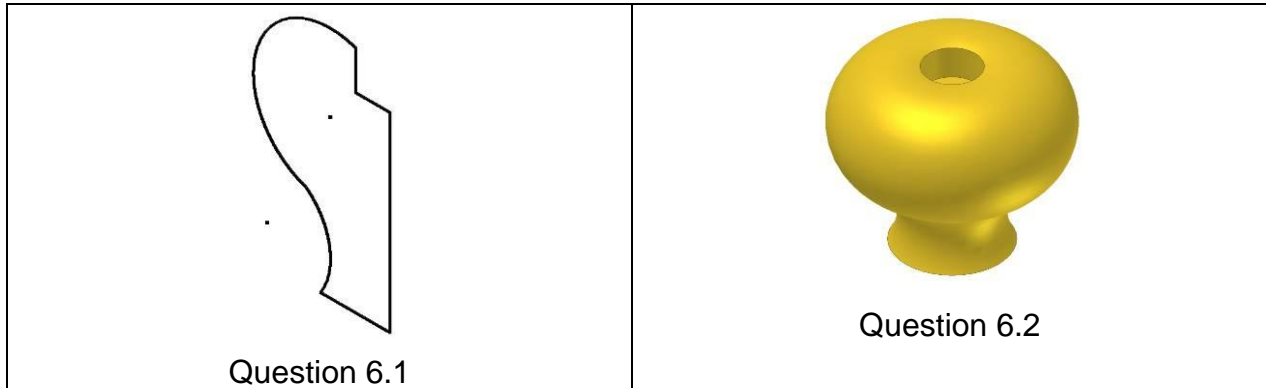
Answer Bank

- | | |
|--|--|
| A. Define a Problem | G. Develop a Design Proposal |
| B. Brainstorm | H. Make a Model or Prototype |
| C. Research and Generate Ideas | I. Test and Evaluate the Design using Specifications |
| D. Identify Criteria and Specify Constraints | J. Refine the Design |
| E. Explore Possibilities | K. Create or Make Solution |
| F. Select an Approach | L. Communicate Processes and Results |

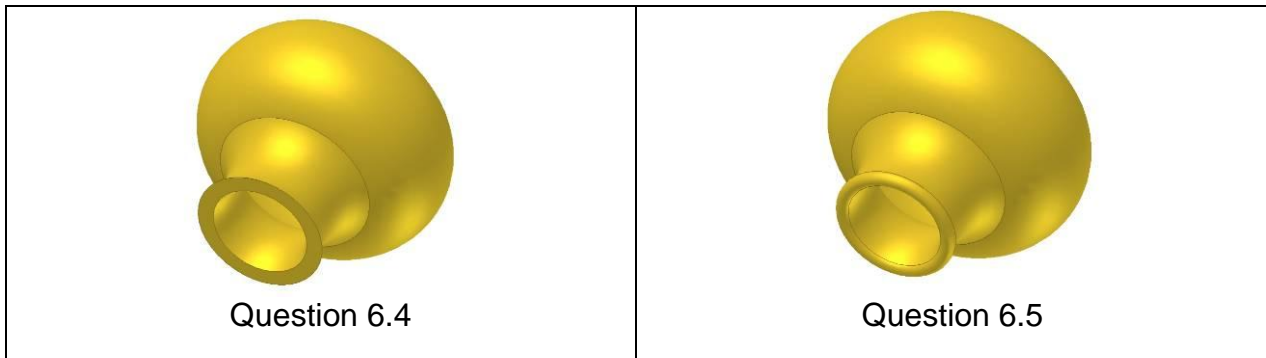
6. A door handle manufacturer uses solid modeling software to create an affordable new door knob. Using only the items found in the Answer Bank below, identify the missing term that best completes each sentence. All images are displayed in isometric views.

[5 POINTS – 1 point each]

The designer sketches a _____ 6.1 _____ on a 2-D sketch plane. Then the _____ 6.2 _____ function is used to create a solid model of the door knob by spinning the sketch around a(n) _____ 6.3 _____ .



Next the designer rotates the door knob in preparation of creating a hollow cavity. The _____ 6.4 _____ function is now used to remove the interior and provide the desired .1" wall thickness. Finally the edges are rounded off using the _____ 6.5 _____ function.



