3S SOLIDWORKS

3DEXPERIENCE®
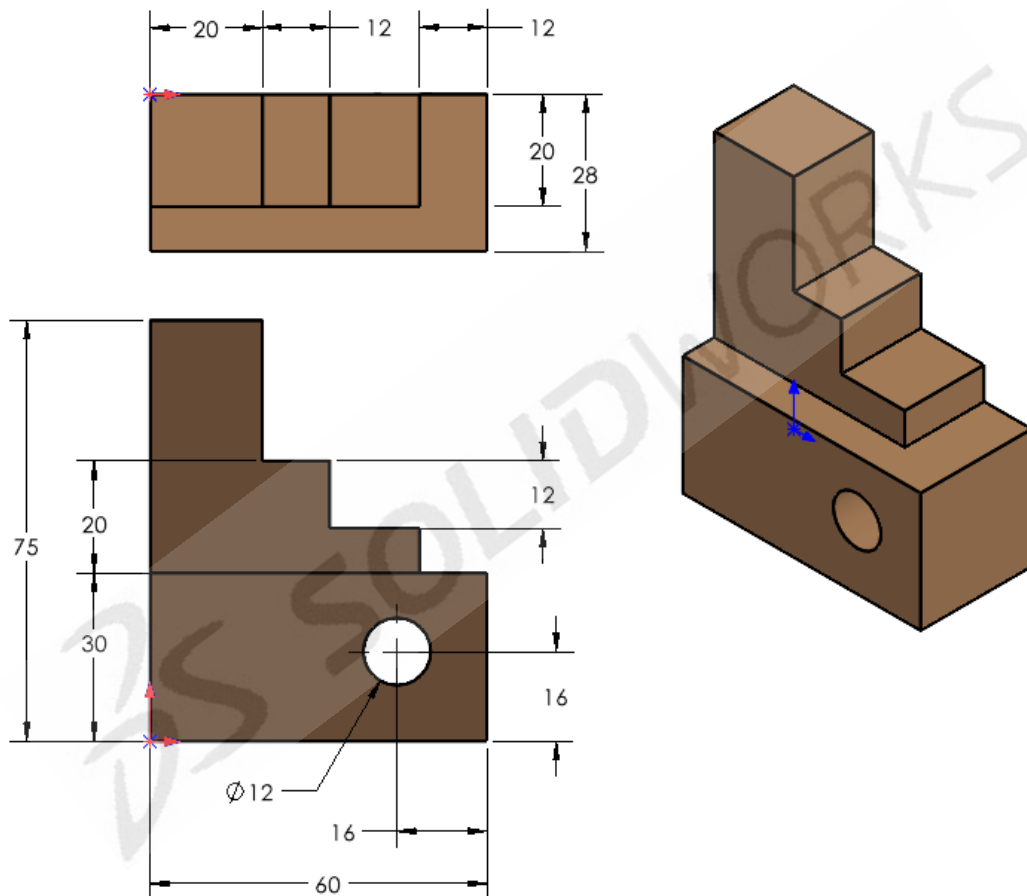
Practice Problem 1.1

Basic Sketch and Extrusion (Level 1)
- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features
- Sketch: Lines, Rectangles, Circles
- Features: Extrude Boss

Volume: 72593 mm³

DS DASSAULT SYSTEMES

Practice Problem 1.2
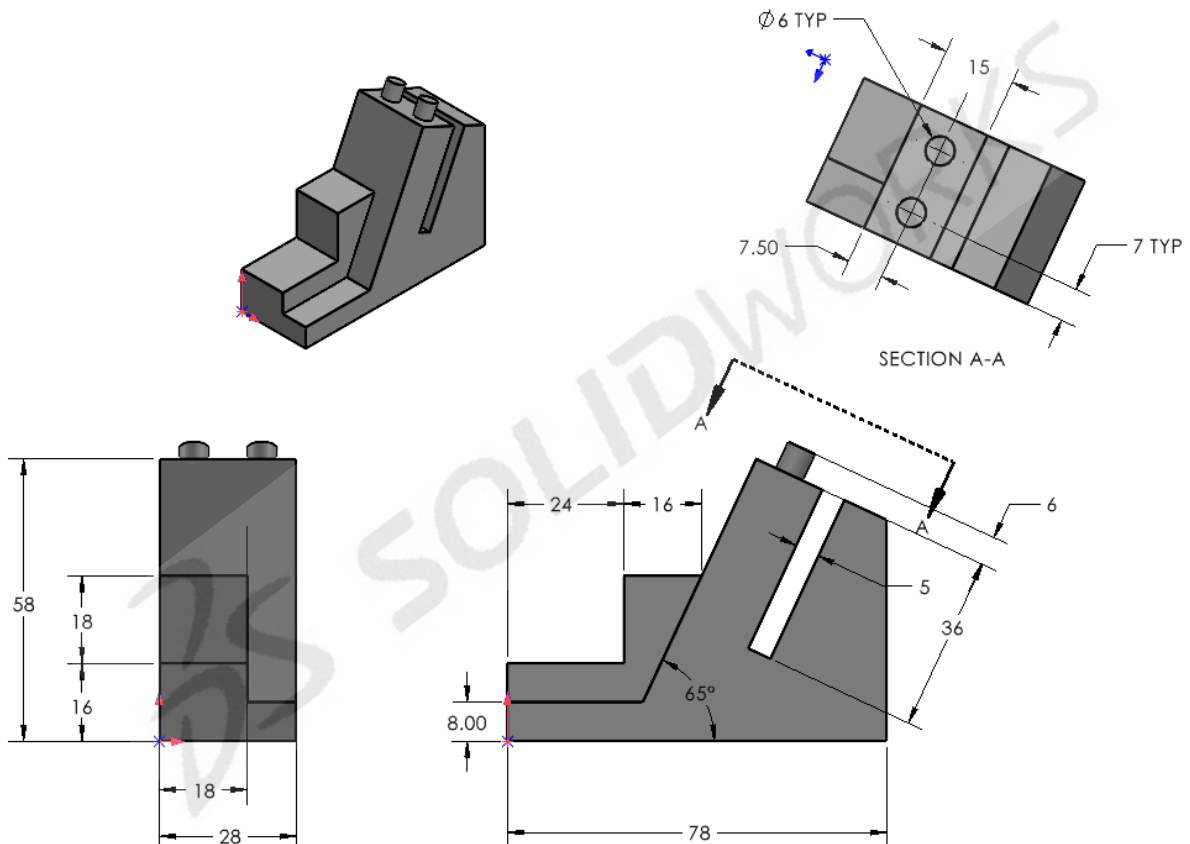
Basic Sketch and Extrusion (Level 1)
- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features
- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss

HINT: Both circular bosses are the same.

Volume: 70039 mm³

Ø6 TYP

15

7.50

7 TYP

SECTION A-A

A

24   16

6

5

36

65°

8.00

78

58

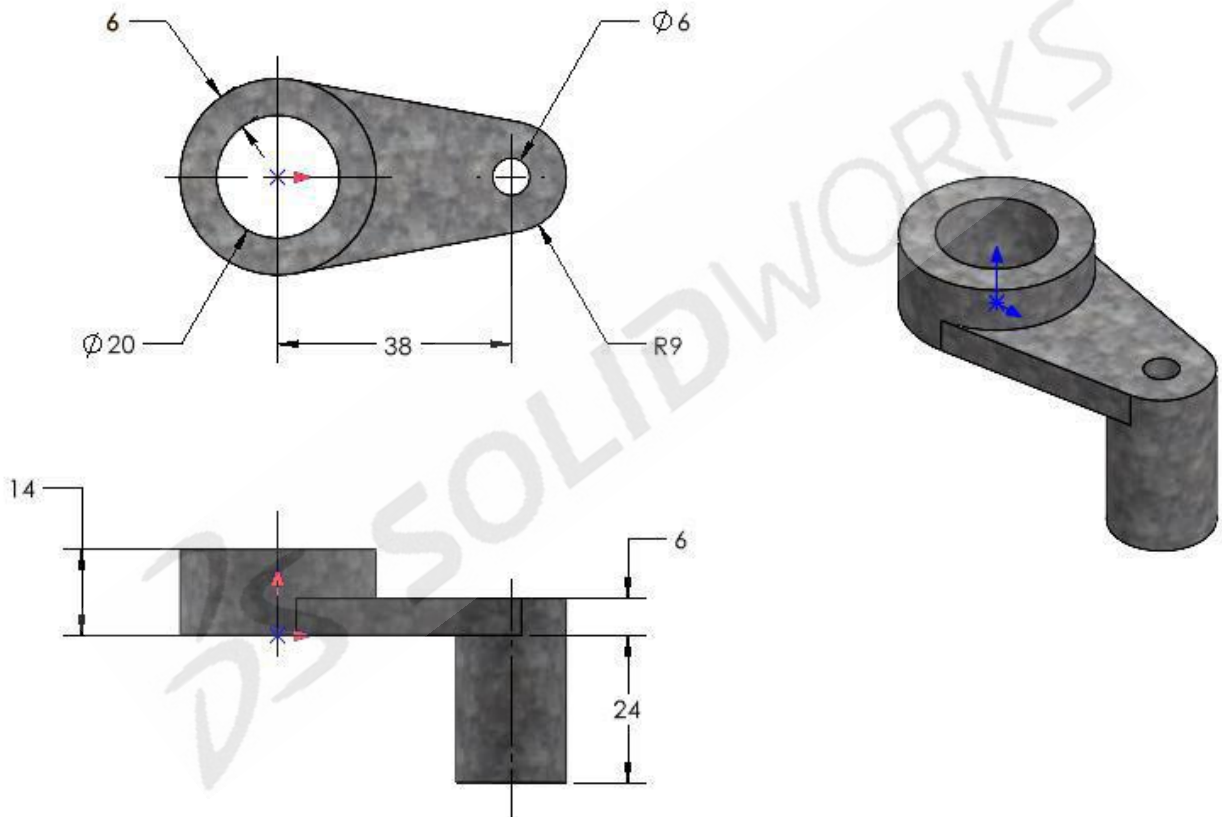18

16

18

28

Practice Problem 1.3

Basic Sketch and Extrusion (Level 1)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Arcs, Circles
- Features: Extrude Boss

Volume: 16268 mm³

Practice Problem 1.4

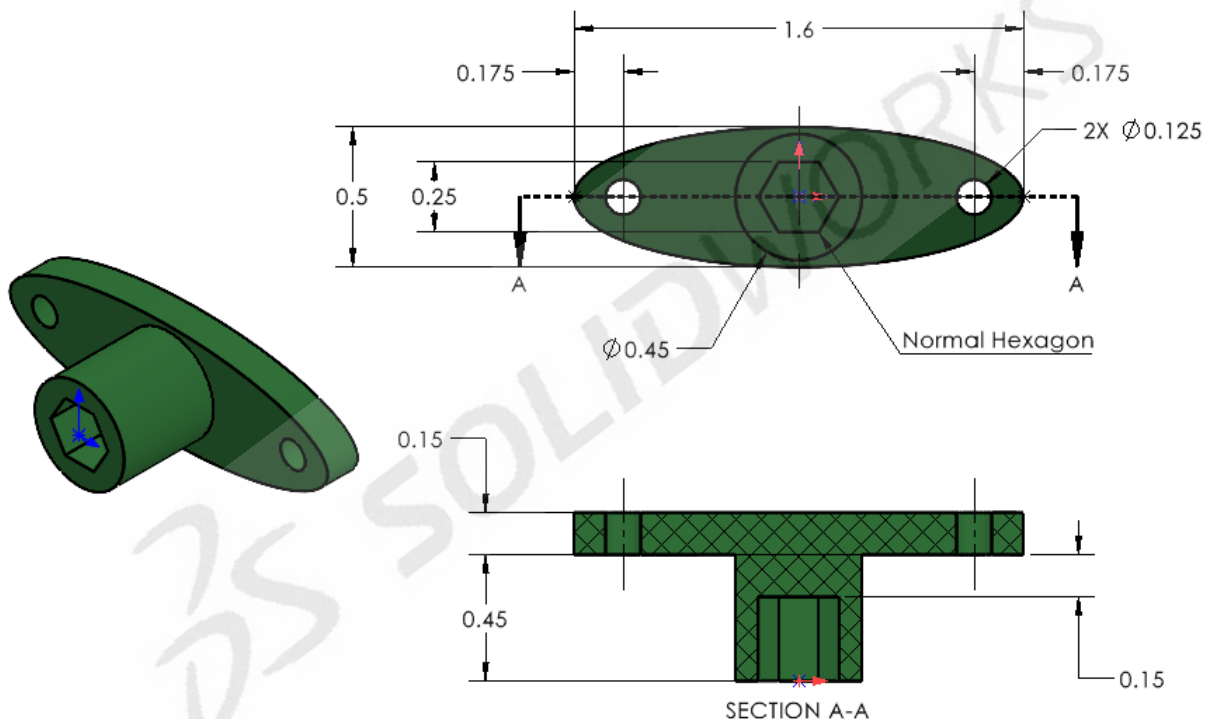## Basic Sketch and Extrusion (Level 1)

- Units: IPS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Arcs, Circles, Polygons
- Features: Extrude Boss

HINT: Use a 6-sided polygon for the blind hole.

Volume: 0.146 in³

Practice Problem 1.5

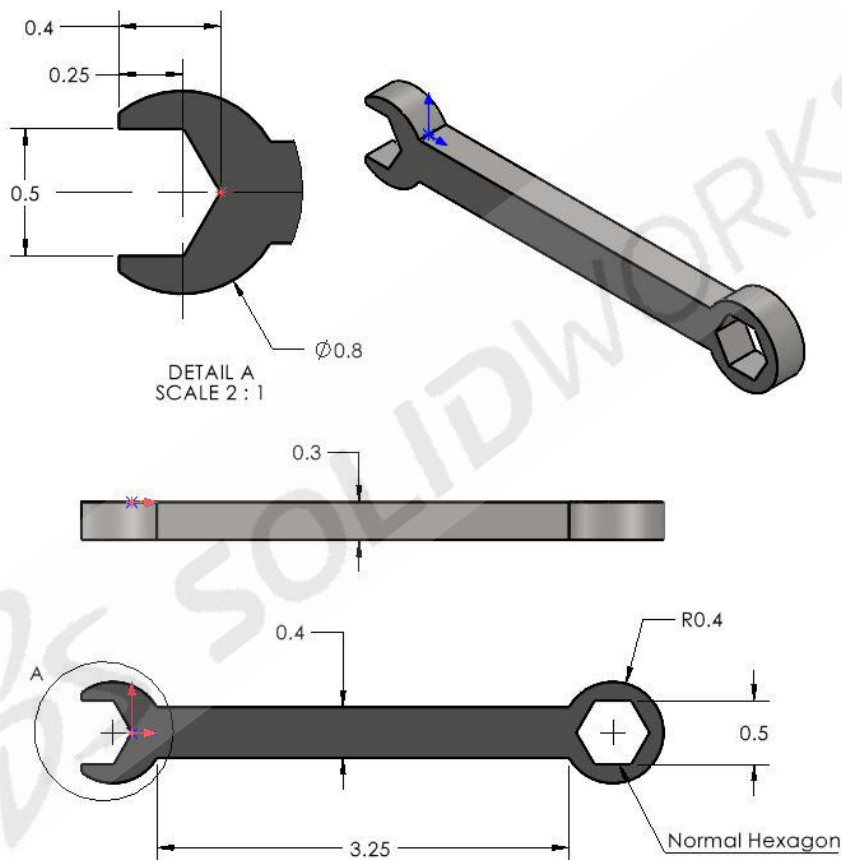## Basic Sketch and Extrusion (Level 1)

- Units: IPS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - o The part's origin location is indicated in red.
  - o The part is symmetric.
  - o All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Arcs, Circles, Polygons
- Features: Extrude Boss

HINT: Use a 6-sided polygon.

Volume: 0.5492 in³

DETAIL A
SCALE 2 : 1

Ø0.8

0.4
0.25
0.5

0.3

0.4
R0.4
0.5
A
3.25
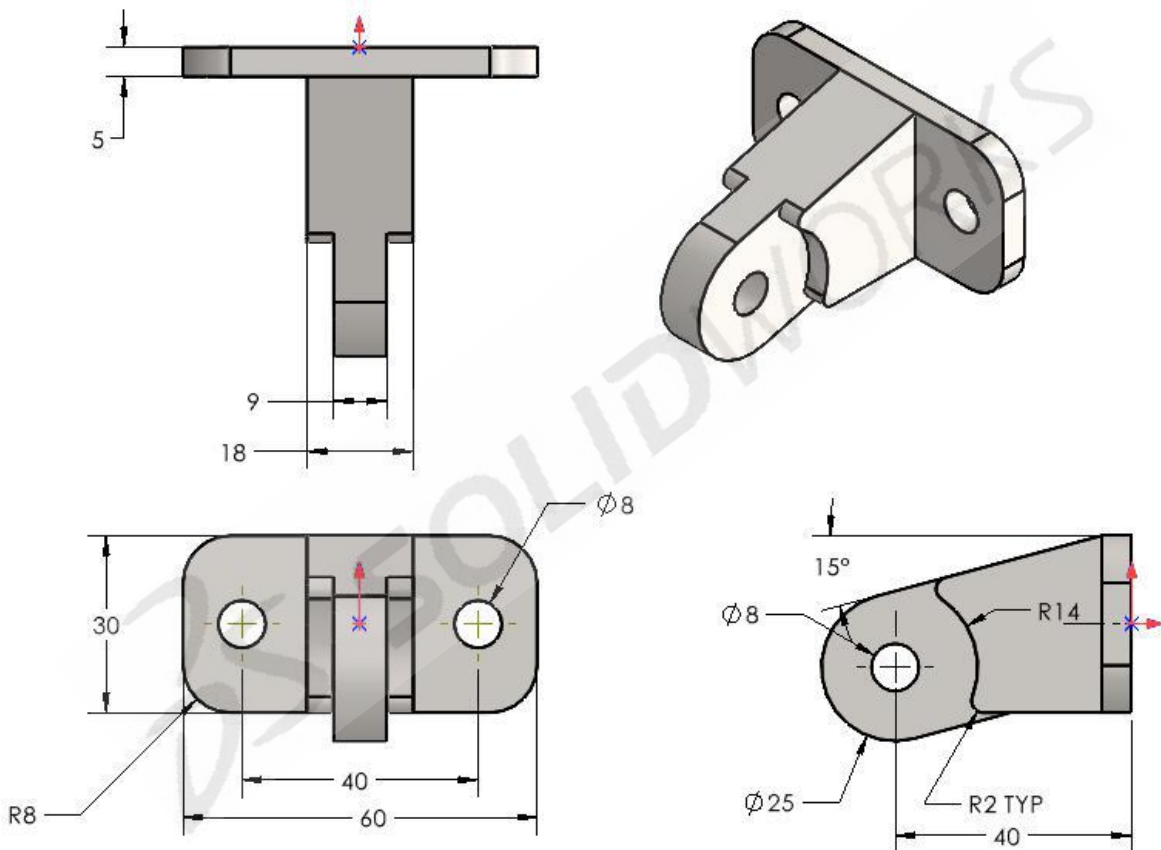Normal Hexagon

Practice Problem 1.6

Basic Sketch and Extrusion (Level 1)
- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features
- Sketch: Lines, Rectangles, Circles
- Features: Extrude Boss

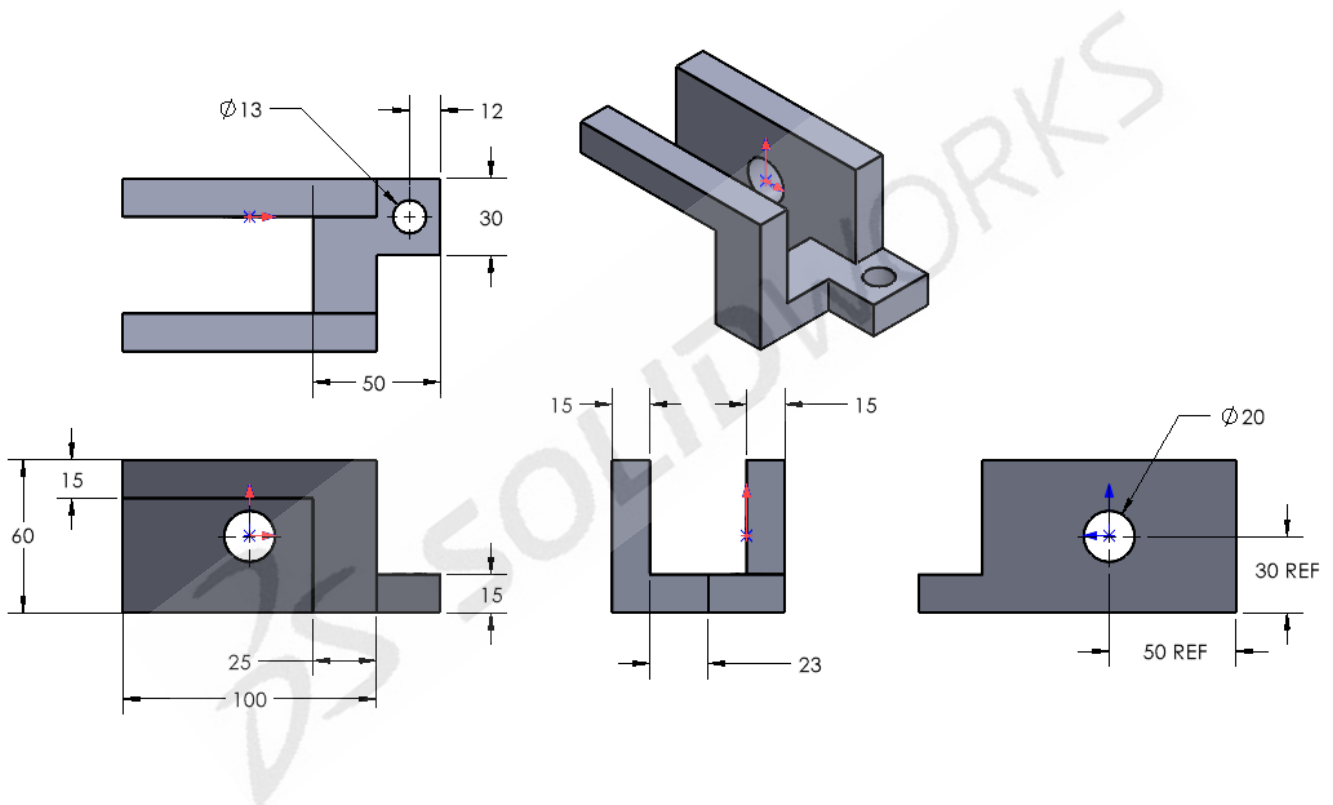**Volume**: 24032 mm³

Practice Problem 1.7

Basic Sketch and Extrusion (Level 1)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 20
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Rectangles, Circles
- Features: Extrude Boss, Extrude Cut
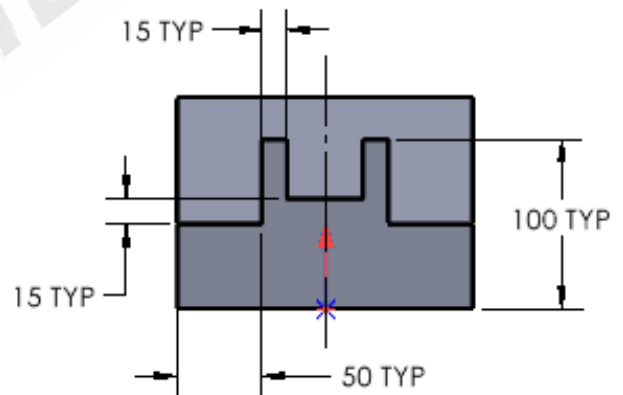
Volume: 148172 mm³
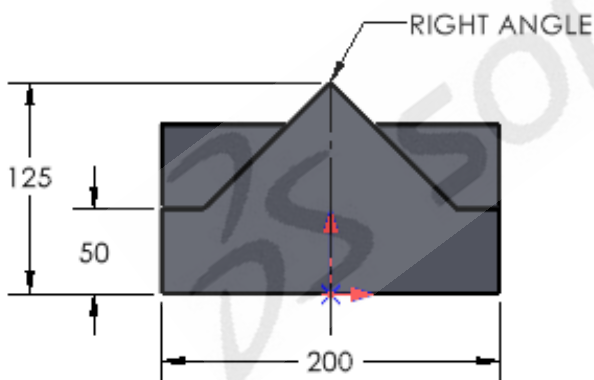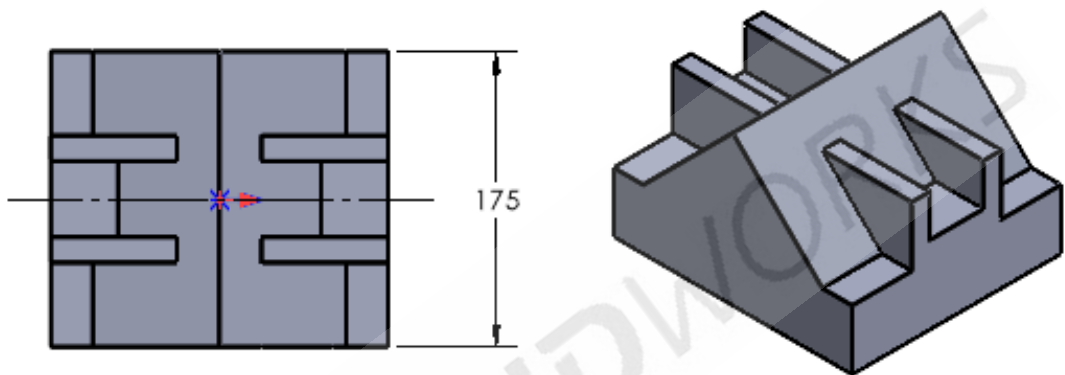
Practice Problem 1.8