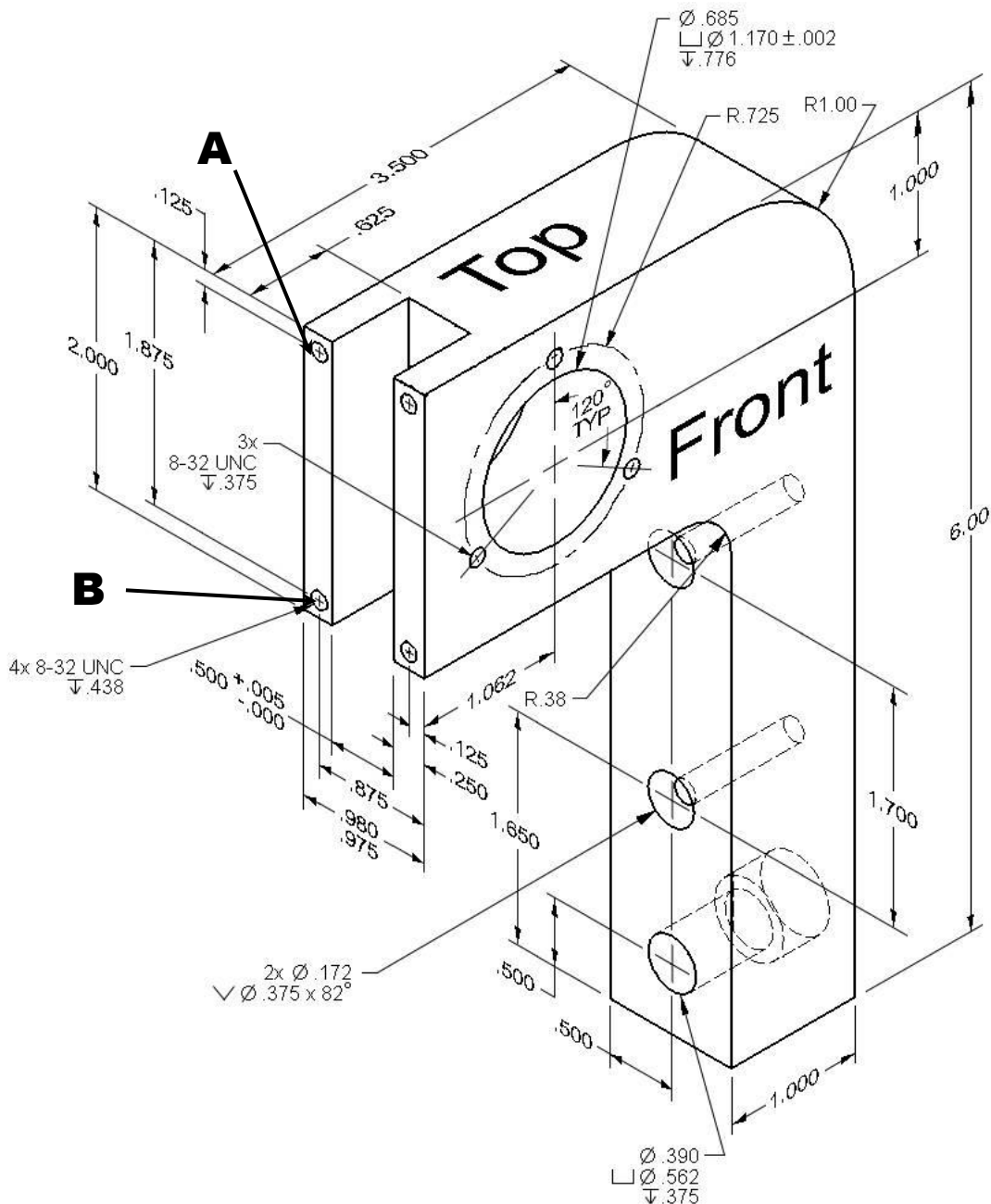
Answer Bank (Note: Answers may only be used once.)

- | | |
|---------------|---------------|
| A. Axis | F. Thread |
| B. Work plane | G. 2D profile |
| C. Shell | H. Rib |
| D. Hole | I. Sweep |
| E. Revolve | J. Fillet |

7. Use the drawing of the Arbor Press Column to answer the following questions, note that holes A & B are labeled in bold text:

[5 POINTS – 1 point each]

- 7.1 How many degrees are between the tapped holes on the front face of the part?
- 7.2 What is the distance between centers on Hole A and Hole B?
- 7.3 What is the minimum allowable depth of the column?
- 7.4 What is the smallest counter bore diameter?
- 7.5 What is the diameter of the thru hole for the counter sink?