Basic Sketch and Extrusion (Level 1)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Rectangles
- Features: Extrude Boss

Volume: 2928250 mm³

175

RIGHT ANGLE

125

50

200

15 TYP

15 TYP

100 TYP

50 TYP

DASSAULT SYSTEMES

Practice Problem 1.9
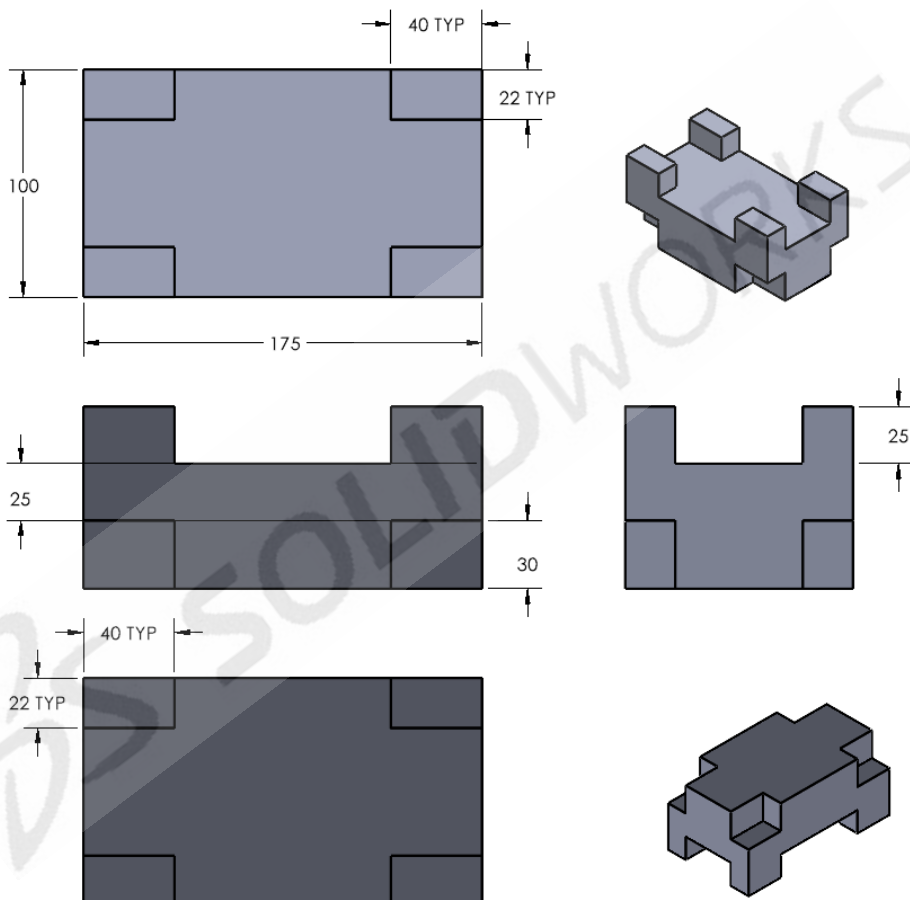
Basic Sketch and Extrusion (Level 1)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss

HINT: Corner bosses and cutouts are the same size.

Volume: 944900 mm³

Practice Problem 1.10

Basic Sketch and Extrusion (Level 1)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
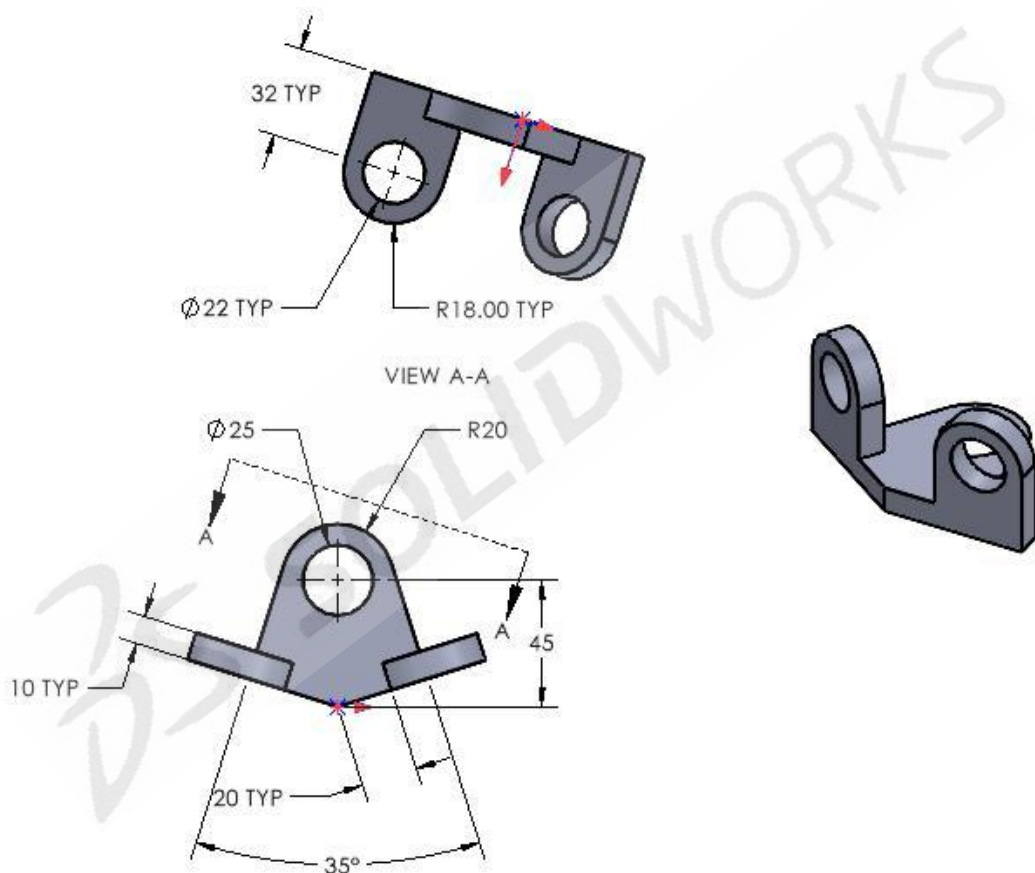 - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Rectangles, Circles
- Features: Extrude Boss

HINTS:

- The 25mm hole is centered on the part, and cuts all the way through the part.
- The 22mm hole is centered on the 36mm wide flange, and cuts through the part.
- Both flanges and the base are the same thickness.

Volume: 45438 mm³

32 TYP

Ø22 TYP — R18.00 TYP

VIEW A-A

Ø25 — R20

A

A 45

10 TYP

20 TYP

35°

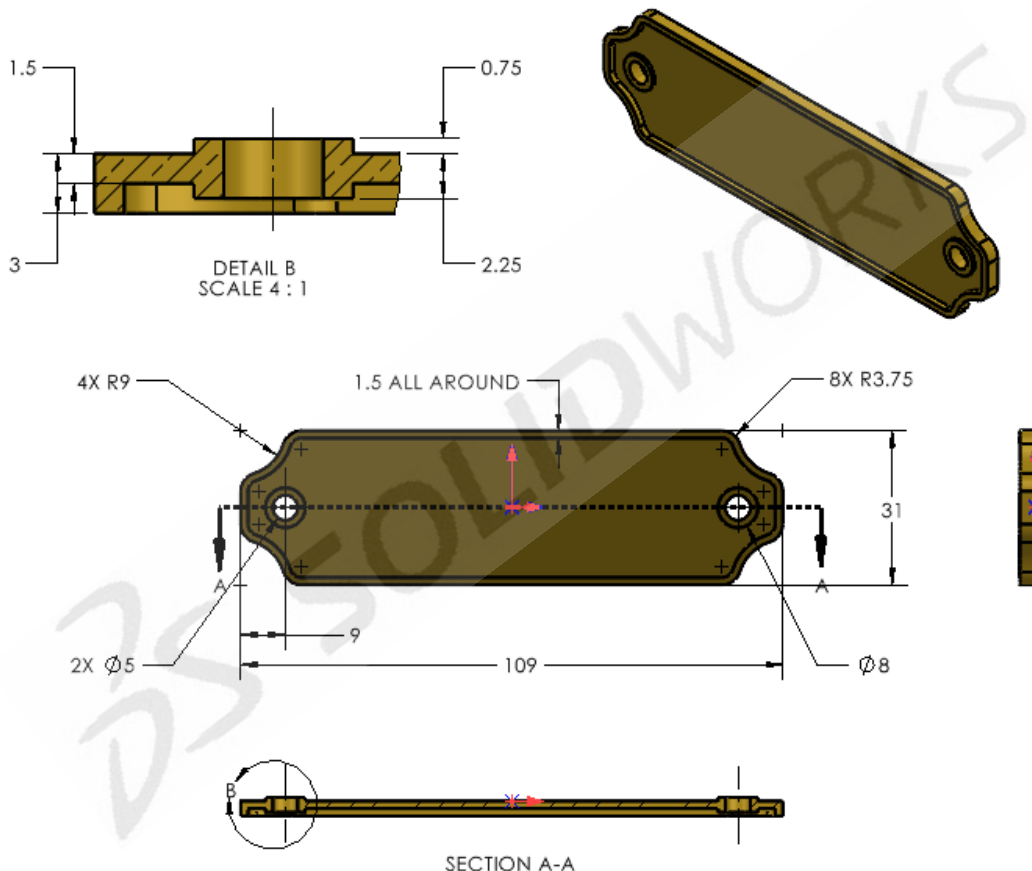# Practice Problem 2.1

Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Sketch Fillets
- Features: Extrude Boss

Volume: 5263 mm³

DETAIL B
SCALE 4 : 1

1.5   0.75
3   2.25

4X R9   1.5 ALL AROUND   8X R3.75

31

2X Ø5   9   109   Ø8

A   A

SECTION A-A

Practice Problem 2.2
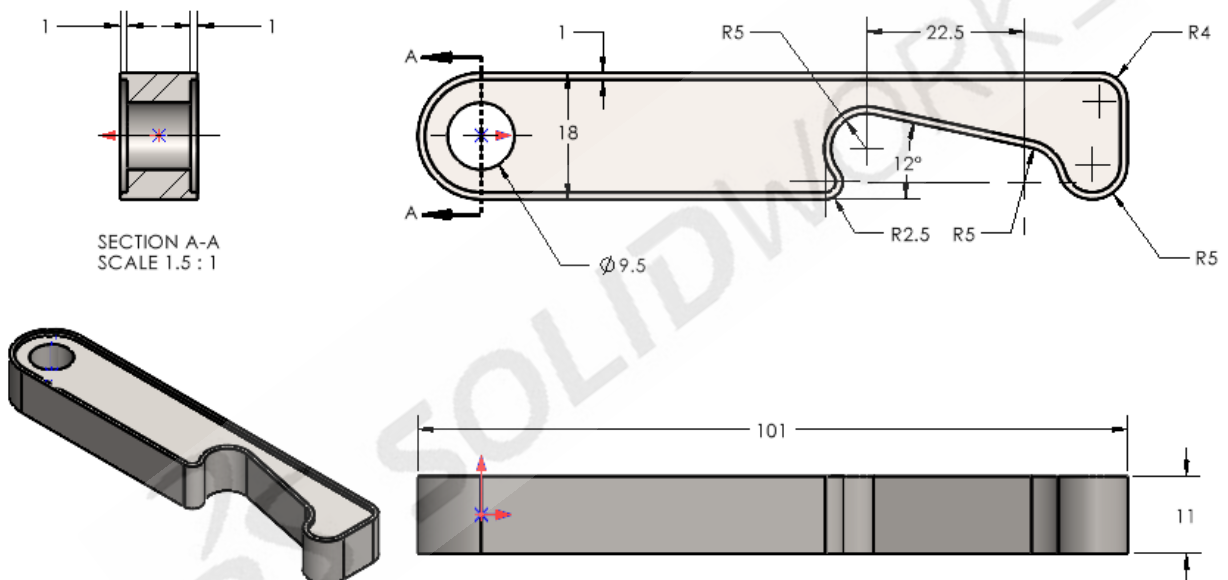
Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Sketch Fillets
- Features: Extrude Boss

HINT: Edge thickness is constant.

Volume: 13031 mm³

SECTION A-A
SCALE 1.5 : 1

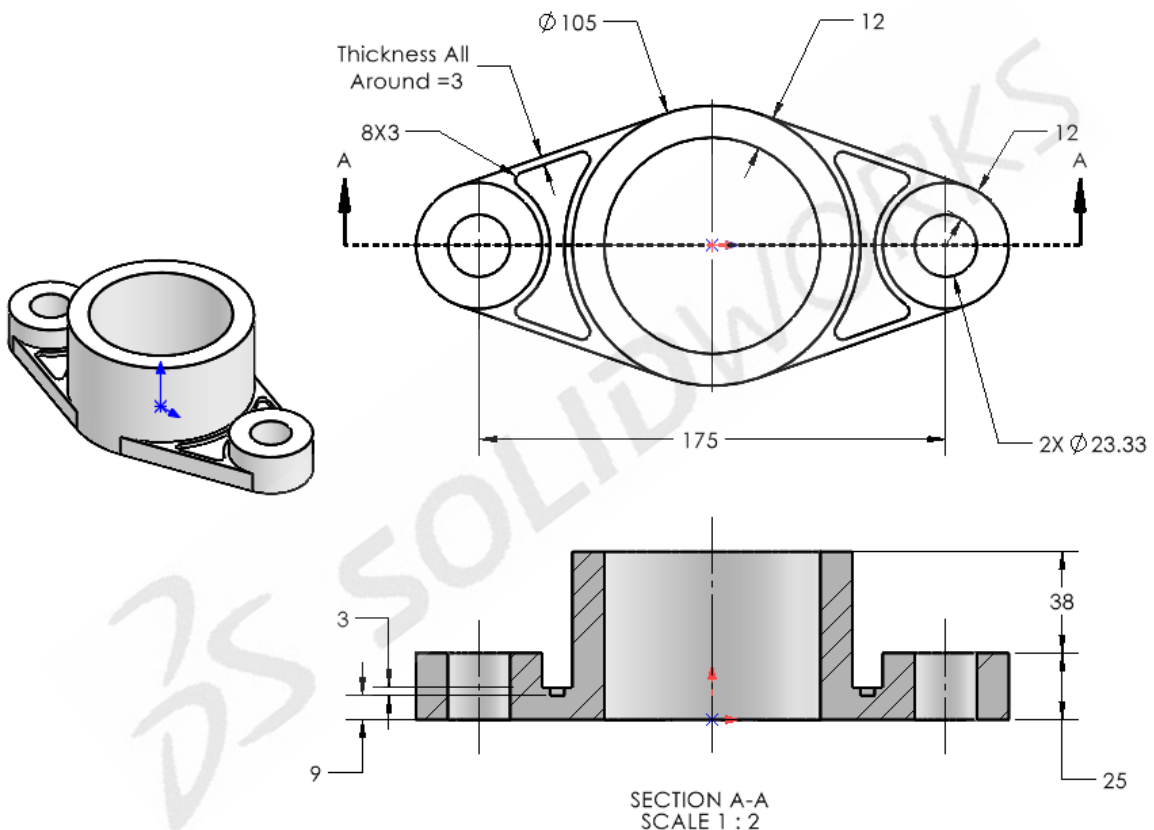**DASSAULT SYSTEMES**
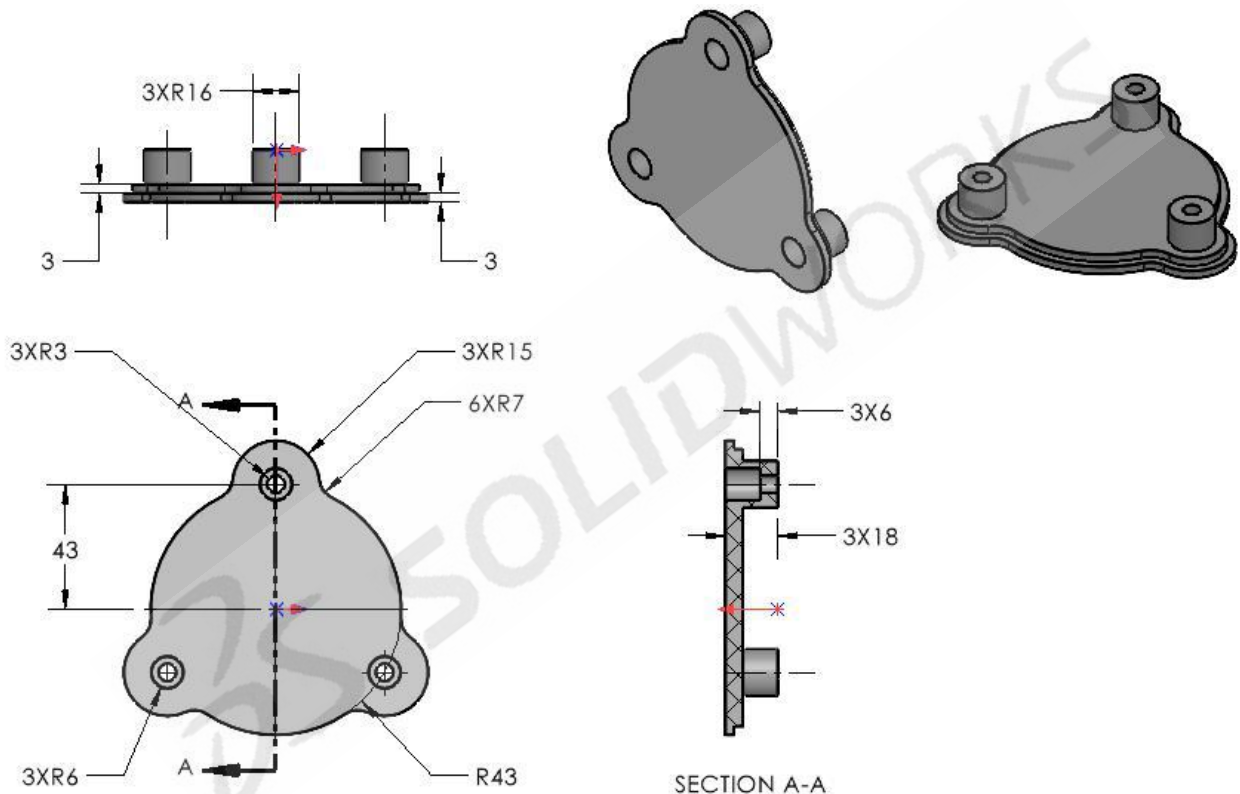
Practice Problem 2.3

Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs, Offset Entities
- Features: Extrude Boss

Volume: 325633 mm³

Thickness All Around =3

Ø 105   12

8X3   12

A   A

2X Ø 23.33

175

SECTION A-A
SCALE 1 : 2

3   38

9   25

Practice Problem 2.4
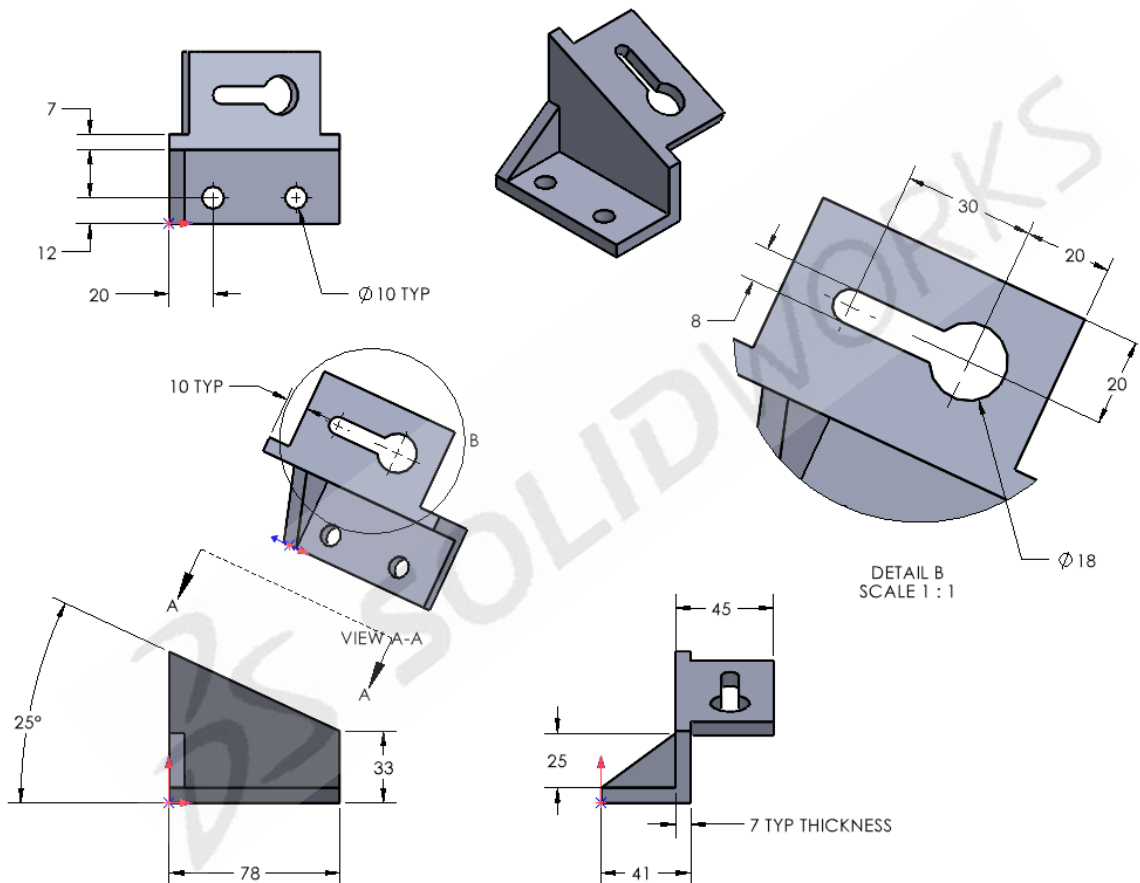
Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs
- Features: Extrude Boss

Volume: 42236 mm³

3XR16

3

3

3XR3

3XR15

6XR7

A

43

A

3XR6

R43

3X6

3X18

SECTION A-A

Practice Problem 2.5
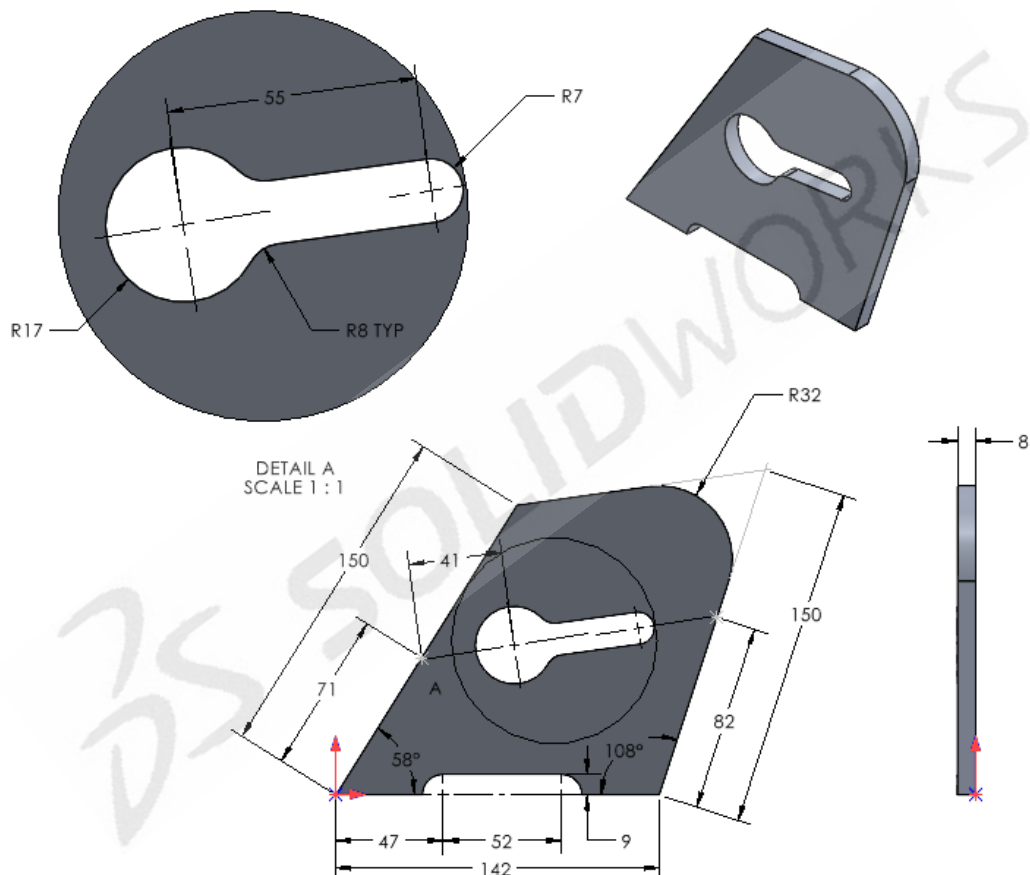
Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Slots
- Features: Extrude Boss

HINT: Plane is not required. Sketch on the angled face of the extrusion.

Volume: 62810 mm³

Practice Problem 2.6

Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 20
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs, Slots
- Features: Extrude Boss

HINT: Use construction lines.

Volume: 109681 mm³

DETAIL A
SCALE 1 : 1

3S DASSAULT SYSTEMES
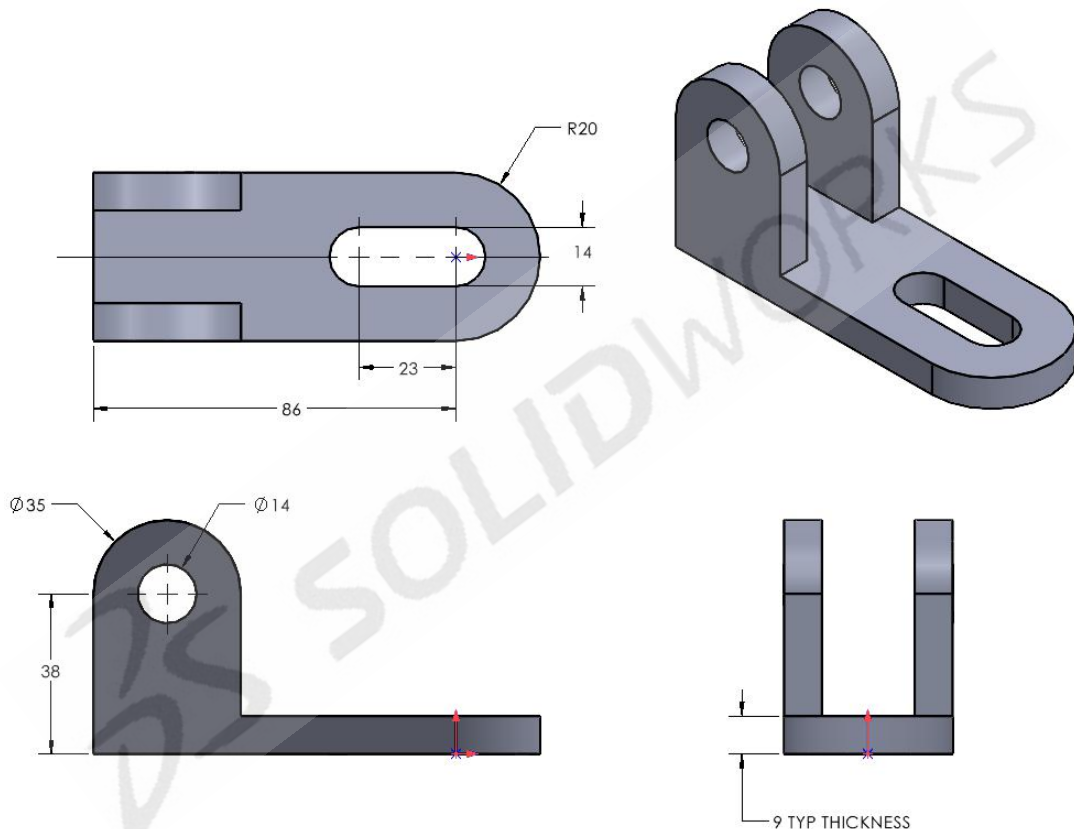
Practice Problem 2.7
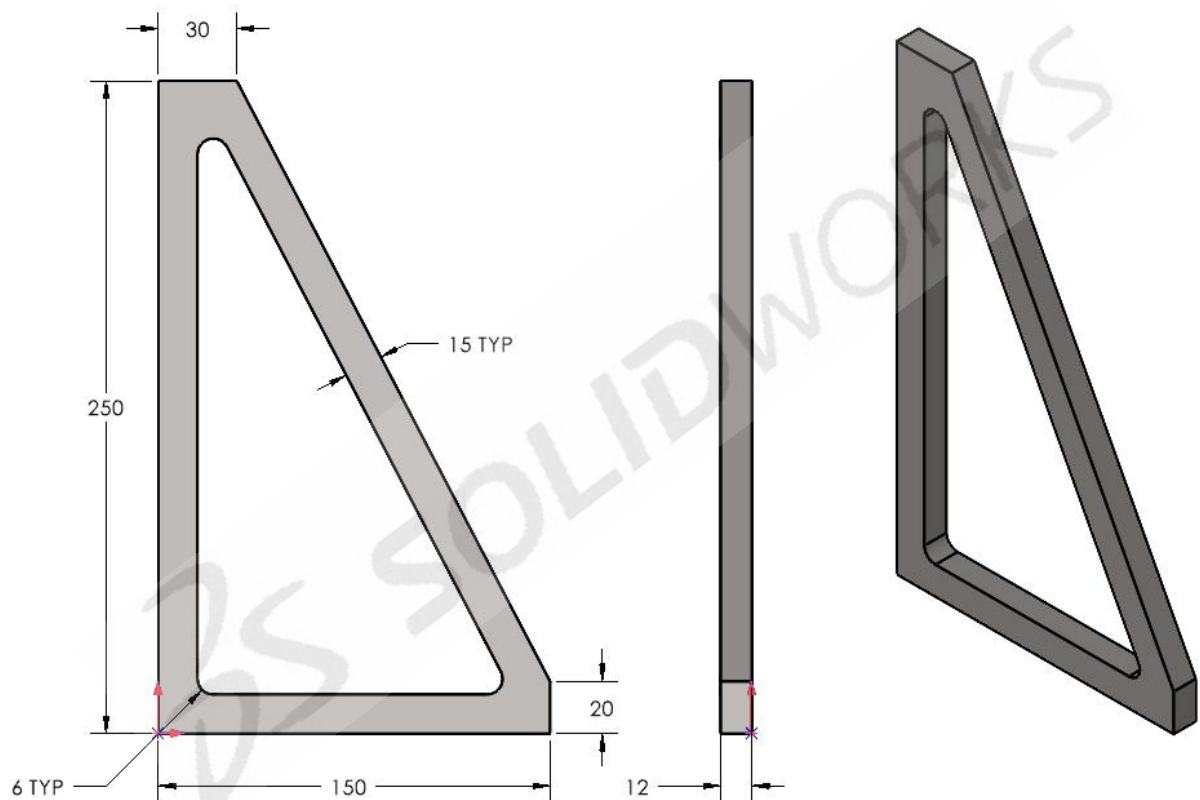
Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim, Rectangles, Slots
- Features: Extrude Boss

Volume: 56490 mm³
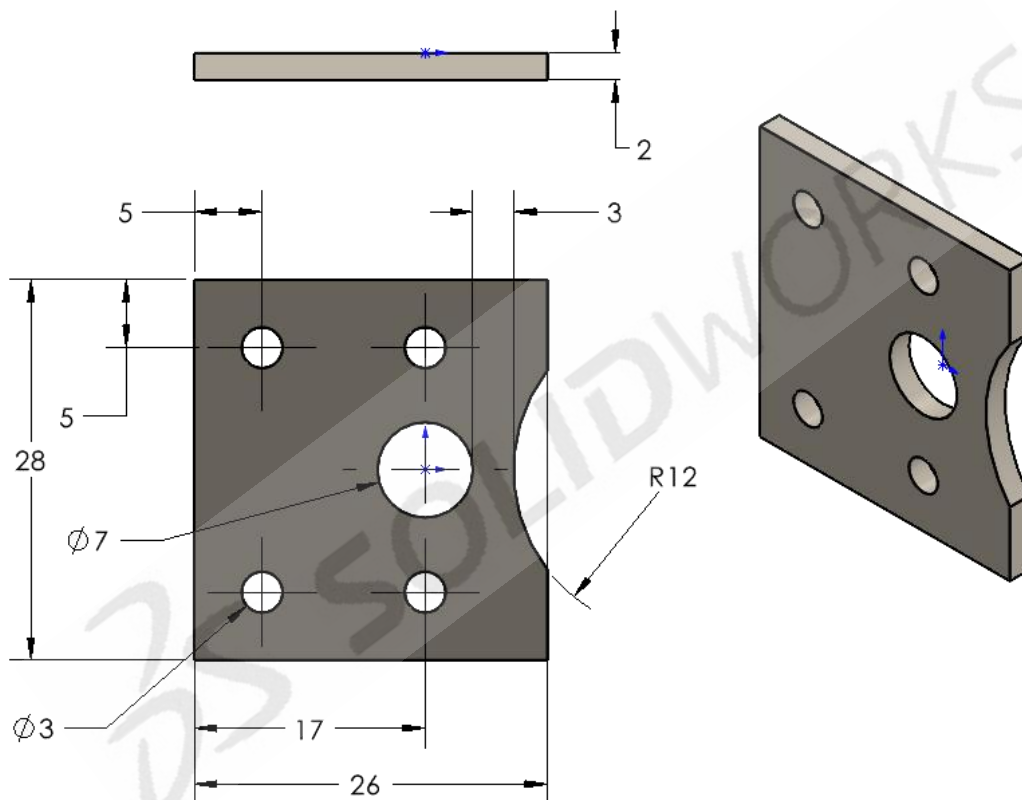
Practice Problem 2.8

Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Trim, Offset Entities
- Features: Extrude Boss

HINT: Offset from outer edge.

Volume: 118440 mm³

Practice Problem 2.9
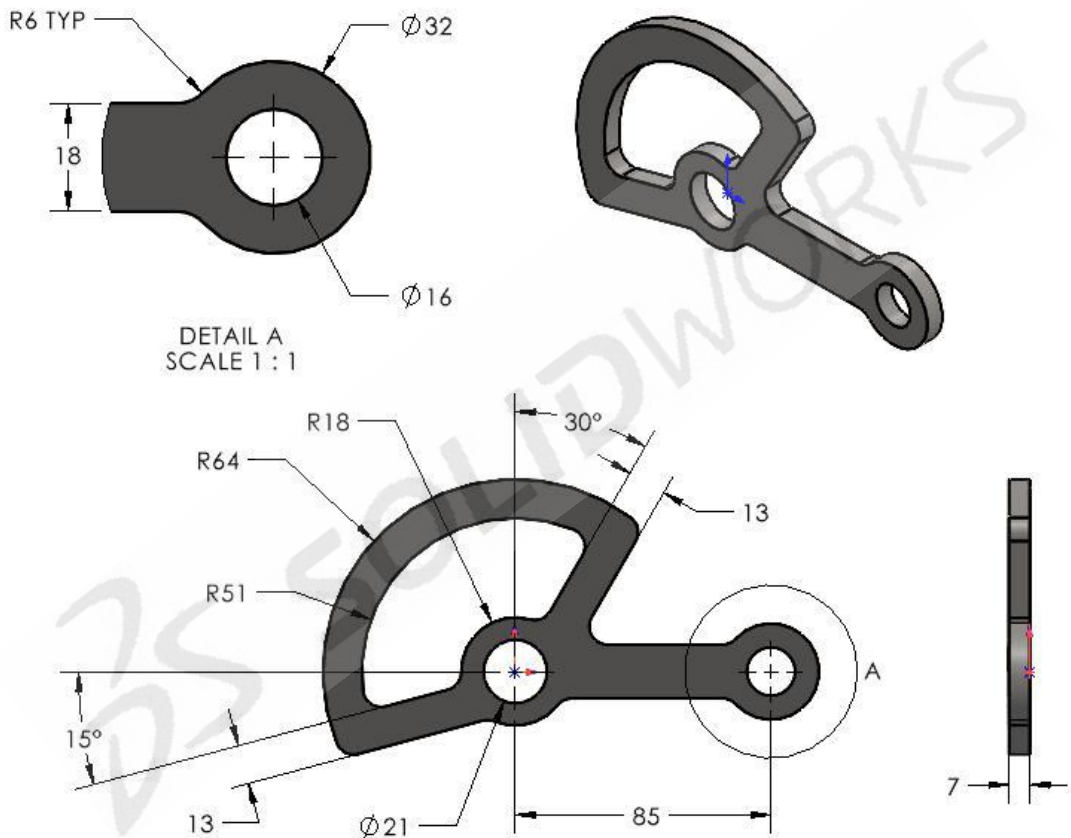
Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim, Rectangles
- Features: Extrude Boss

Volume: 1273 mm³

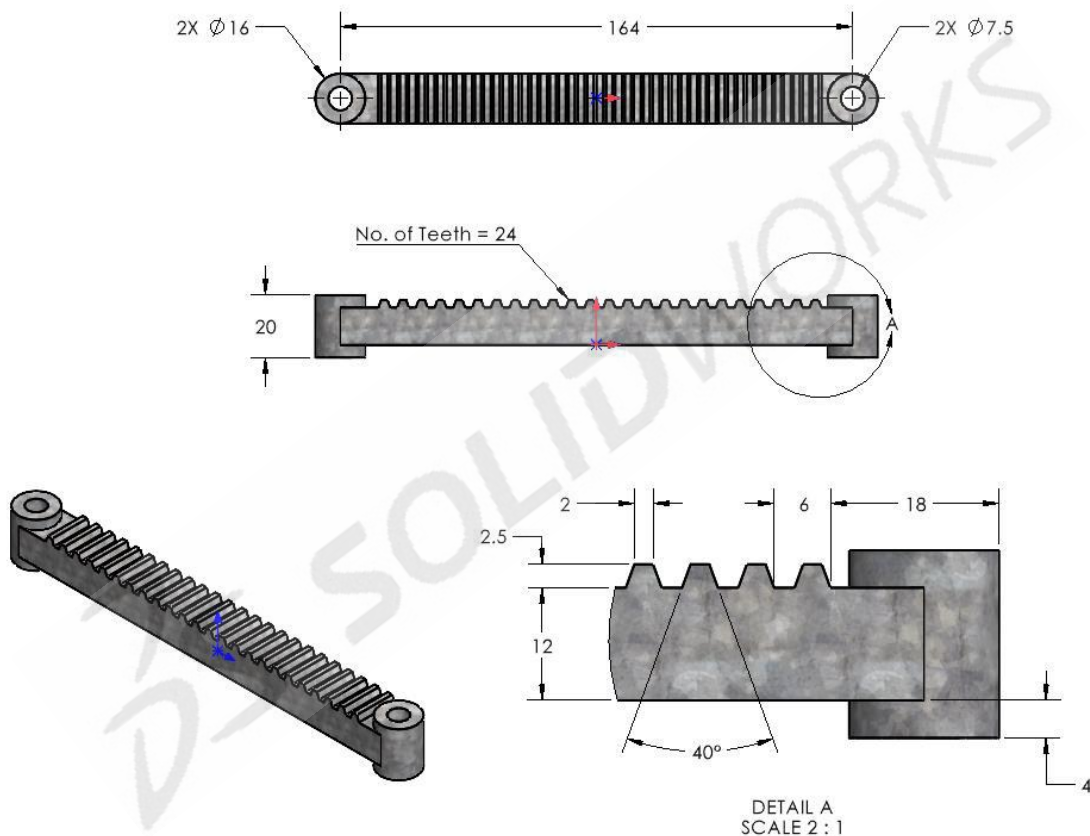# Practice Problem 2.10

Sketch Tools & End Conditions (Level 2)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arc, Sketch Fillets, Trim
- Features: Extrude Boss

HINT: Start with circles, arcs, and lines and trim.

Volume: 36748 mm³

R6 TYP
Ø32
18
Ø16

DETAIL A
SCALE 1 : 1

R18
R64
30°
13
R51
A
15°
13
Ø21
85
7

Practice Problem 3.1
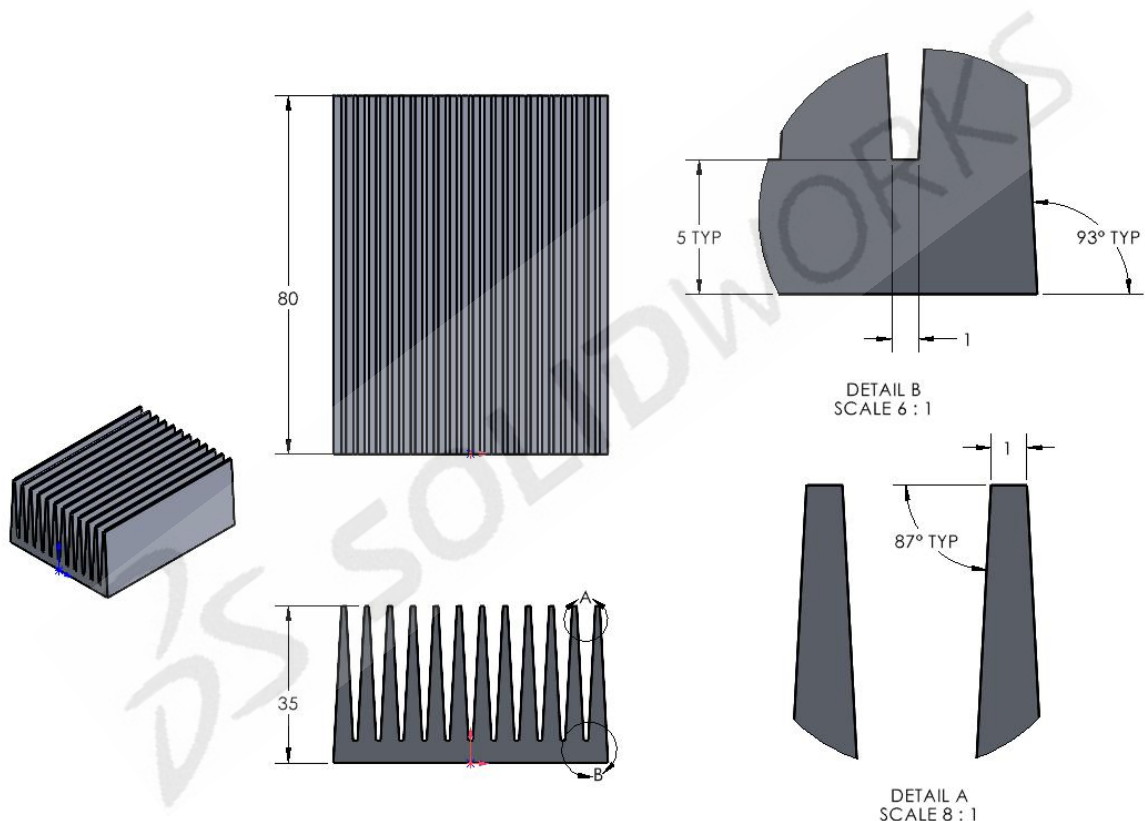
Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Sketch Patterns
- Features: Extrude Boss

HINT: Use a Linear Sketch pattern to create the teeth.

Volume: 38144 mm³

2X Ø16   164   2X Ø7.5

No. of Teeth = 24

20

A

2   6   18

2.5

12

40°

4

DETAIL A
SCALE 2 : 1

3S DASSAULT SYSTEMES

Practice Problem 3.2

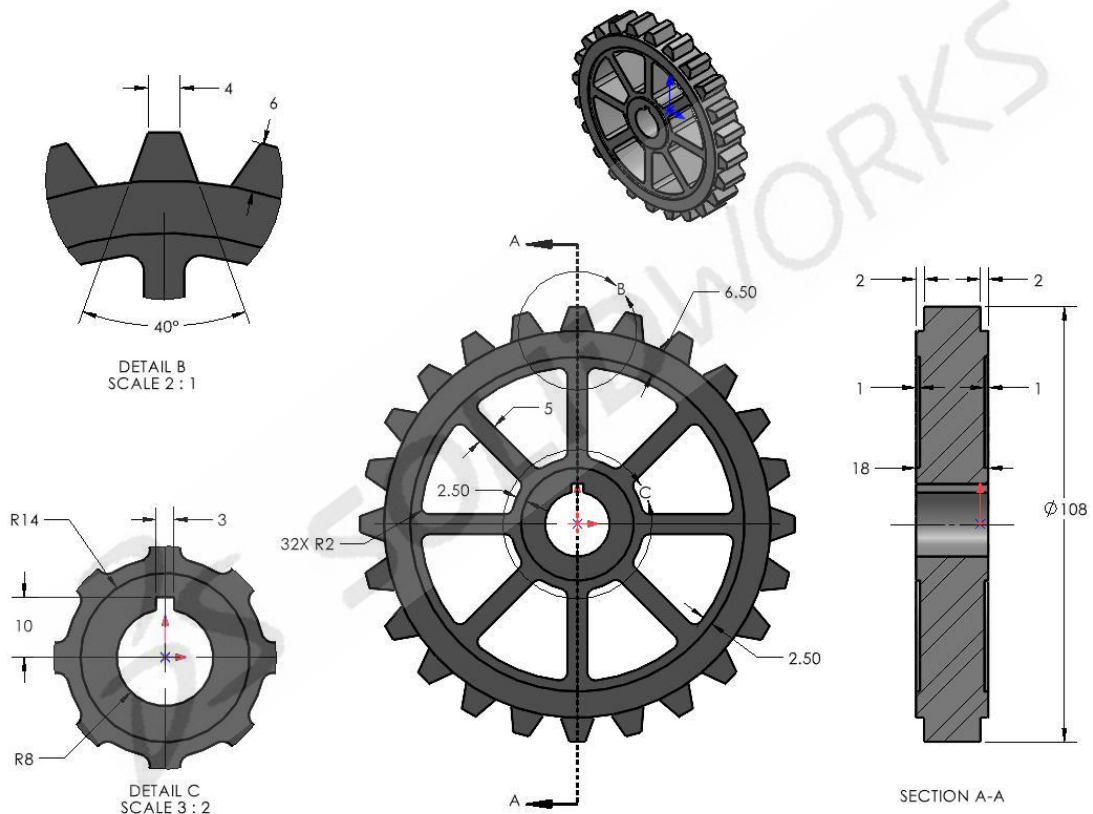## Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - o The part's origin location is indicated in red.
    - o The part is symmetric.
    - o All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Sketch Patterns
- Features: Extrude Boss

HINT: Use a Linear Sketch pattern to create the vanes.