8. Portions of an engineer's notebook for reverse engineering the portable TV pictured to the right are listed in the Answer Bank below. Match the heading (8.1- 8.5) with the corresponding engineer's notebook entry listed in the Answer Bank.

[5 POINTS – 1 point each]

8.1 Visual Design Principle

8.2 Visual Design Element

8.3 Functional Analysis

8.4 Structural Analysis- Materials Used

8.5 Structural Analysis- Fastening Methods

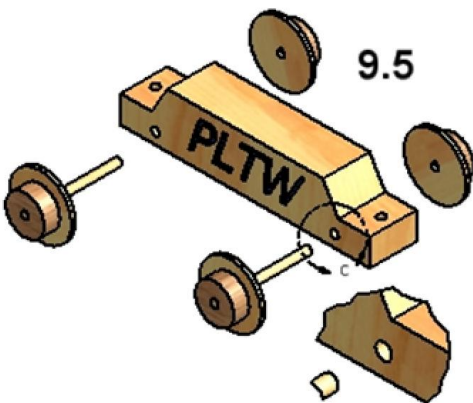
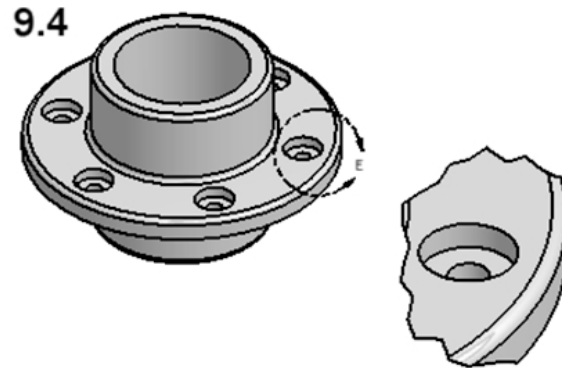
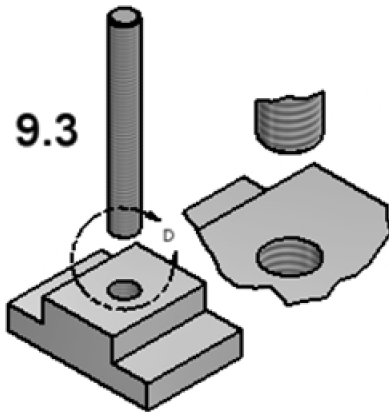
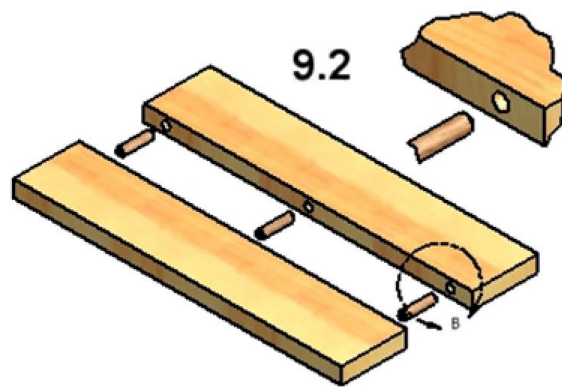
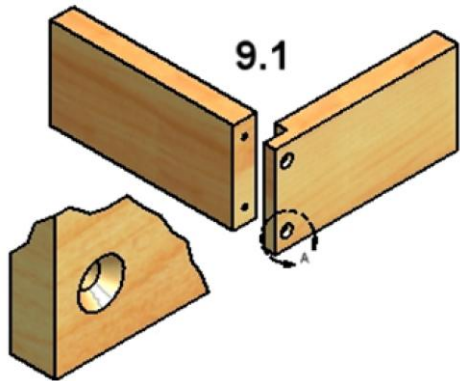


Answer Bank

- A. The color scheme is very unique- Purple, grays and gold
- B. Product utilizes machine screws, pressed fittings, adhesives, and snap fits in its construction.
- C. Cord plugged into outlet, TV powers up.
- D. The repeating pattern on the front cover is very eye catching
- E. The case is an injection molded part, scratch resistant, can withstand high impact, non porous.

9. Using the images (9.1-9.5) below, match the letter of the hole from the Answer Bank that best describes the hole pictured.