Volume: 98479 mm³

80

35

5 TYP

93° TYP

1

DETAIL B
SCALE 6 : 1

1

87° TYP

DETAIL A
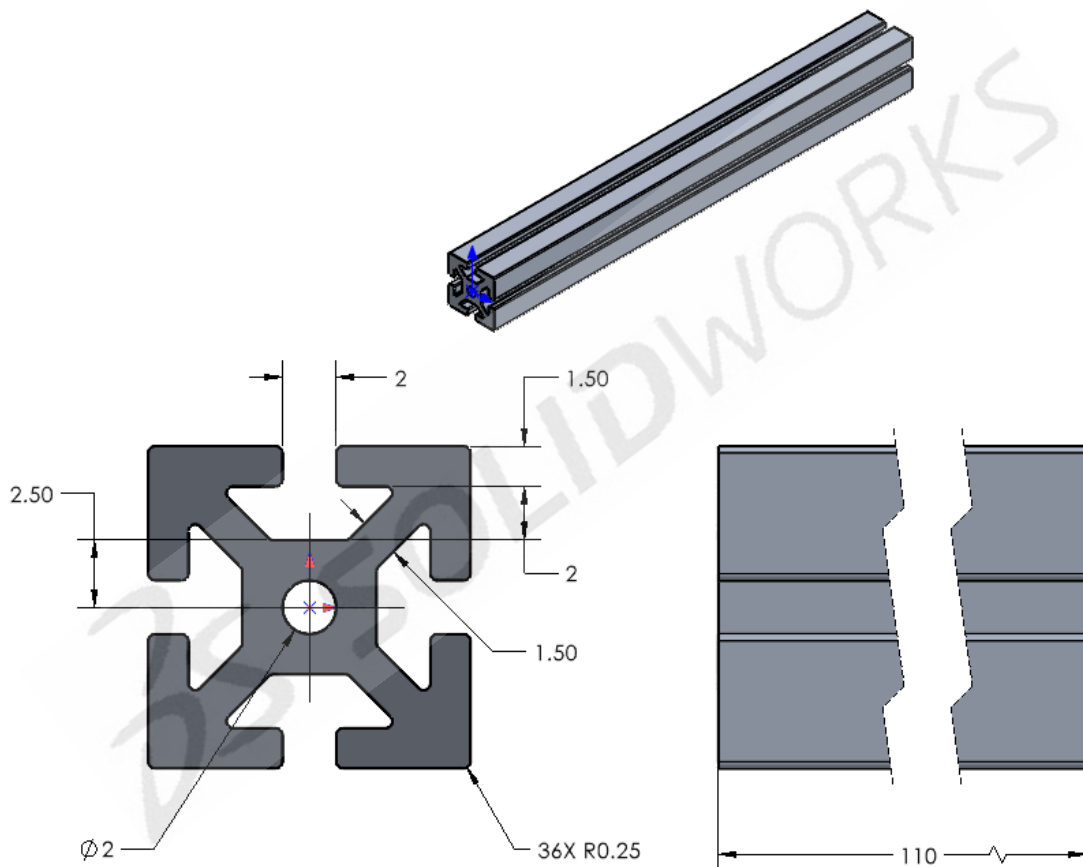SCALE 8 : 1

A

B

Practice Problem 3.3
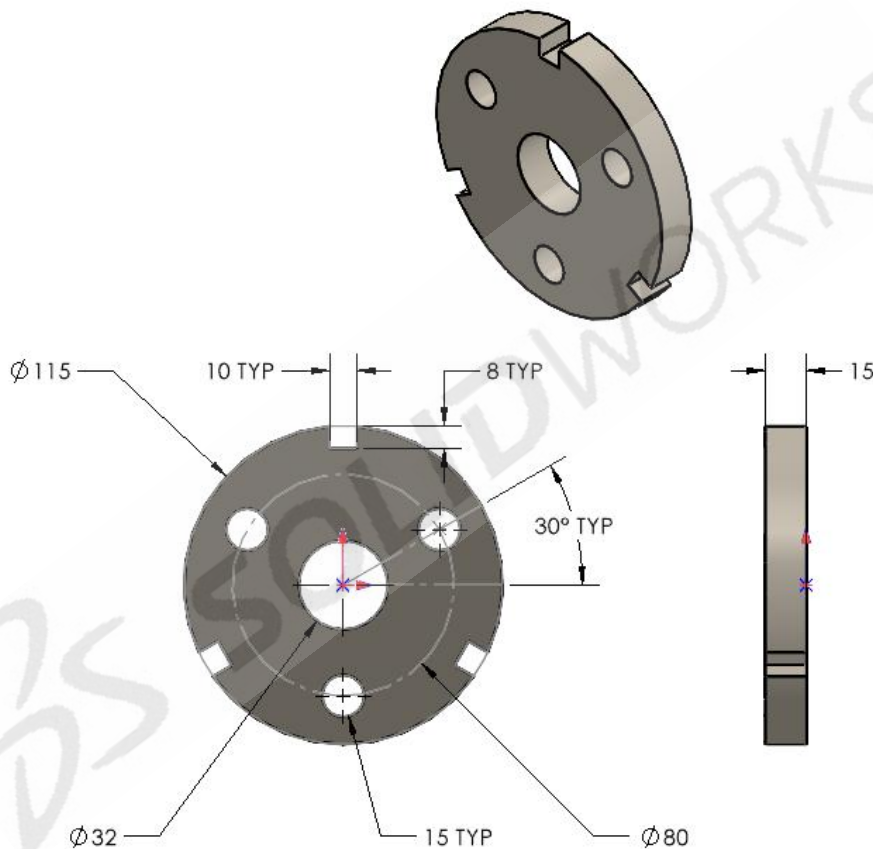
Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Arcs, Sketch Patterns, Sketch Fillets, Offset Entities
- Features: Extrude Boss

HINT: There are 24 gear teeth.

Volume: 81601 mm³

DETAIL B
SCALE 2 : 1

40°
4
6

DETAIL C
SCALE 3 : 2

R14
3
10
R8

A
B
6.50
5
2.50
32X R2
C
2.50
A

SECTION A-A

2
2
1
1
18
Ø108

3S SOLIDWORKS

3DEXPERIENCE

Practice Problem 3.4

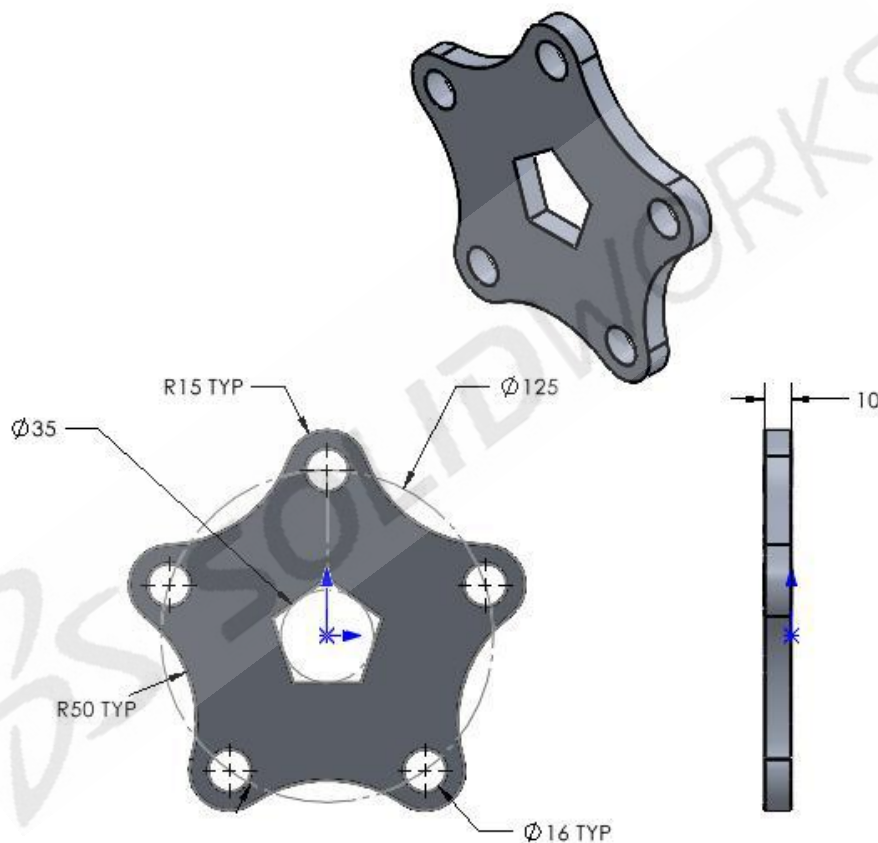## Global Variables&Sketch Patterns (Level 3)
- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features
- Sketch: Lines, Circles, Centerlines, Sketch Patterns, Trim, Offset Entities, Sketch Fillets
- Features: Extrude Boss

Volume: 9921 mm³
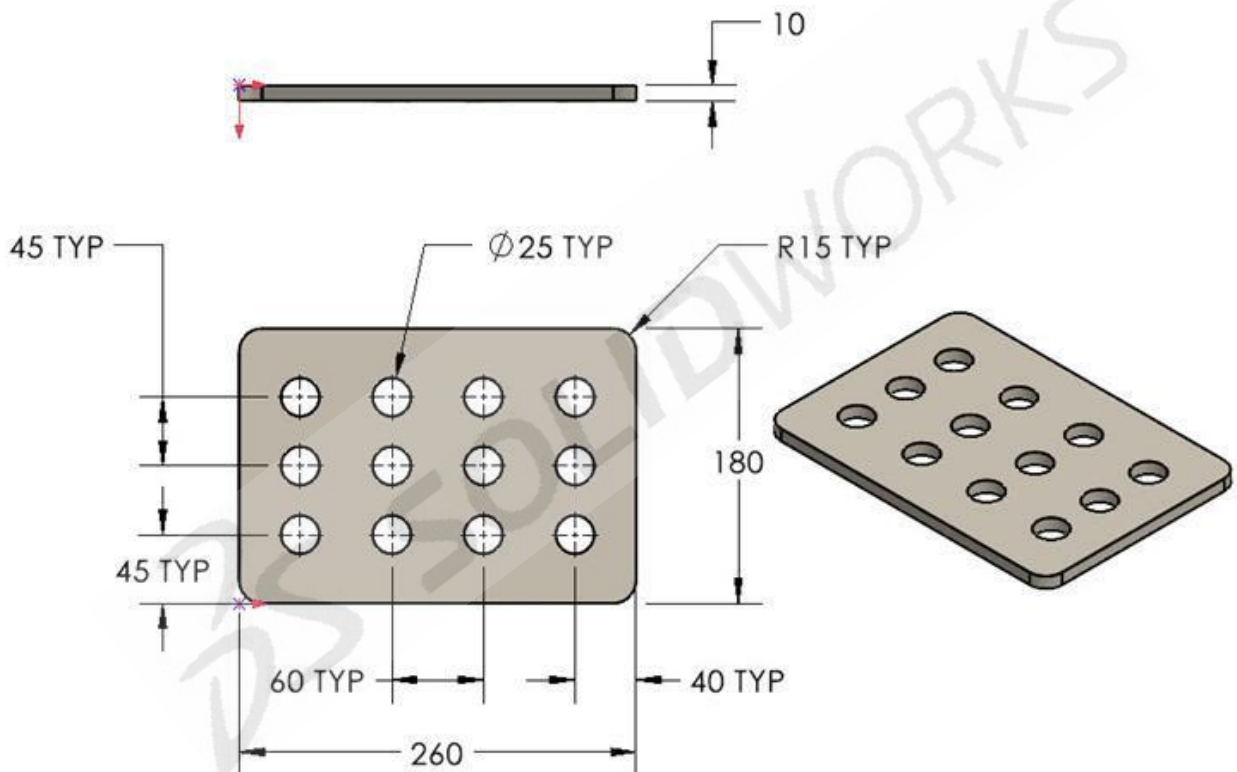
3S DASSAULT SYSTEMES

Practice Problem 3.5

Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Rectangles, Sketch Patterns
- Features: Extrude Boss

HINT: Use a circular sketch pattern.

Volume: 132122 mm³

3DEXPERIENCE

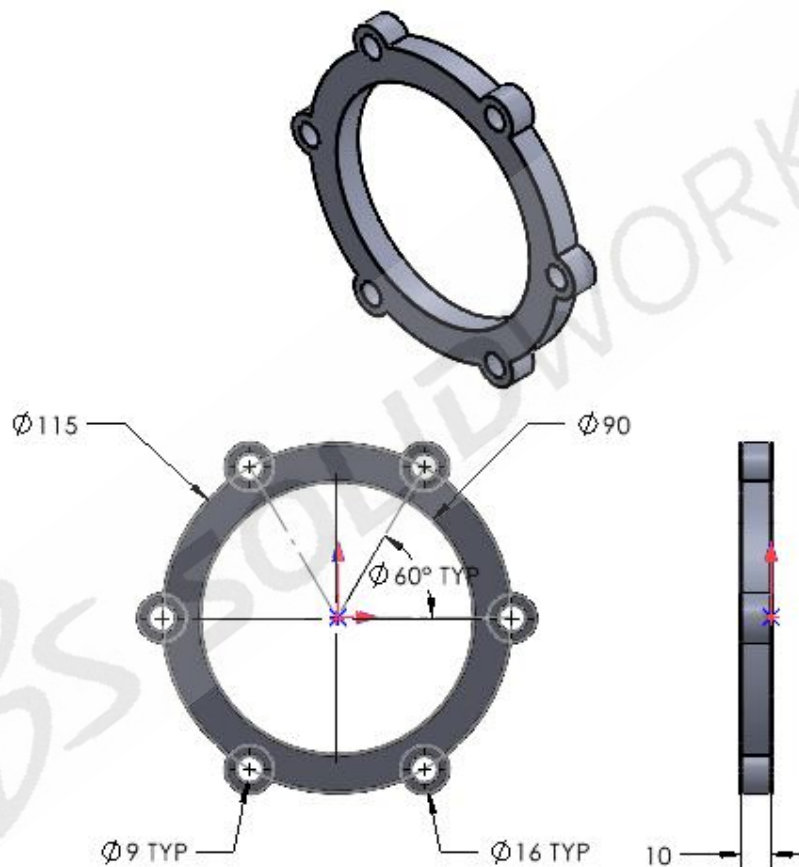# Practice Problem 3.6

Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Arcs, Polygons, Sketch Patterns
- Features: Extrude Boss

HINT: Use a 5-sided polygon.

Volume: 108939 mm³

3S DASSAULT SYSTEMES

Practice Problem 3.7
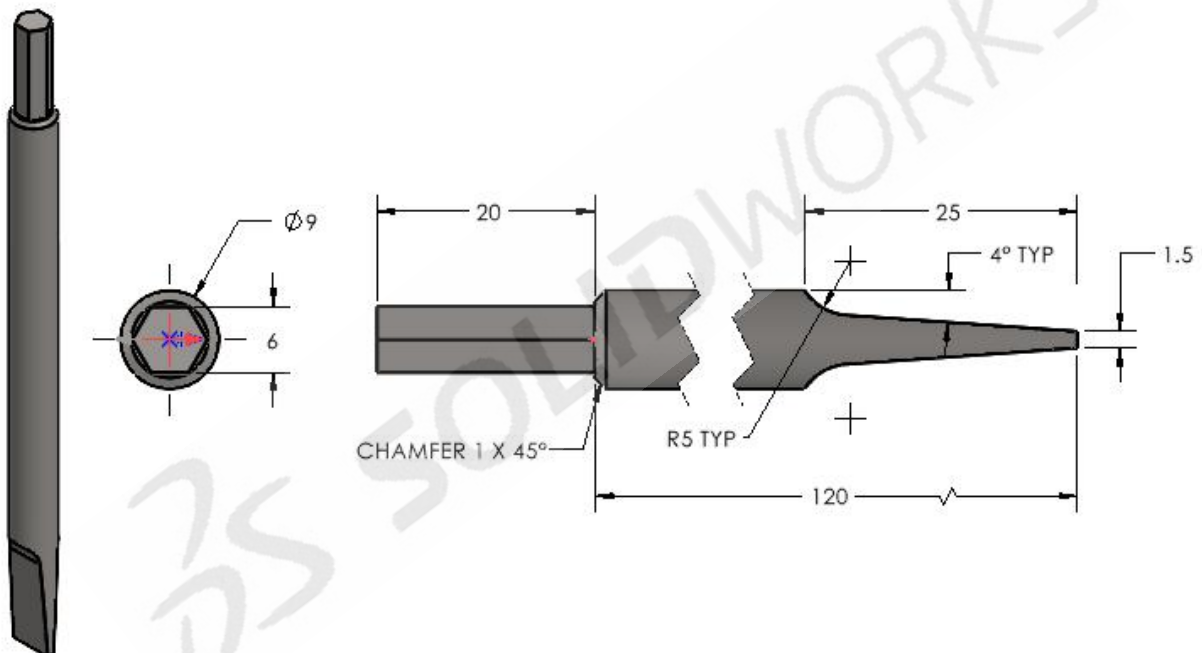
Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Rectangles, Sketch Patterns
- Features: Extrude Boss

Volume: 407164 mm³

Practice Problem 3.8

Global Variables&Sketch Patterns (Level 3)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Polygons, Sketch Patterns
- Features: Extrude Boss

HINT: Bosses are centered on the edges.

Volume: 50984 mm³

Ø115 Ø90 Ø 60° TYP Ø9 TYP Ø16 TYP 10
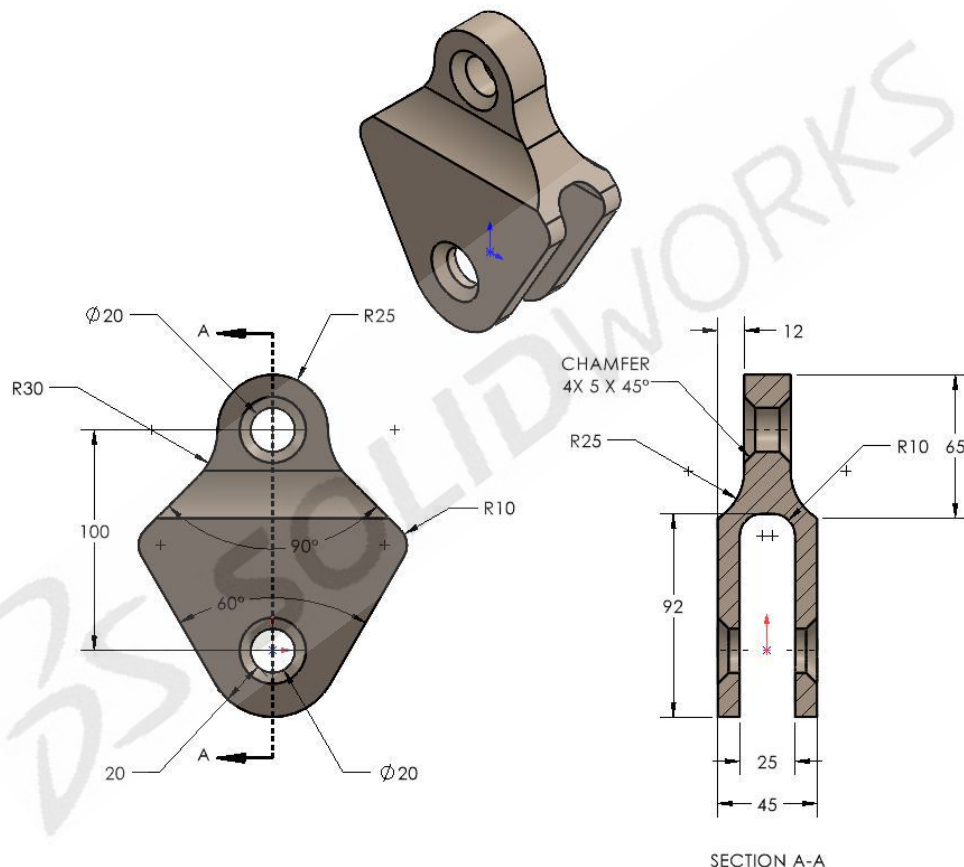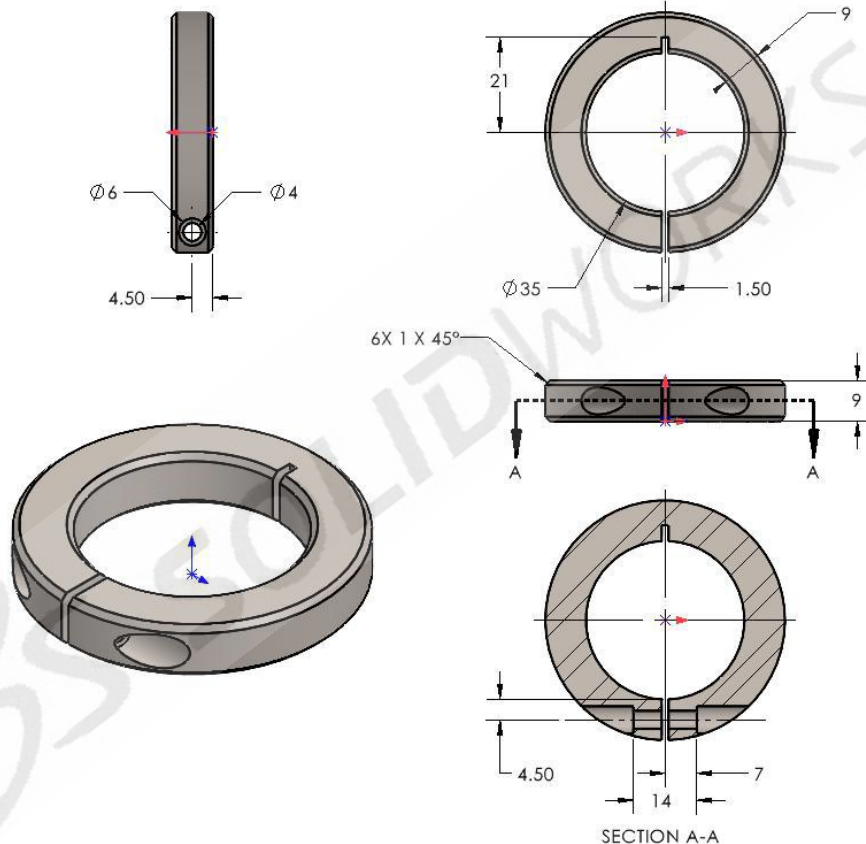
Practice Problem 4.1

Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - o The part's origin location is indicated in red.
  - o The part is symmetric.
  - o All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers

HINT: Use the Polygon tool to create hex.

Volume: 7393 mm³
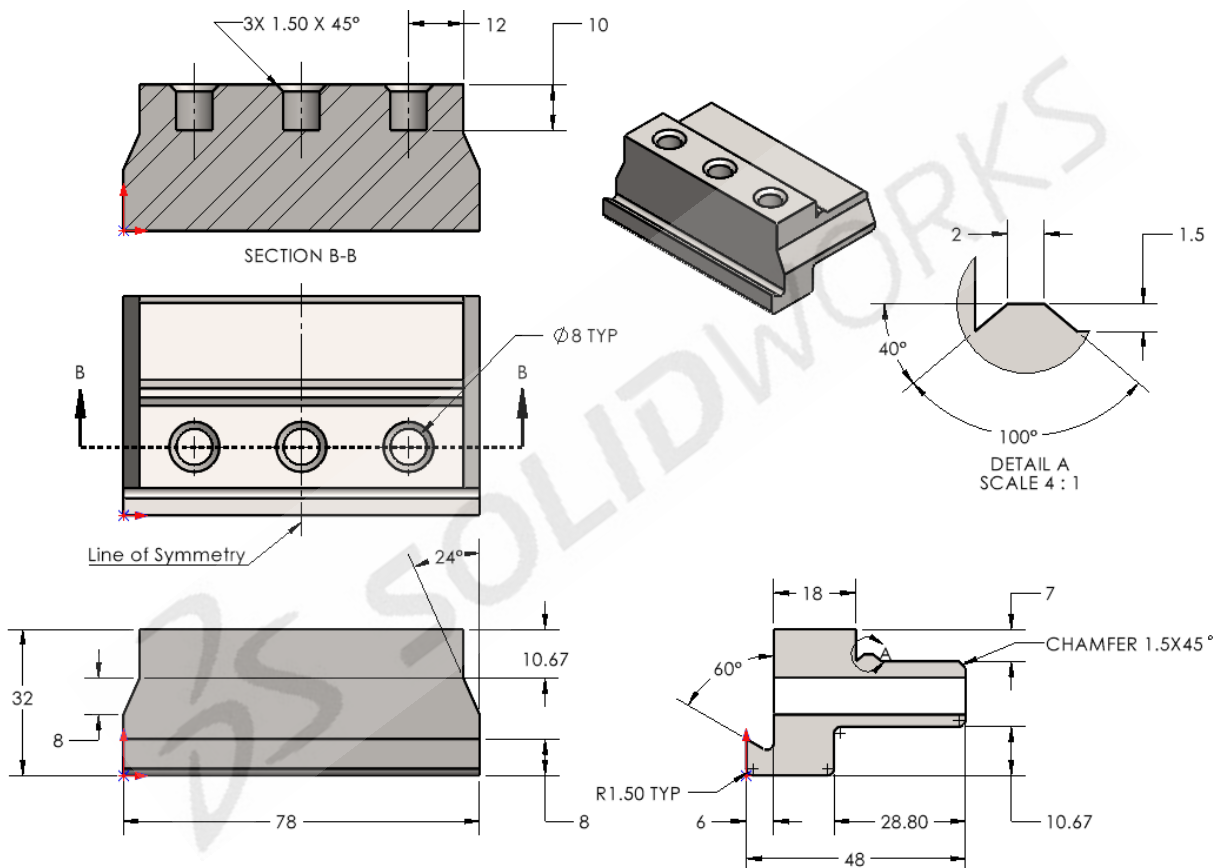
Practice Problem 4.2

Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arc, Sketch Fillets
- Features: Extrude Boss, Extrude Cut

Volume: 226455 mm³

SECTION A-A

Practice Problem 4.3

Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - o The part's origin location is indicated in red.
  - o The part is symmetric.
  - o All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers

Volume: 10173 mm³

SECTION A-A
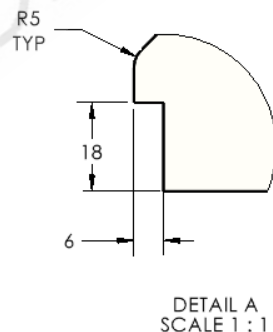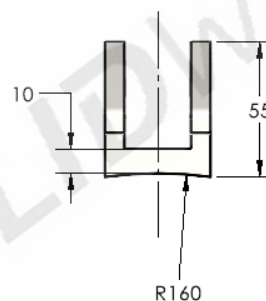
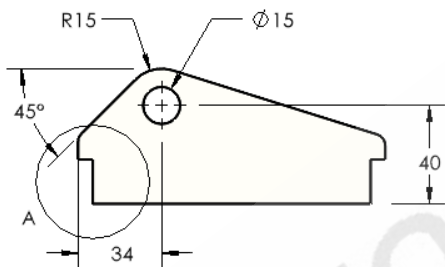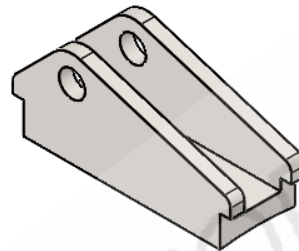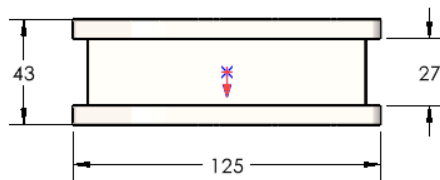# Practice Problem 4.4

Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers

Volume: 66273 mm³

3X 1.50 X 45°   12   10

SECTION B-B

Ø8 TYP

B — B

Line of Symmetry

24°

2 — 1.5

40°

100°

DETAIL A
SCALE 4 : 1

32

8

78

10.67

8

24°

R1.50 TYP

60°

18   7

CHAMFER 1.5X45°

6   28.80   10.67
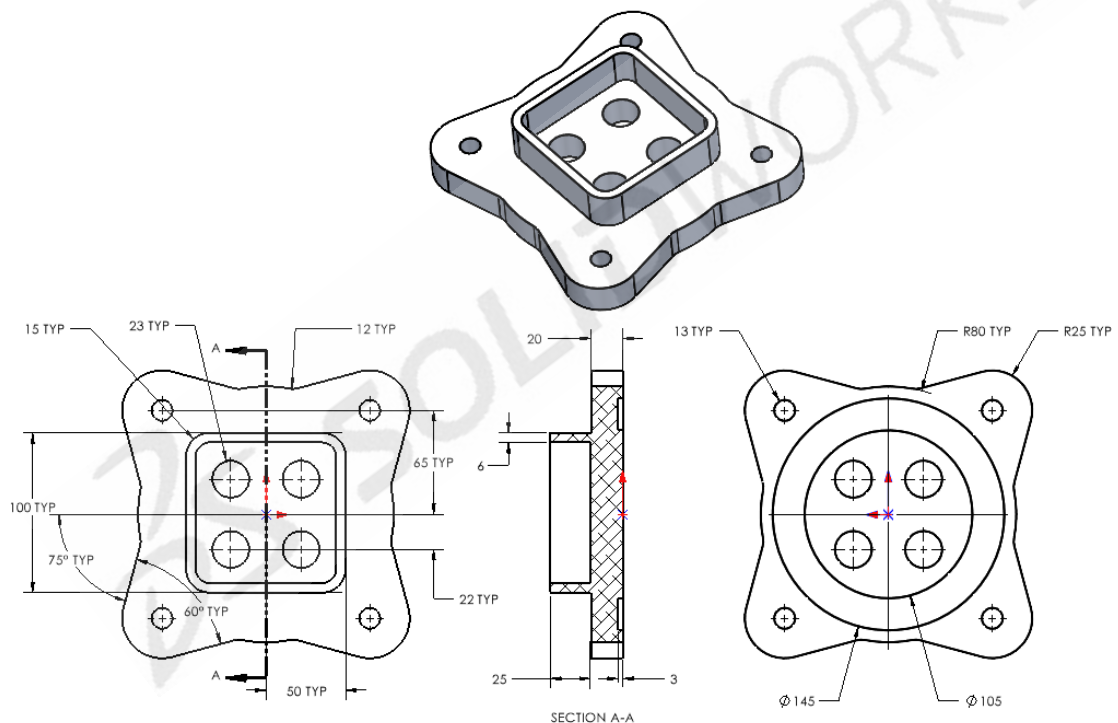
48

Practice Problem 4.5
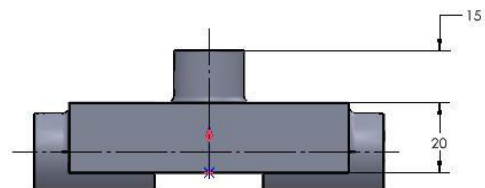
Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 20
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers

Volume: 107923 mm³

R15   Ø15

45°

A

34

R5 TYP

10   55

R160

18

6

DETAIL A
SCALE 1 : 1

43   27

125

40

Practice Problem 4.6
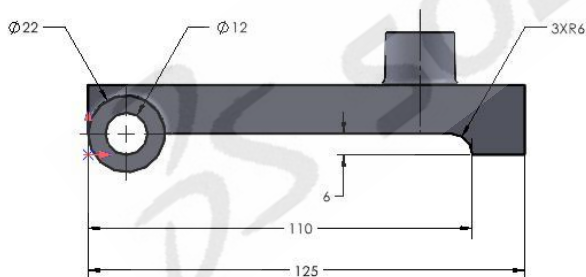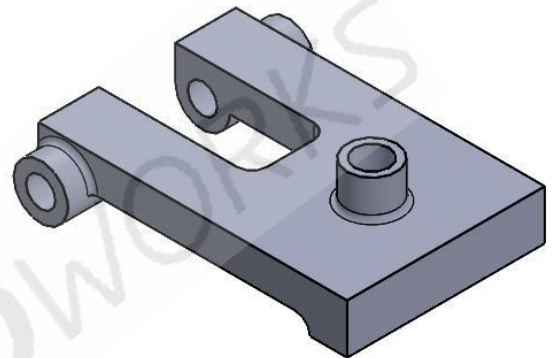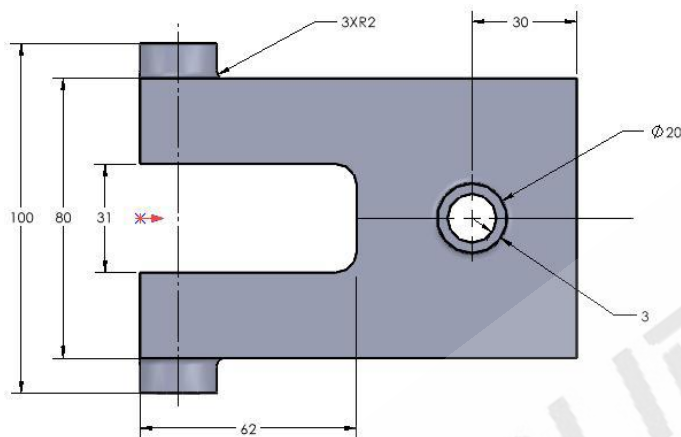
Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 35
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Sketch Fillets
- Features: Extrude Boss, Extrude Cut

Volume: 554745 mm³

Practice Problem 4.7
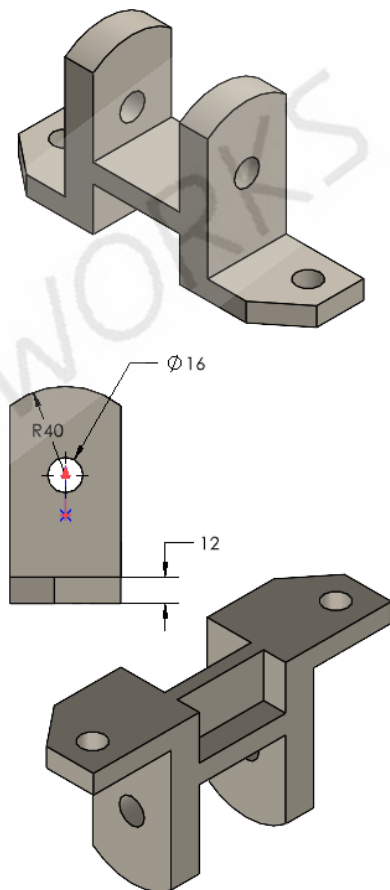
Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 25
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Rectangles
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers

HINT: Start with a rectangle, placing the lower right corner at the origin.

Volume: 130592 mm³

Practice Problem 4.8

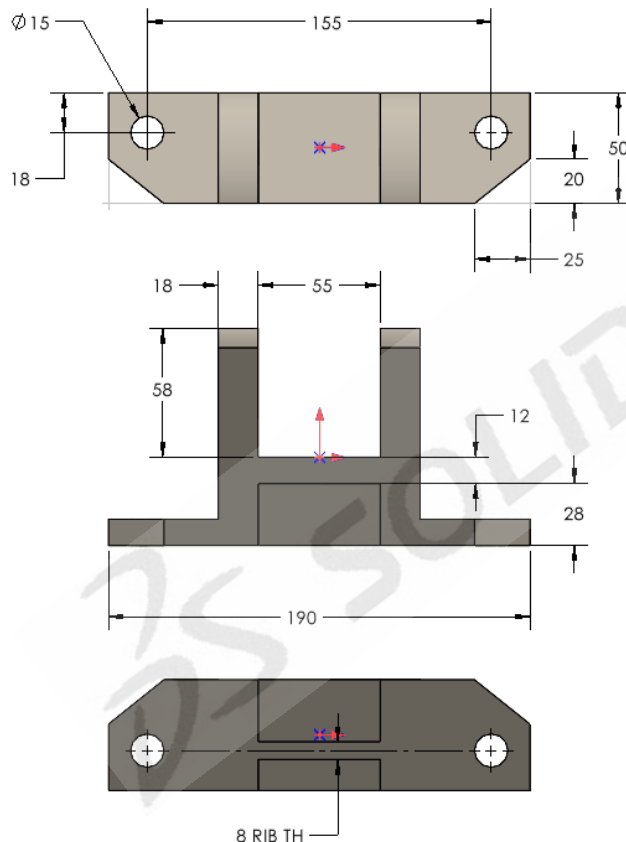## Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers

HINT: The rib is centered on the lower circular holes.
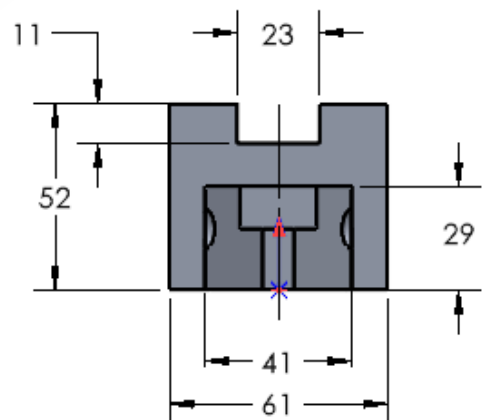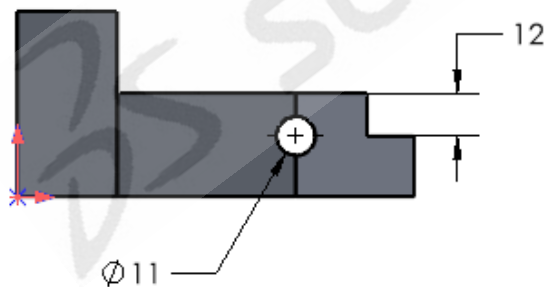
Volume: 258631 mm³
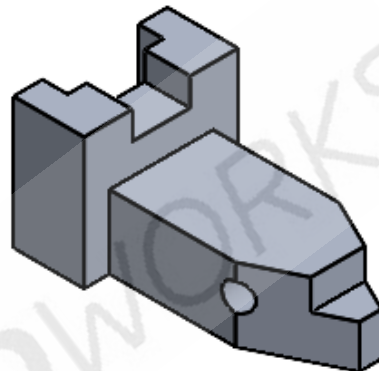
Practice Problem 4.9

Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss, Extrude Cut
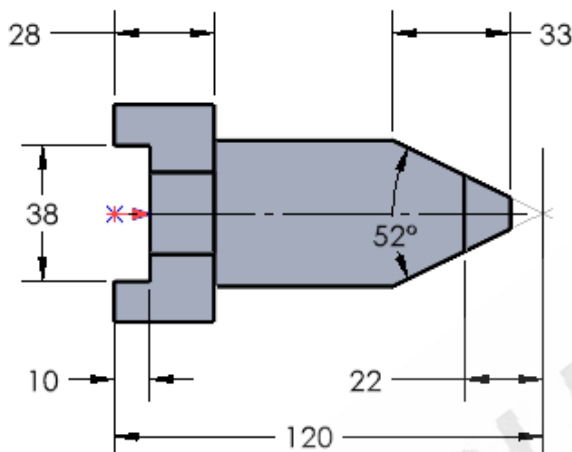
Volume: 141606 mm³

Practice Problem 4.10
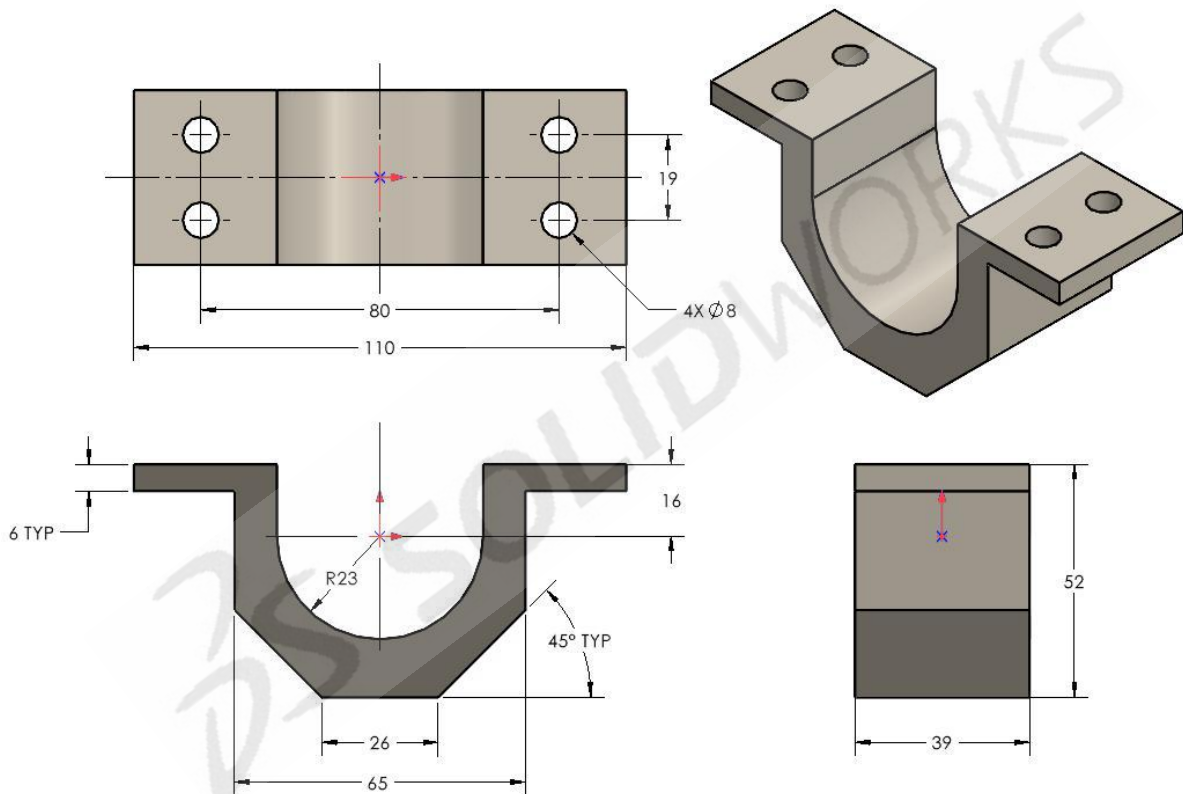
Extrude Cut & Fillet/Chamfer (Level 4)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs
- Features: Extrude Boss, Extrude Cut

HINT: Create all 8 holes in a single feature.

Volume: 65203 mm³

Practice Problem 5.1

Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is *asymmetric*.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Sketch Patterns
- Features: Extrude Boss
- Reference Geometry: Planes

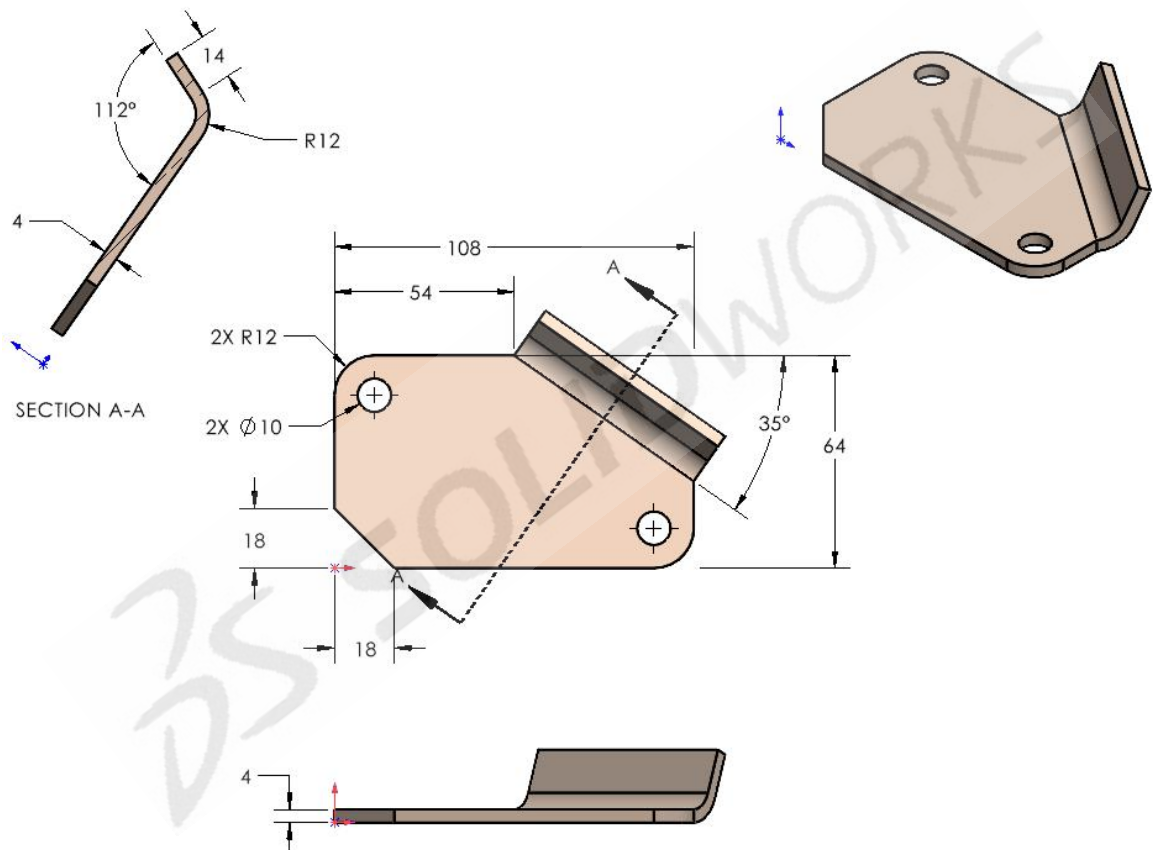**Volume:** 28862 mm³

SECTION A-A

Practice Problem 5.2
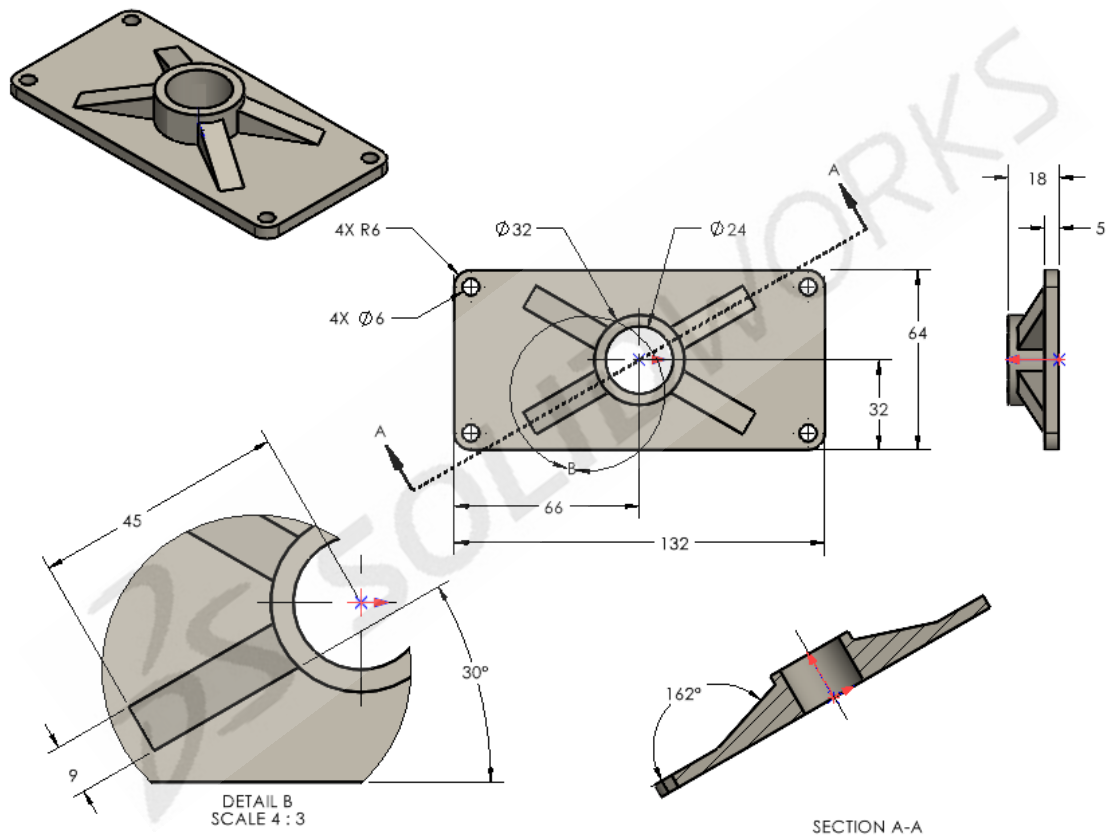
Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss
- Reference Geometry: Planes

HINT: Start ribs inside cylinder wall.