[5 POINTS – 1 point each]



Answer Bank

A. Tapped Hole
D. Countersink Hole

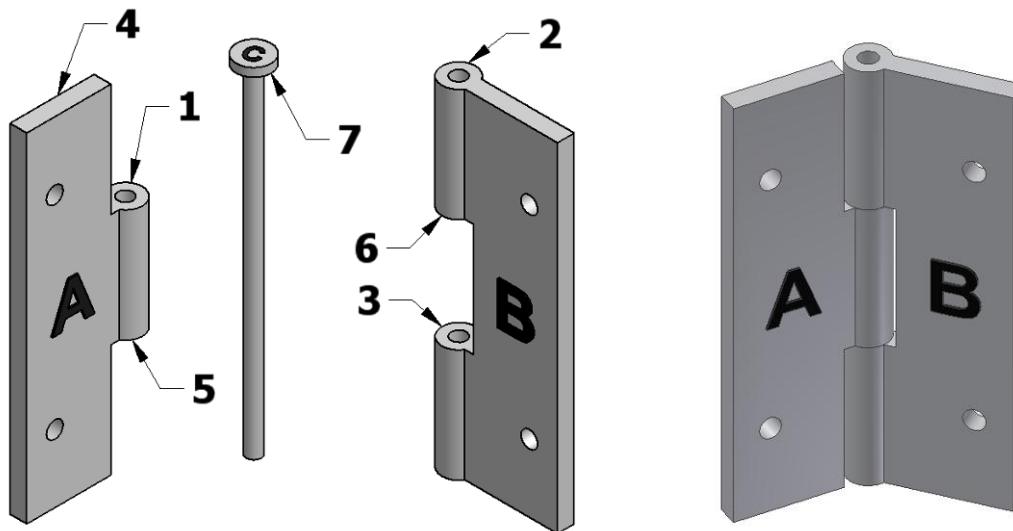
B. Through Hole
E. Counterbore Hole

C. Blind Hole

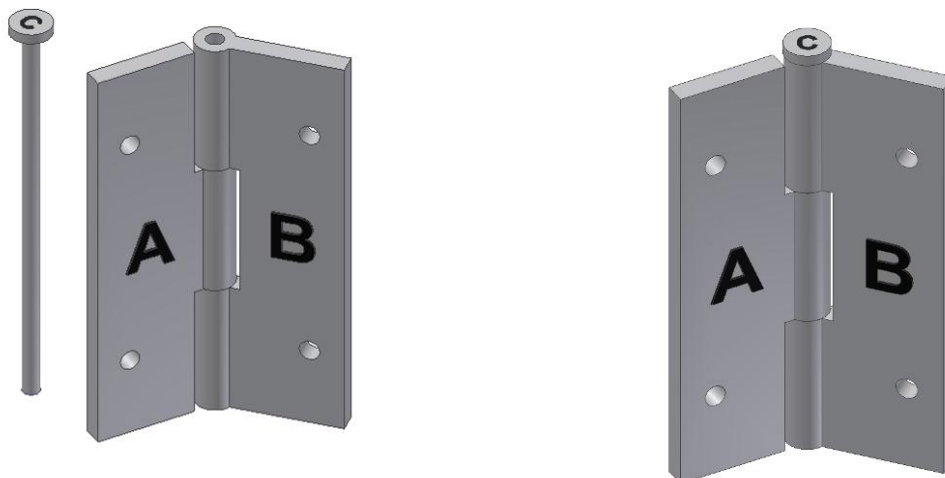
10. Parts A, B, and C combines to create a door hinge. When assembled the hinge is open at a 90 degrees and part A is grounded. Answer the questions below on your recording sheet.

[5 POINTS – 1 point each]

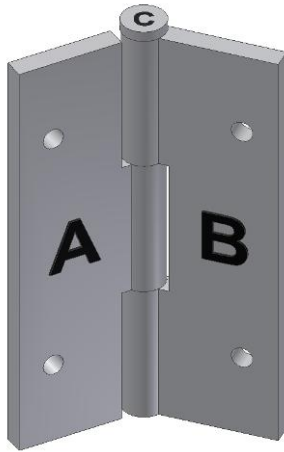
10.1: What assembly constraint(s) could be used to place Part A and Part B together as shown in the picture below? Reference numbers for edges or letters for surfaces in your answer.



10.2: What assembly constraint in one step could be used to place Part C into Parts A and B as shown in the picture below?



10.3: What assembly constraint will be used to place a 90 degree angle between Face A and Face B on the assembled hinge as shown in the picture below?



10.4: How many degrees of freedom are left once the parts of the hinge are assembled?

10.5: List any remaining degrees of freedom and corresponding part(s).