Volume: 48824 mm³

DETAIL B
SCALE 4 : 3

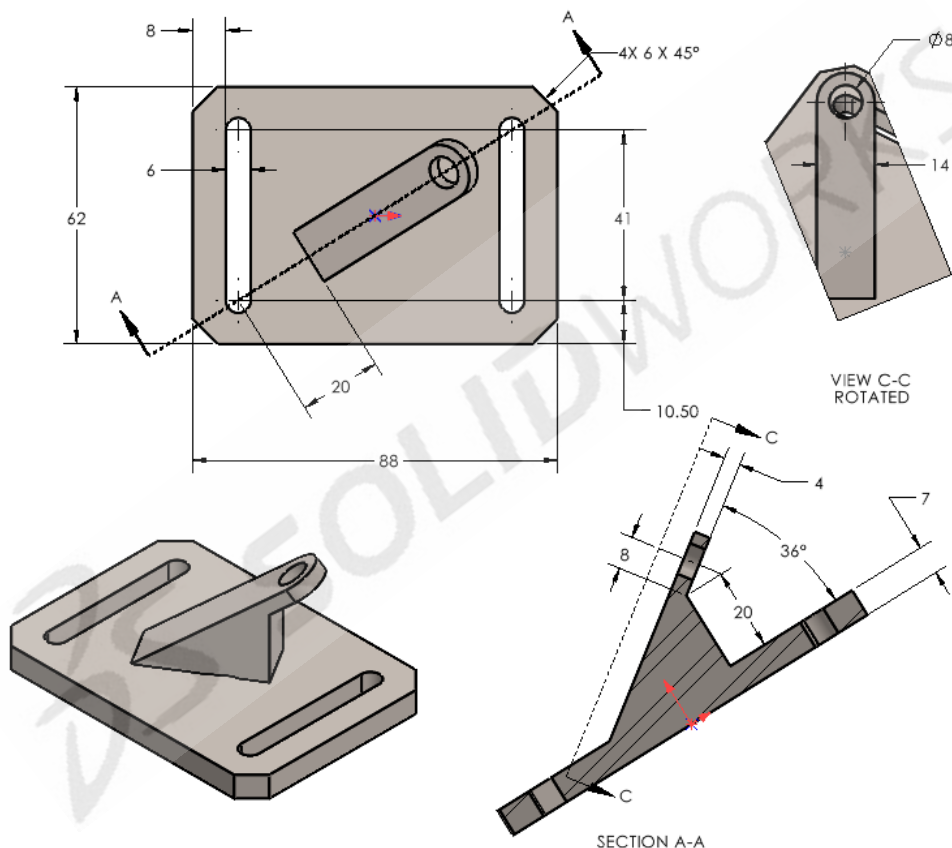SECTION A-A

Practice Problem 5.3

Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is *asymmetric*.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Rectangles, Arcs, Circles, Slots
- Features: Extrude Boss
- Reference Geometry: Planes

Volume: 40316 mm³

VIEW C-C
ROTATED

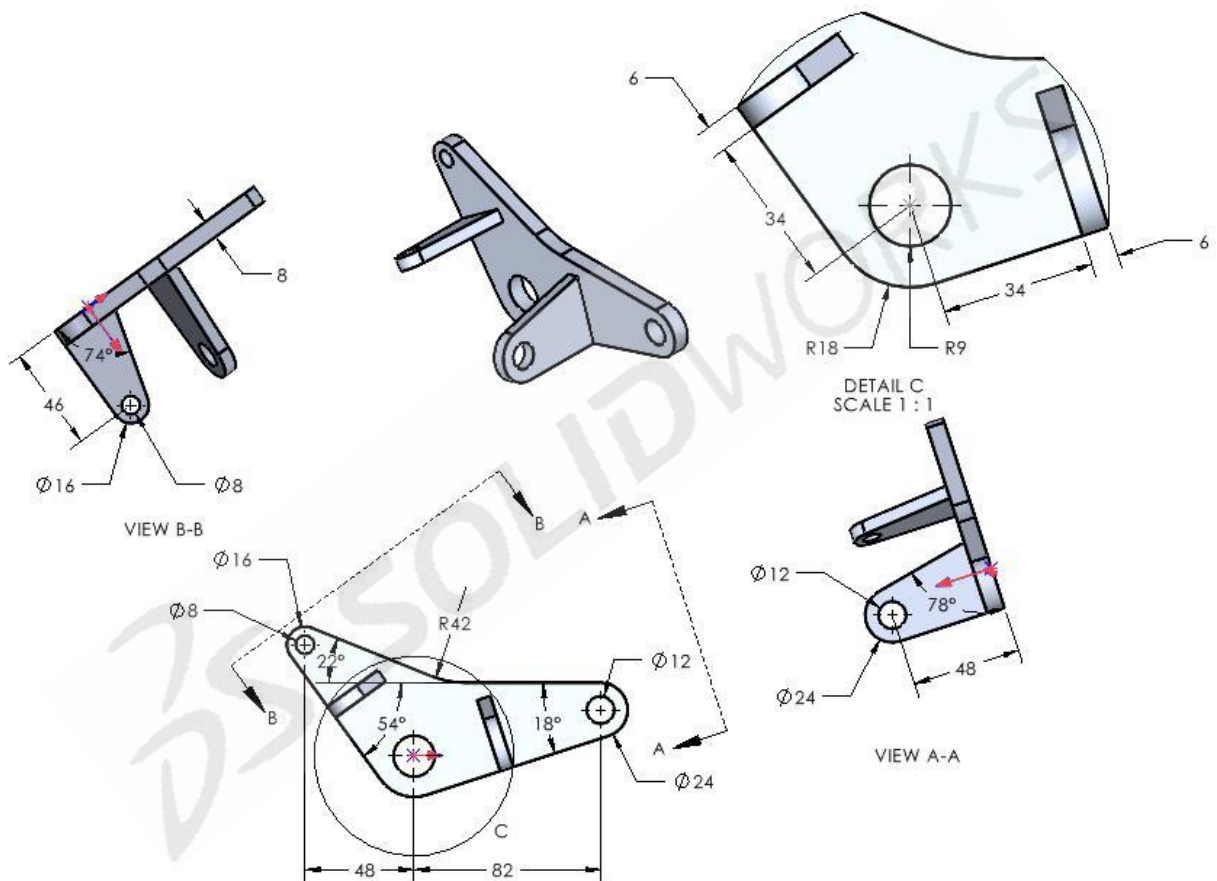SECTION A-A

Practice Problem 5.4

Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Arcs, Circles, Sketch Fillets
- Features: Extrude Boss
- Reference Geometry: Planes

Volume: 54372 mm³

DETAIL C
SCALE 1 : 1

VIEW B-B

VIEW A-A

Practice Problem 5.6

Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 35
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers
- Reference Geometry: Planes

Volume: 2344 mm³

SECTION A-A
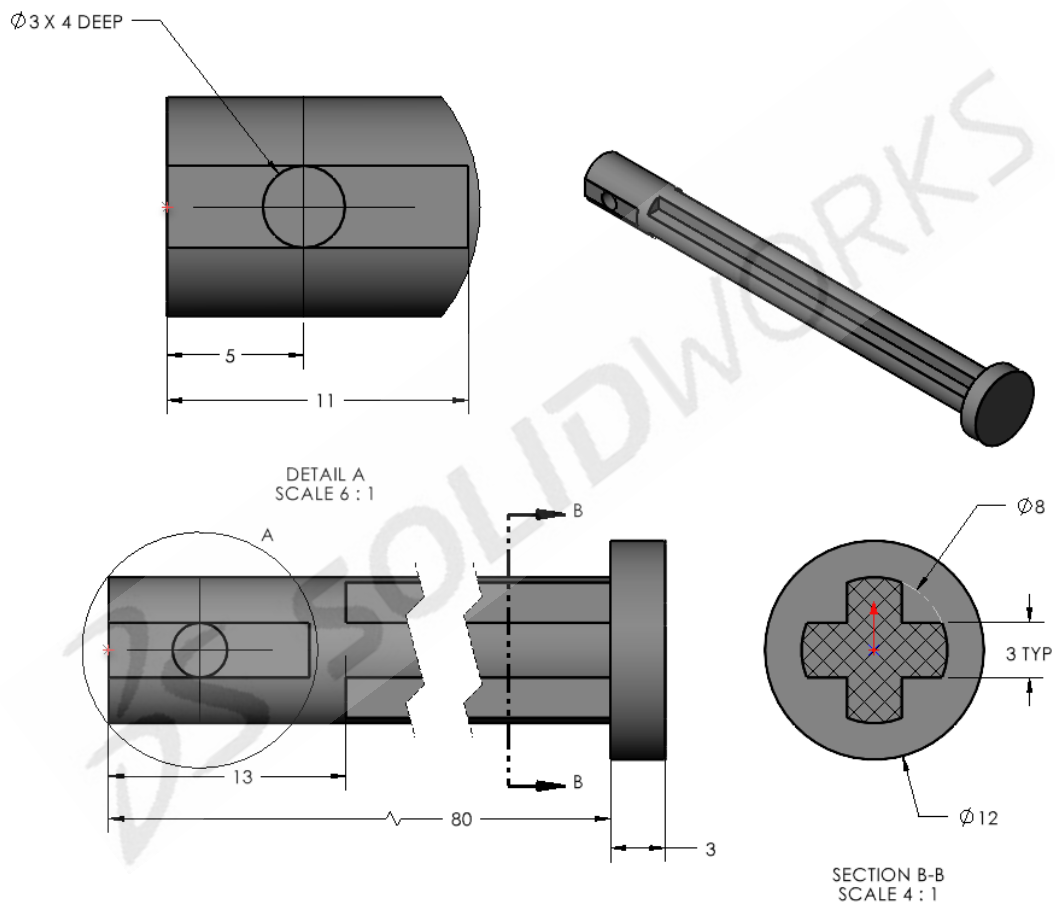
Practice Problem 5.7
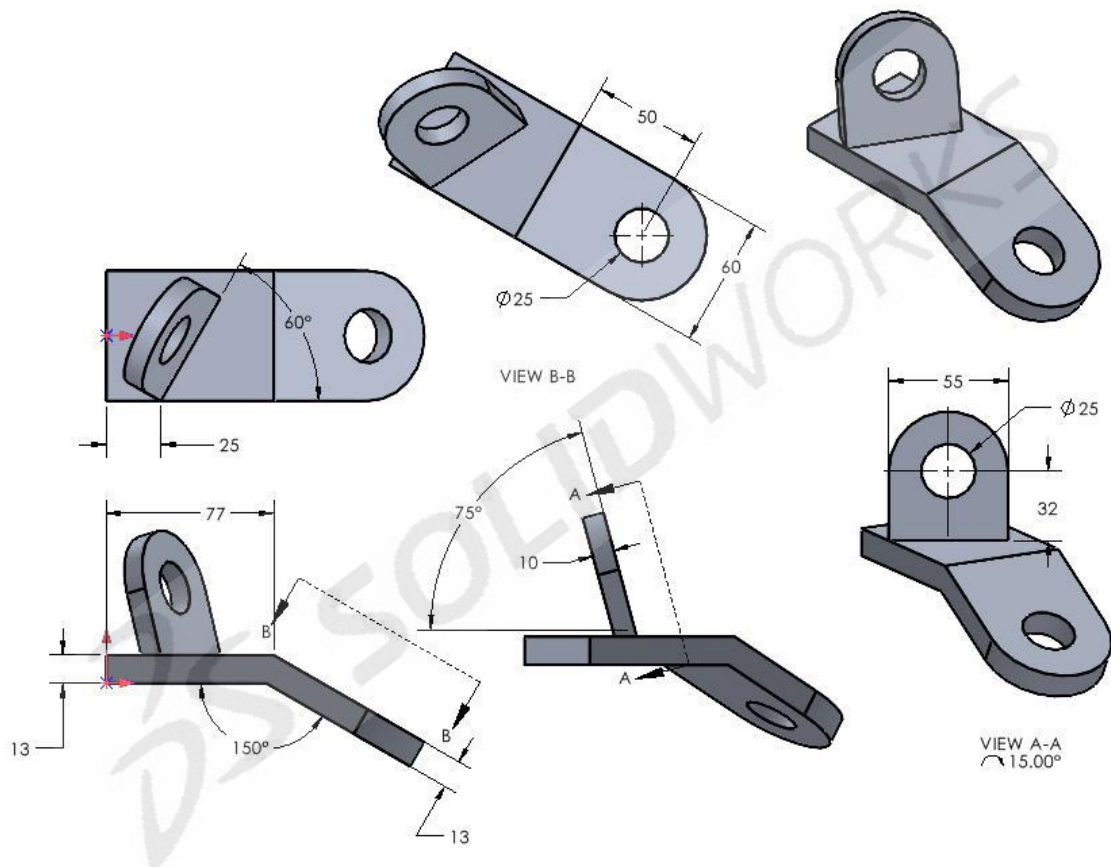
Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 20
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim
- Features: Extrude Boss, Extrude Cut
- Reference Geometry: Planes

Volume: 3494 mm³

⌀3 X 4 DEEP

5

11

DETAIL A
SCALE 6 : 1

A

B

13

80

B

3

⌀8

3 TYP

⌀12

SECTION B-B
SCALE 4 : 1

3DEXPERIENCE

Practice Problem 5.8

Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
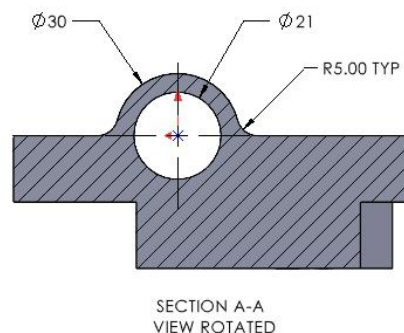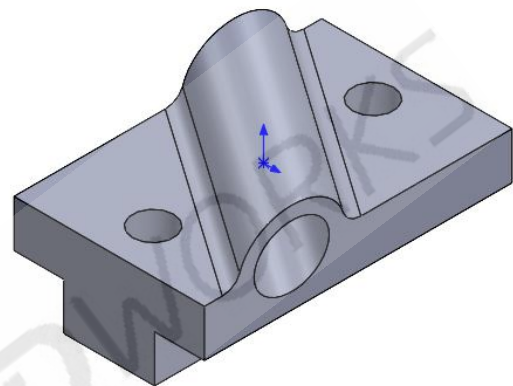 - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim
- Features: Extrude Boss, Extrude Cut
- Reference Geometry: Planes

HINT: Use a sketch to define the plane.

Volume: 132174 mm³

VIEW B-B

VIEW A-A
⌒15.00°

DS DASSAULT SYSTEMES

Practice Problem 5.9

Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is *asymmetric*.
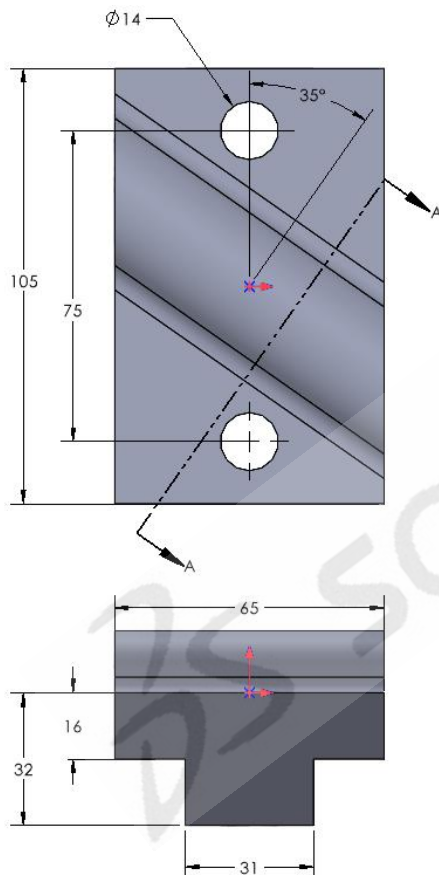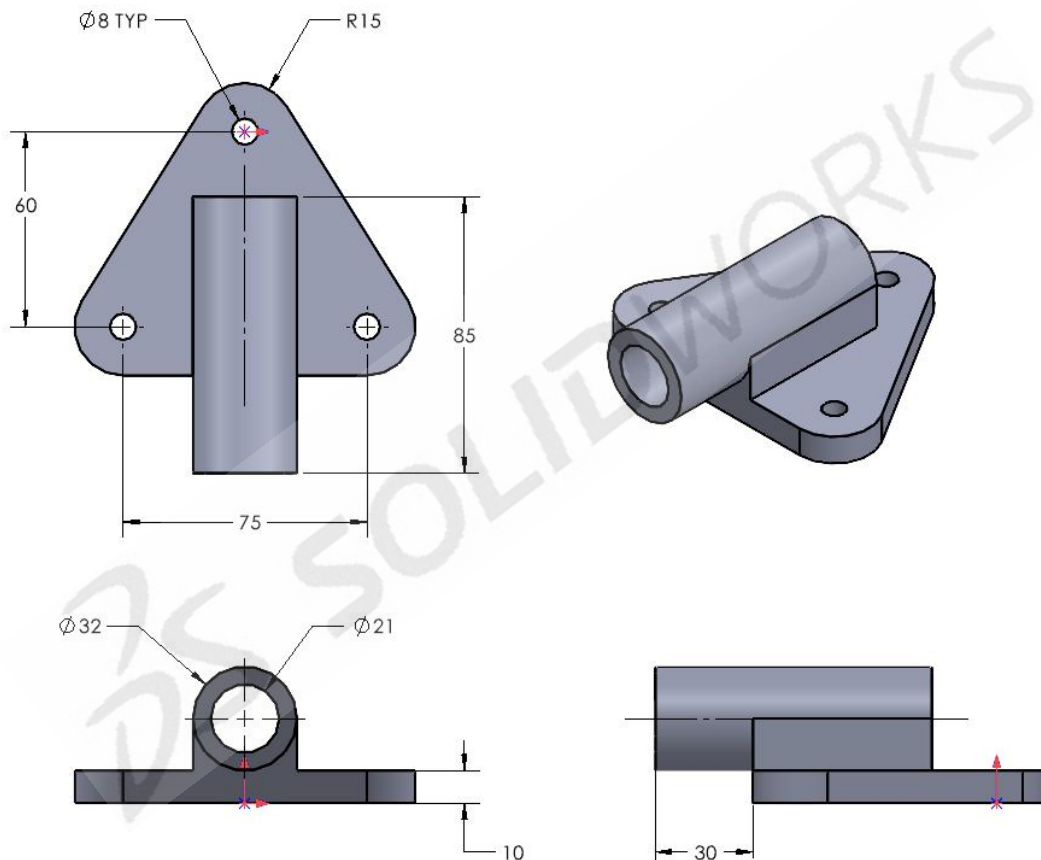   - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines,Circles
- Features: Extrude Boss, Extrude Cut
- Reference Geometry: Planes, Axes

HINTS:

- Create an axis using a standard plane.
- Use Up to Surface end conditions.

Volume: 152544 mm³

Ø14
35°
A
105
75
A
65
16
32
31

Ø30
Ø21
R5.00 TYP

SECTION A-A
VIEW ROTATED

Practice Problem 5.10
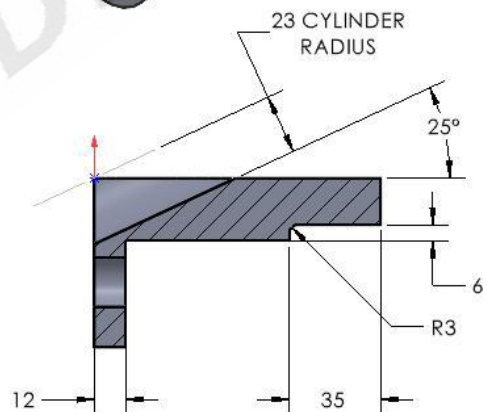
Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Sketch Fillets, Convert Entities, Trim
- Features: Extrude Boss, Extrude Cut
- Reference Geometry: Planes

HINT: The pipe is tangent to the plate.

Volume: 105501 mm³

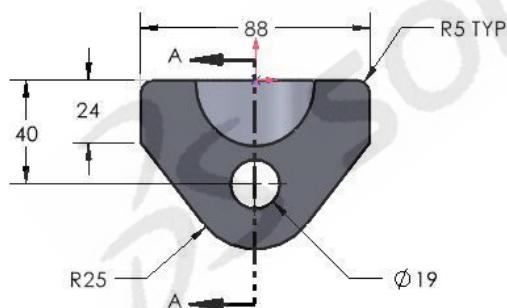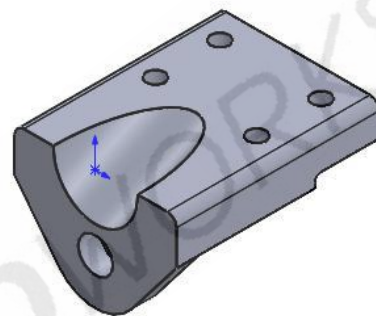# Practice Problem 5.11
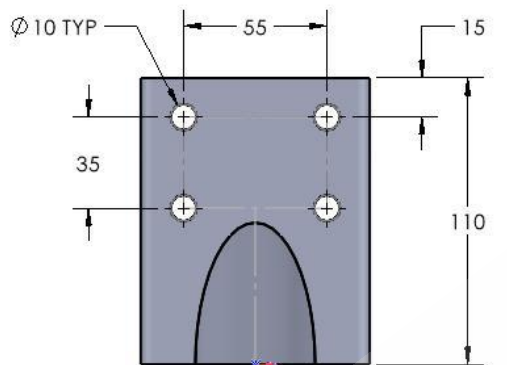
Reference Geometry (Level 5)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Rectangles, Arcs, Circles
- Features: Extrude Boss, Extrude Cut
- Reference Geometry: Planes

HINT: Create a plane on an angle through the front edge, and cut with a circle.

Volume: 208819 mm³

Practice Problem 6.1
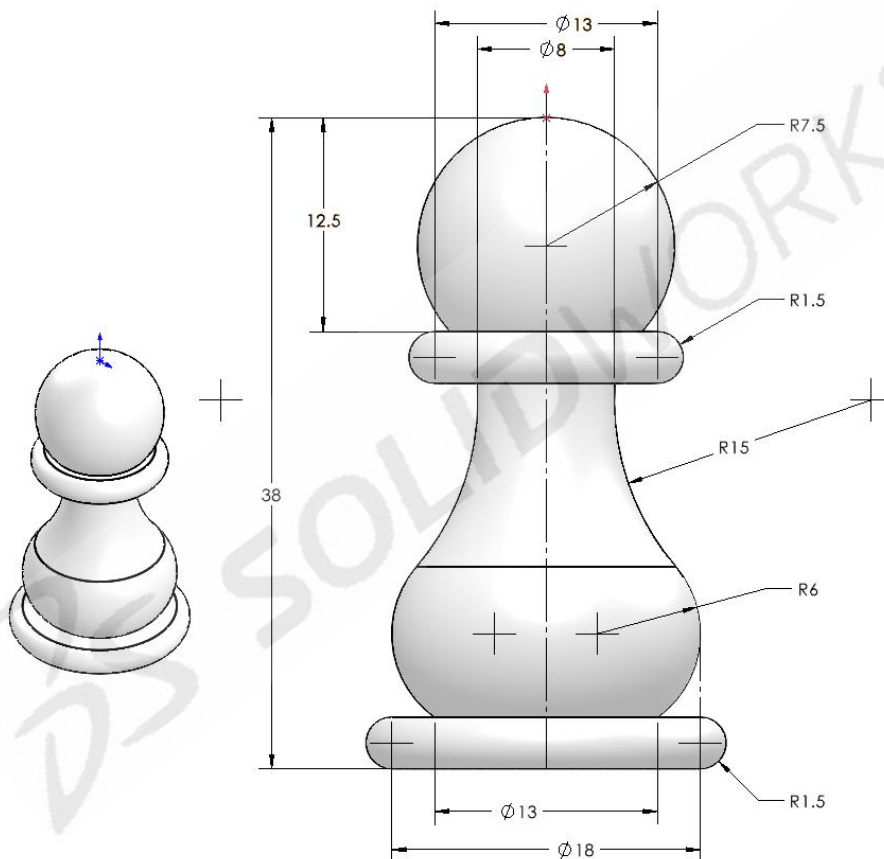
Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Arcs
- Features: Revolves

HINT: This can be built using a single feature.

Volume: 5996 mm³
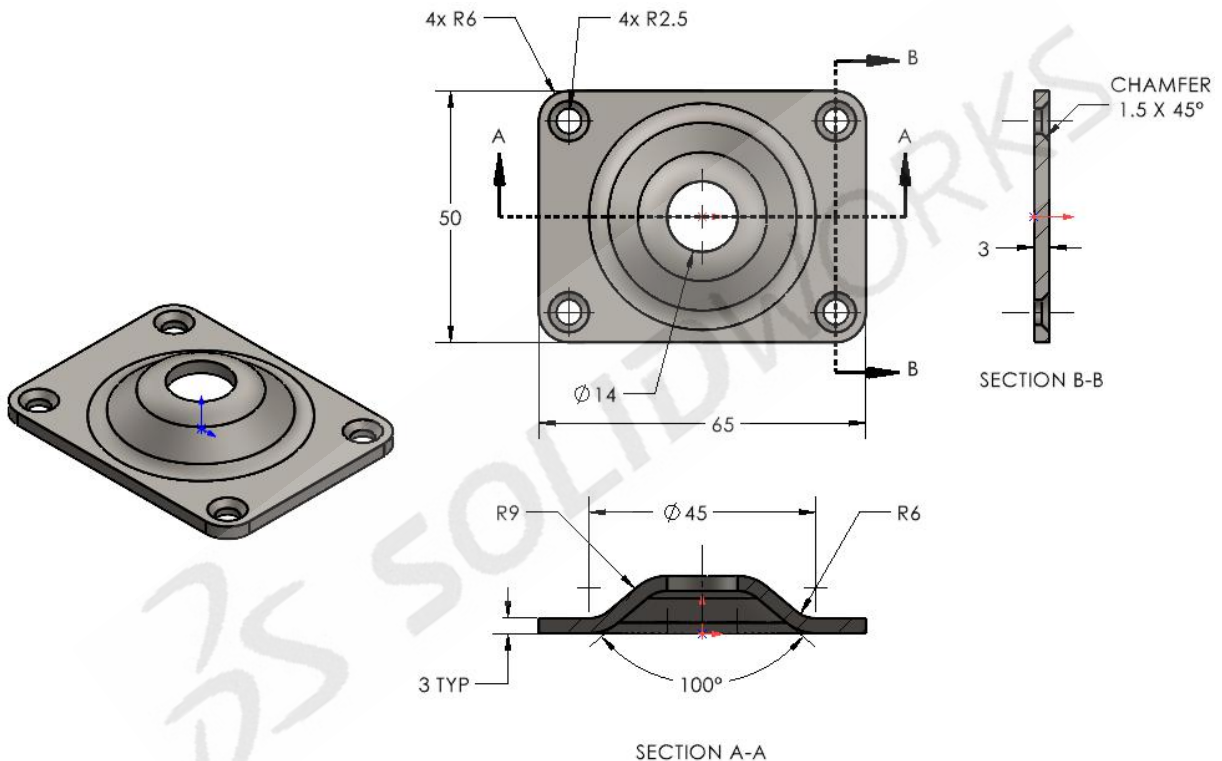
Practice Problem 6.2

Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Revolves, Extrude Boss, Fillets and Chamfers

Volume: 9603 mm³

4x R6   4x R2.5

B

CHAMFER
1.5 X 45°

A   A

50   3

B

SECTION B-B

Ø14

65

R9   Ø45   R6

3 TYP   100°
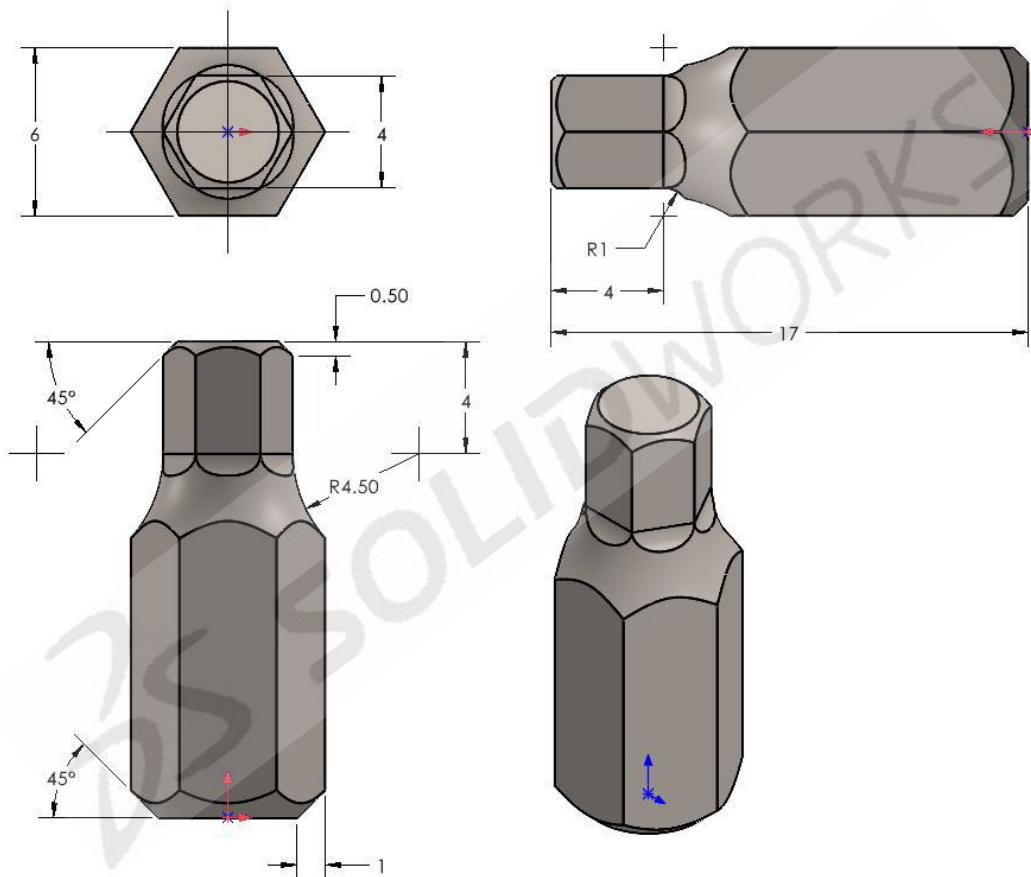
SECTION A-A

Practice Problem 6.3

Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs, Polygons
- Features: Revolves, Extrude Boss, Fillets and Chamfers
- Reference Geometry: Planes
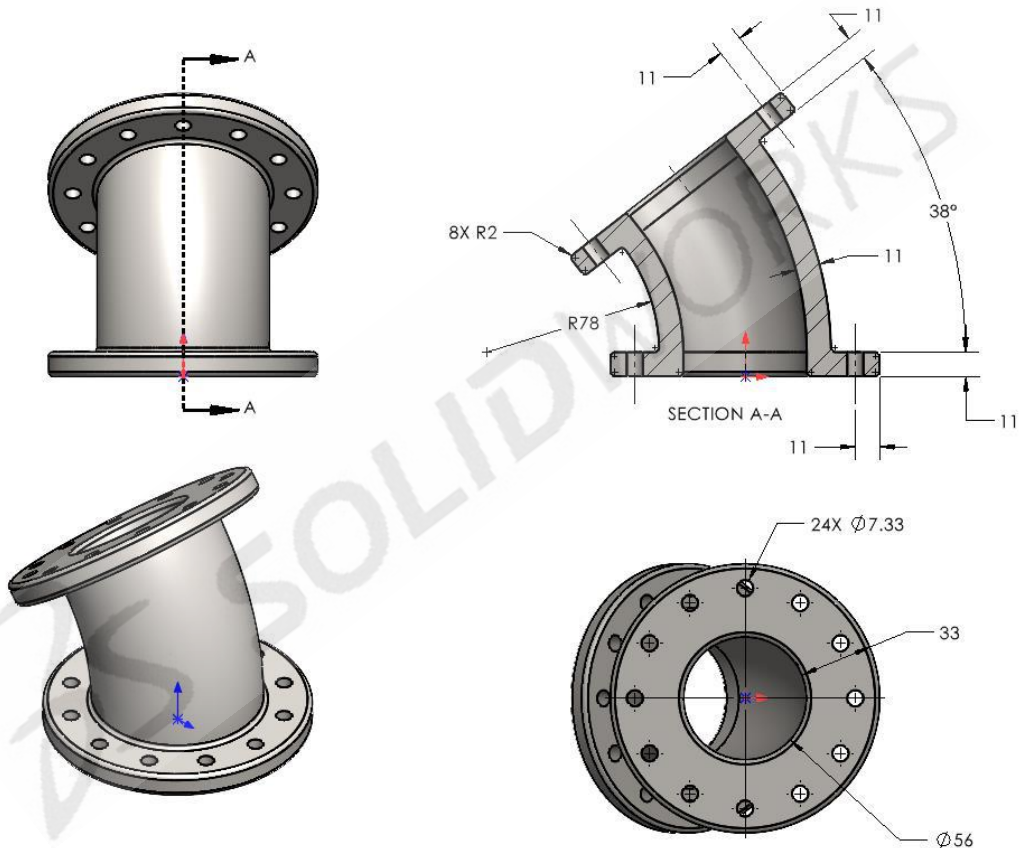
Volume: 427 mm³

Practice Problem 6.4

Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs
- Features: Revolves, Extrude Boss, Fillets and Chamfers

Volume: 370322 mm³

SECTION A-A

3S DASSAULT SYSTEMES

Practice Problem 6.5

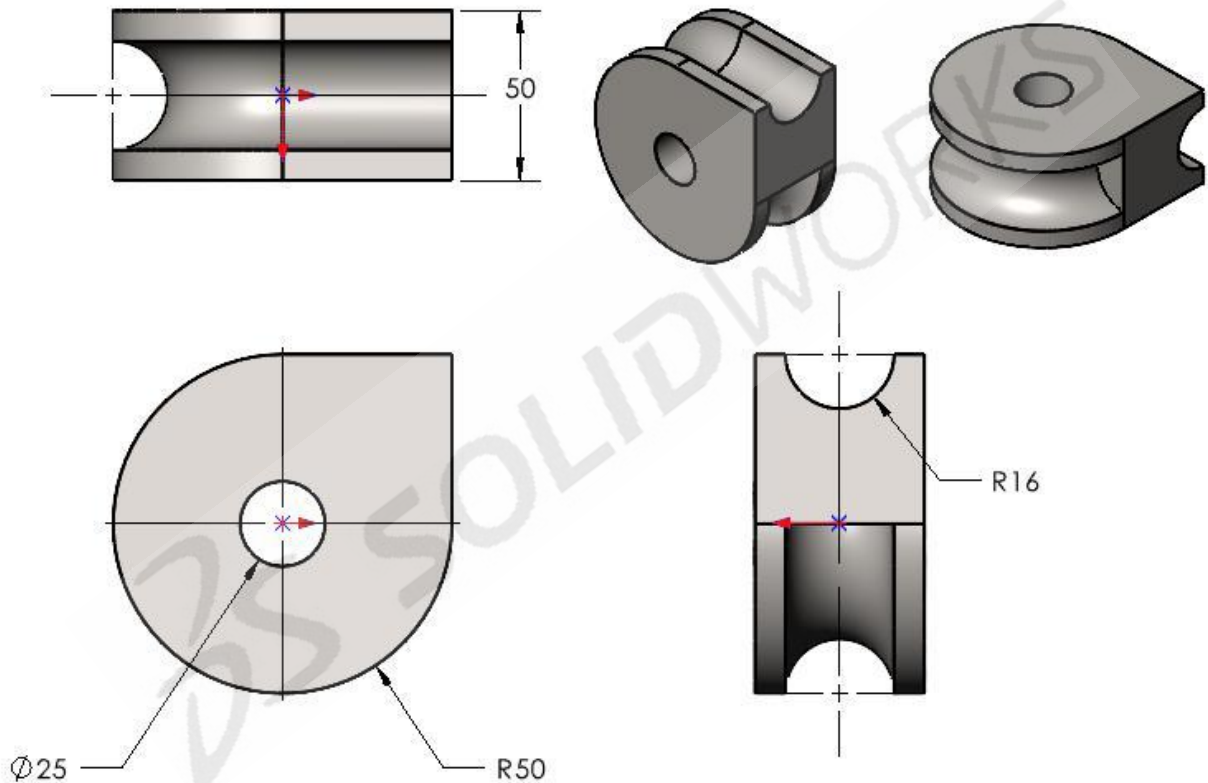## Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Arcs
- Features: Revolves, Extrude Boss

HINT: Cut with a revolve feature.

Volume: 292994 mm³
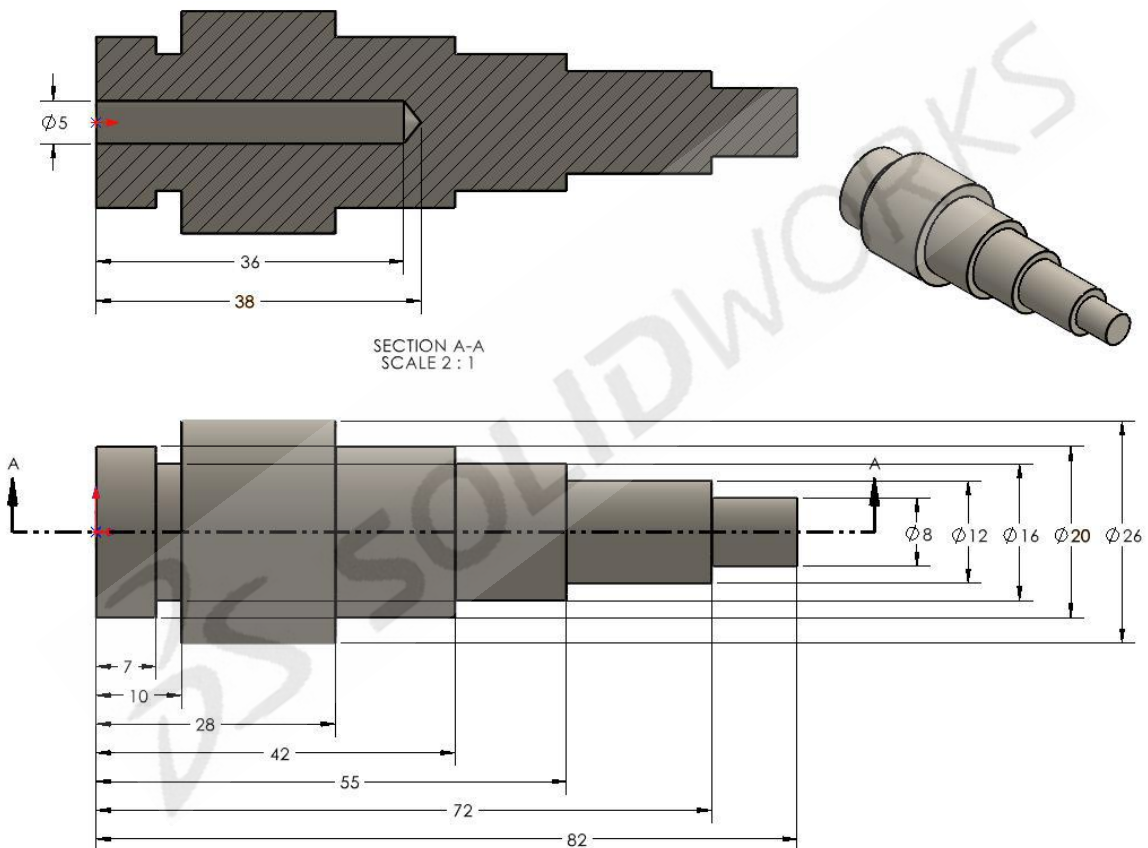
Practice Problem 6.6

Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines
- Features: Revolves

Volume: 21076 mm³

SECTION A-A
SCALE 2 : 1

Practice Problem 6.7

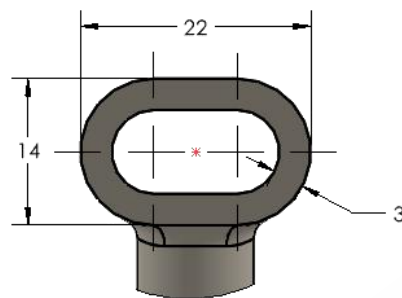## Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.
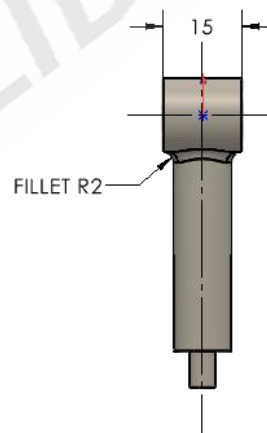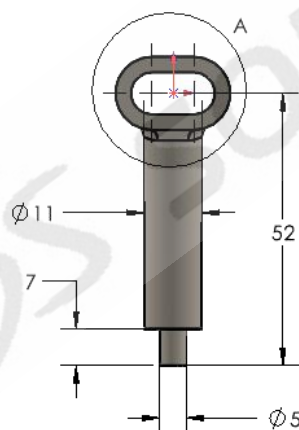
Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim, Slots, Offset Entities
- Features: Revolves, Extrude Boss, Extrude Cut

HINT: Slot is dimensioned to the overall width.

Volume: 6049 mm³

DETAIL A
SCALE 2 : 1

Practice Problem 6.8
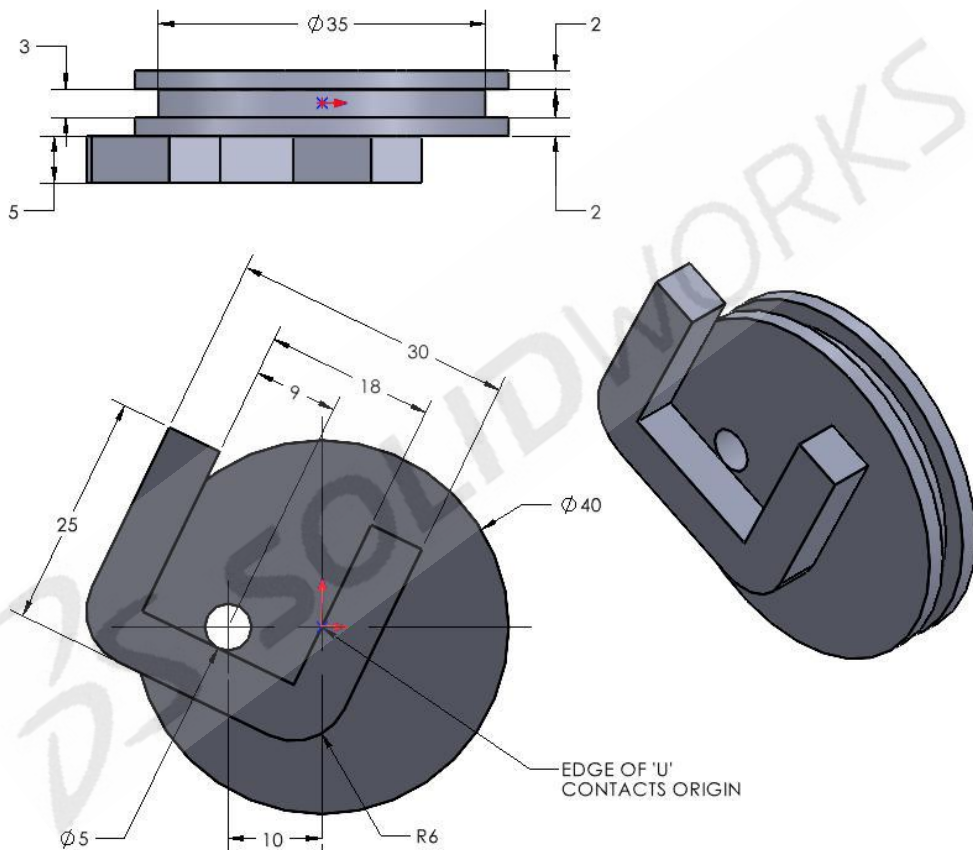
Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim, Sketch Fillets, Offset Entities
- Features: Revolves, Extrude Boss, Extrude Cut

HINT: The "U" boss is tangent to the through hole and passes through the Origin.

Volume: 9738 mm³

EDGE OF 'U'
CONTACTS ORIGIN

Practice Problem 6.9
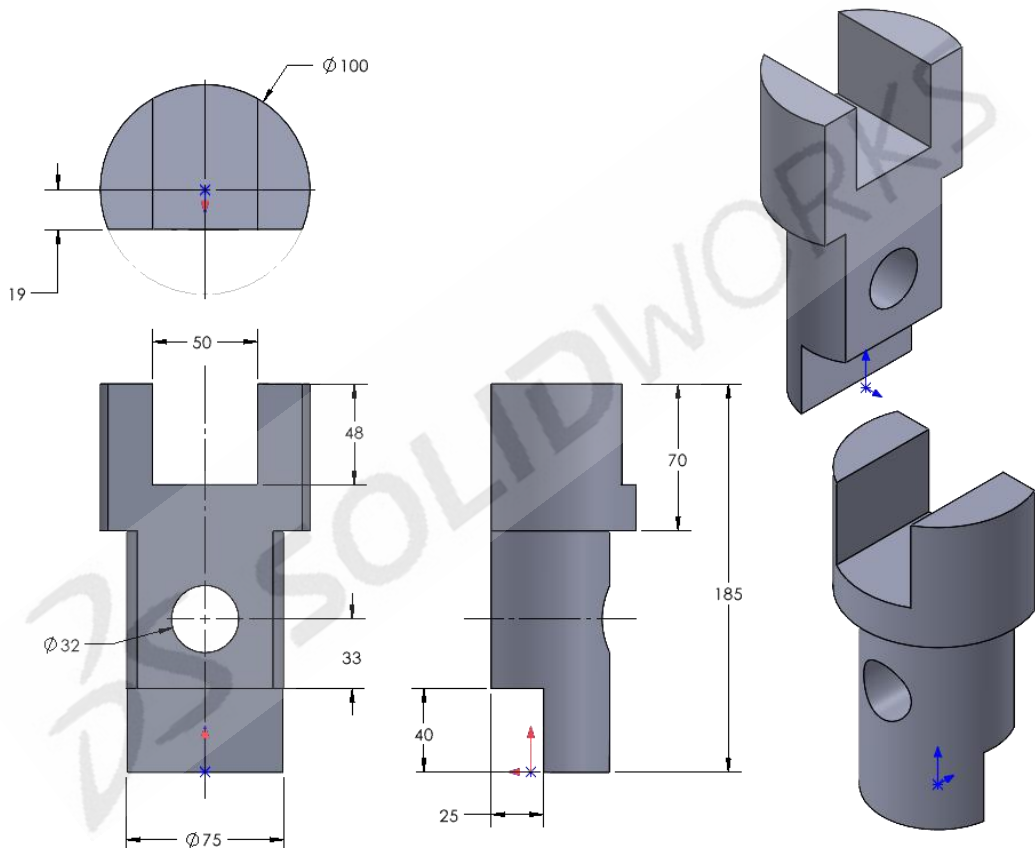
Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim
- Features: Revolves, Extrude Cut

HINT: Start with a full revolve feature.

Volume: 537697 mm³

3DEXPERIENCE

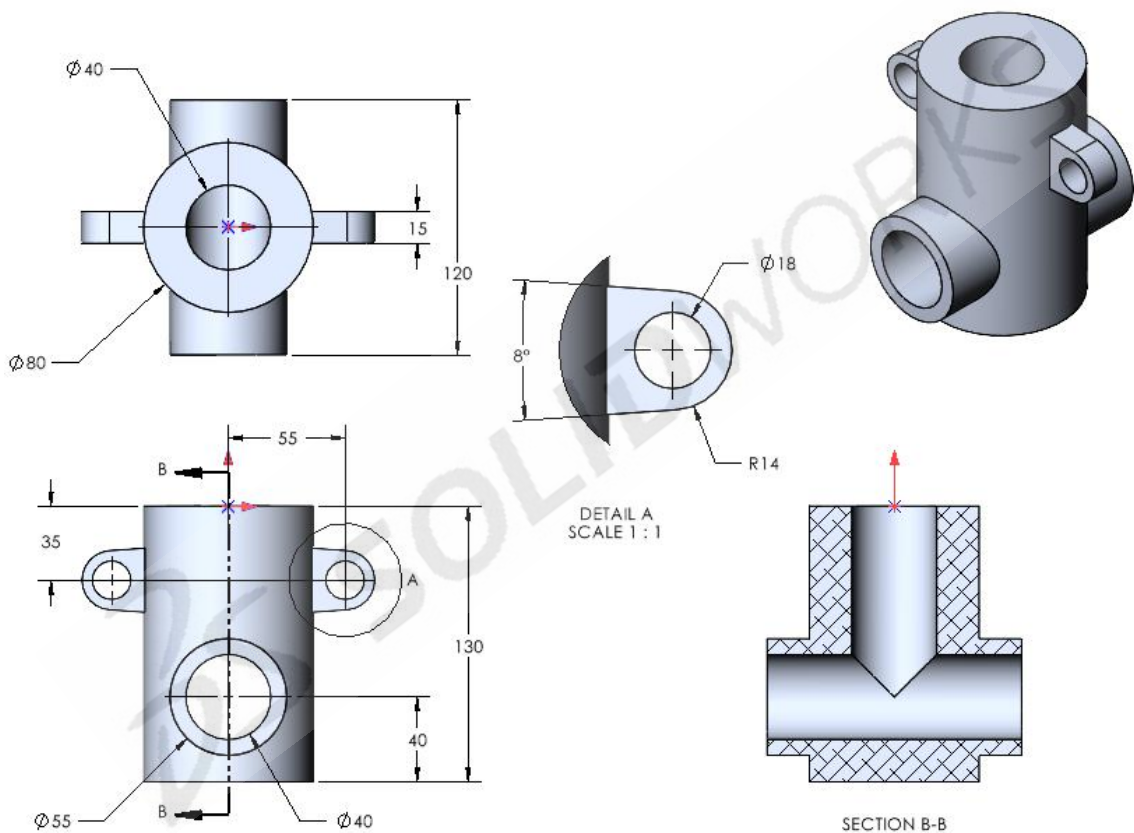# Practice Problem 6.10

Revolve Boss/Cut (Level 6)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - o The part's origin location is indicated in red.
  - o The part is symmetric.
  - o All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles, Trim, Arcs
- Features: Revolves, Extrude Boss, Extrude Cut

HINT: Bosses then cuts.

Volume: 532863 mm³

Ø40
Ø80
15
120

Ø18
8°
R14

DETAIL A
SCALE 1 : 1

55
B
35
130
40
Ø55
Ø40
B

SECTION B-B

3S DASSAULT SYSTEMES
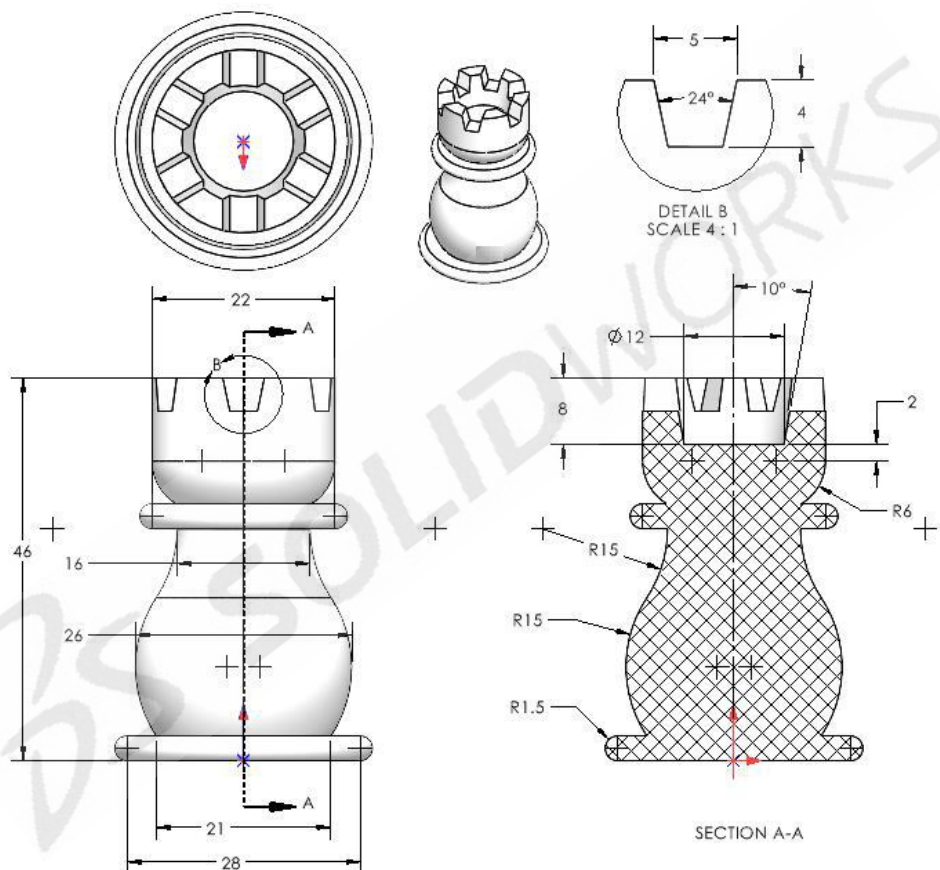
Practice Problem 7.1

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines
- Features: Revolves, Extrude Cut
- Patterns: Circular

Volume: 17327 mm³

DETAIL B
SCALE 4 : 1

SECTION A-A

Practice Problem 7.2
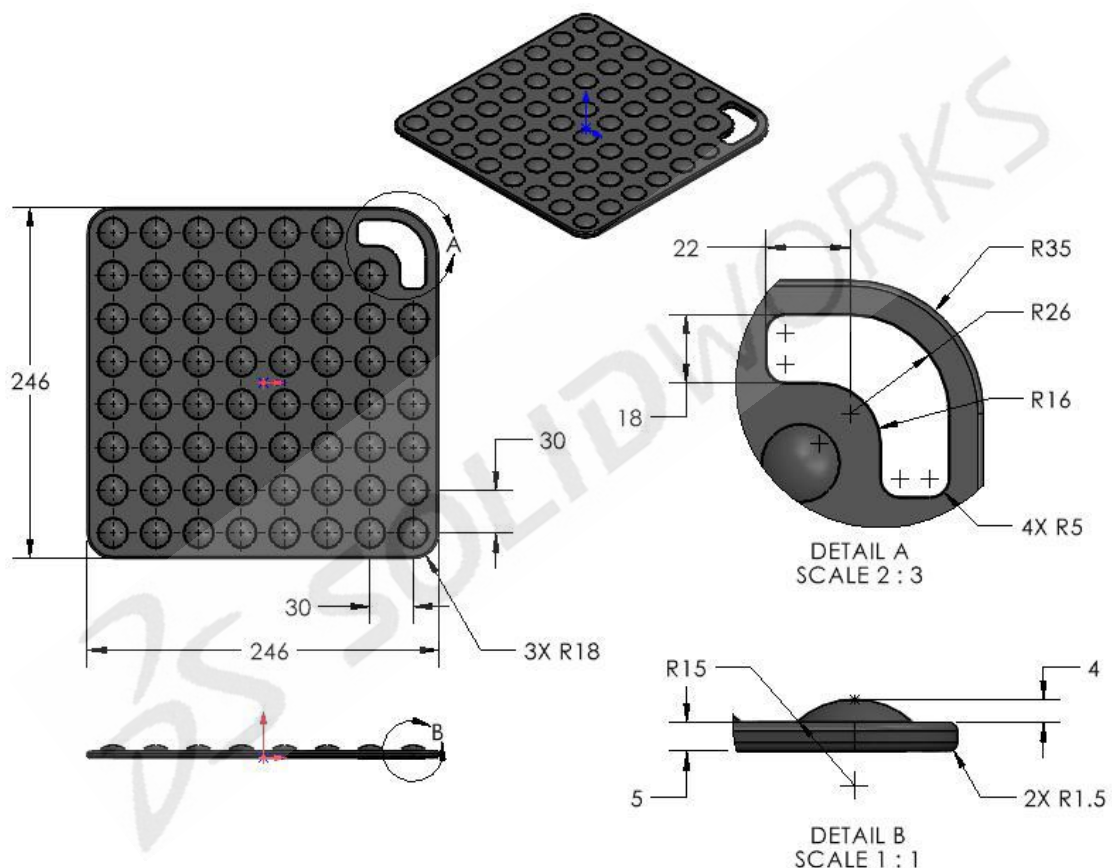
Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - o The part's origin location is indicated in red.
  - o The part is *asymmetric*.
  - o All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines
- Features: Extrude Boss, Revolves, Fillets and Chamfers
- Patterns: Linear
- Reference Geometry: Planes

HINT: Skip instances in the Linear Pattern.

Volume: 334754 mm³
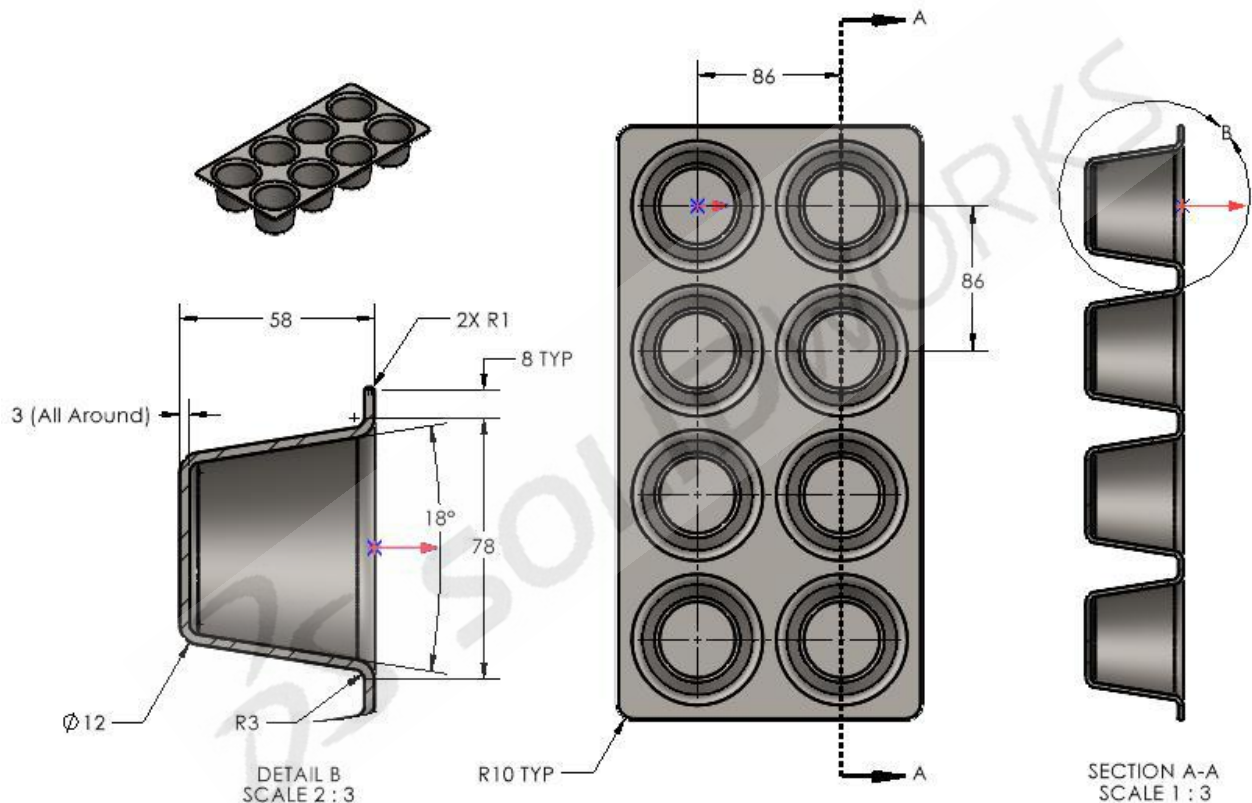
Practice Problem 7.3

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Arcs, Centerlines
- Features: Extrude Boss, Revolves
- Patterns: Linear

Volume: 398448 mm³

DETAIL B
SCALE 2 : 3

SECTION A-A
SCALE 1 : 3
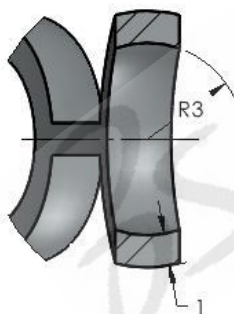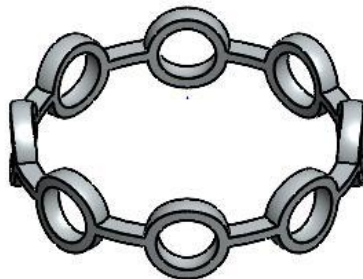
Practice Problem 7.4

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Arcs
- Features: Revolves
- Patterns: Circular

Volume: 421 mm³

R14.5

2

DETAIL B
SCALE 6 : 1

R3

1

SECTION A-A

1

B

Practice Problem 7.5

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is axisymmetric.
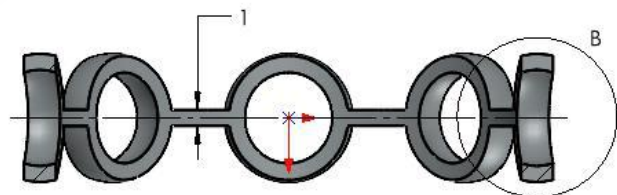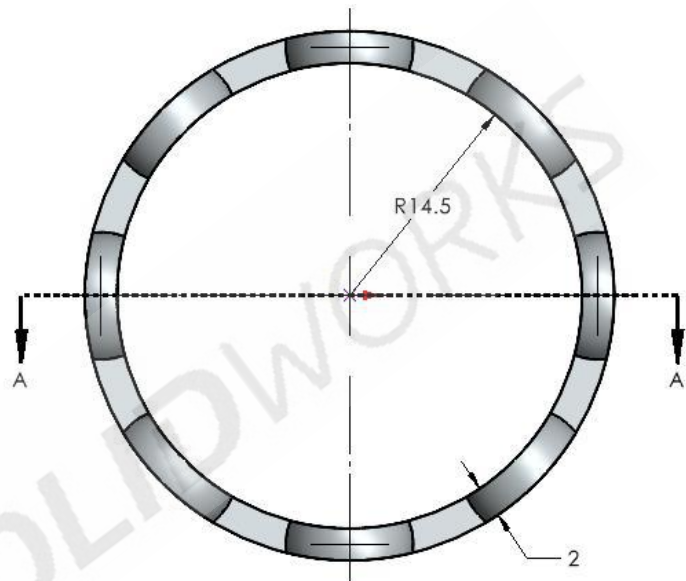 - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Rectangles
- Features: Extrude Boss, Extrude Cut
- Patterns: Circular, Mirror
- Reference Geometry: Planes

HINT: The holes and cuts are patterned.

Volume: 3687610 cm³

DETAIL A
SCALE 1 : 2

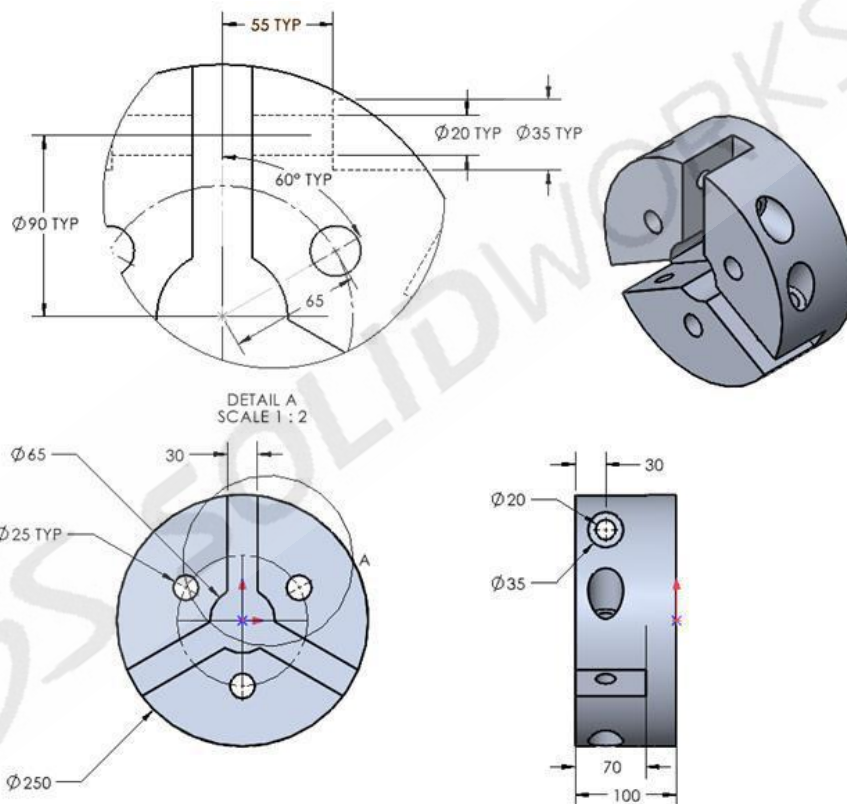# Practice Problem 7.6
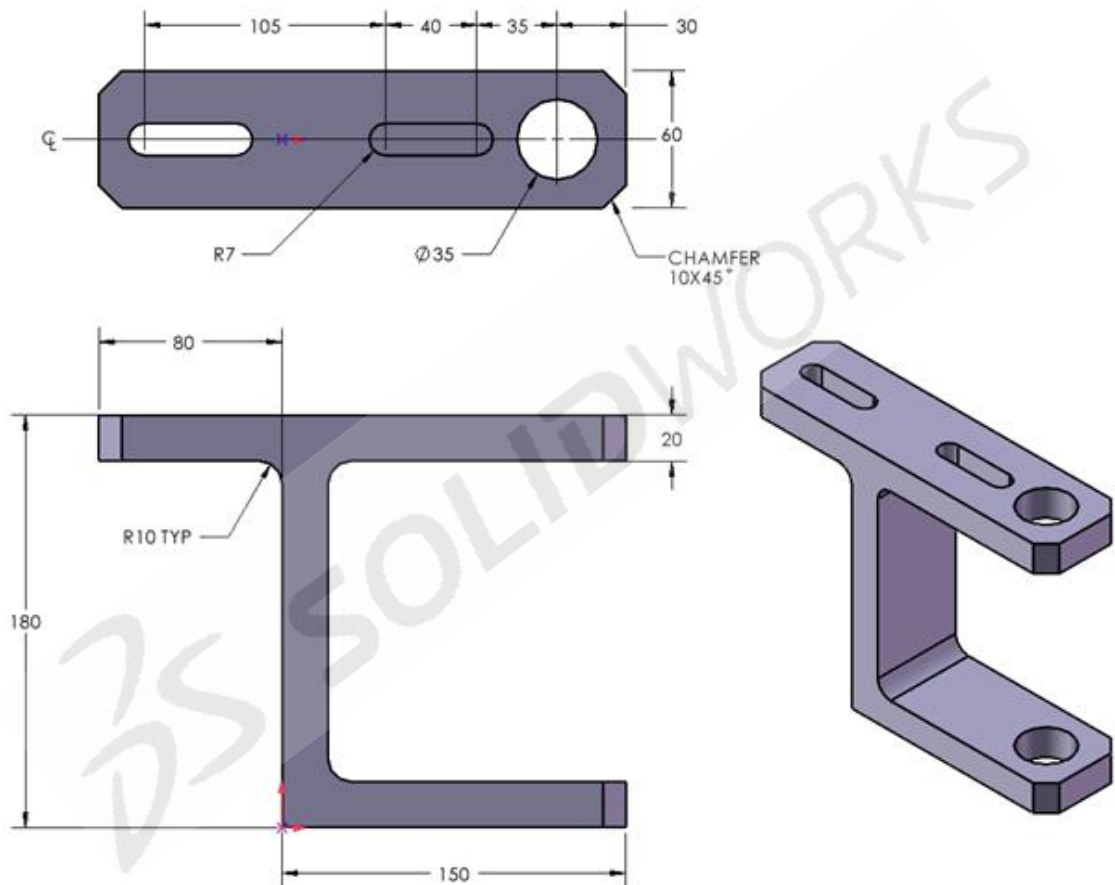
Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Rectangles, Offset, Slots, Centerlines
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers
- Patterns: Linear

HINT: Thickness remains the same.

Volume: 554821 mm³

Practice Problem 7.7

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 30
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is axisymmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines
- Features: Extrude Boss, Revolves, Fillets and Chamfers
- Patterns: Circular

HINT: All 4 blades are evenly spaced.

Volume: 787 mm³

SECTION A-A

ƏS DASSAULT SYSTEMES

Practice Problem 7.8

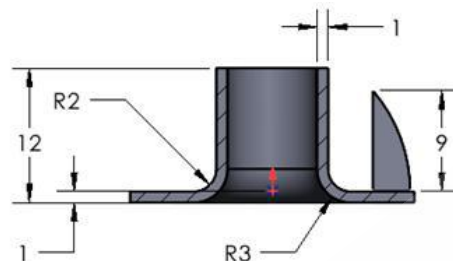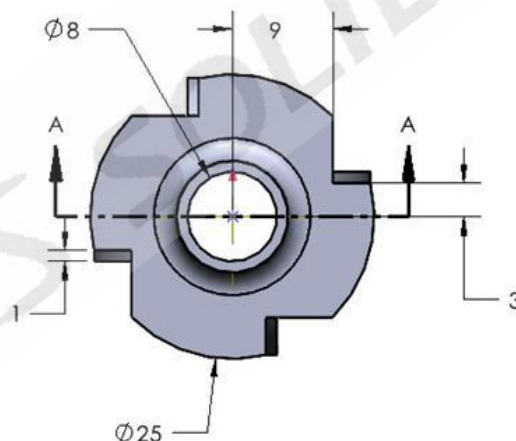## Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 25
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Slots
- Features: Extrude Boss, Extrude Cut
- Patterns: Linear, Mirror

Volume: 18306608 mm³

DETAIL A
SCALE 1 : 1

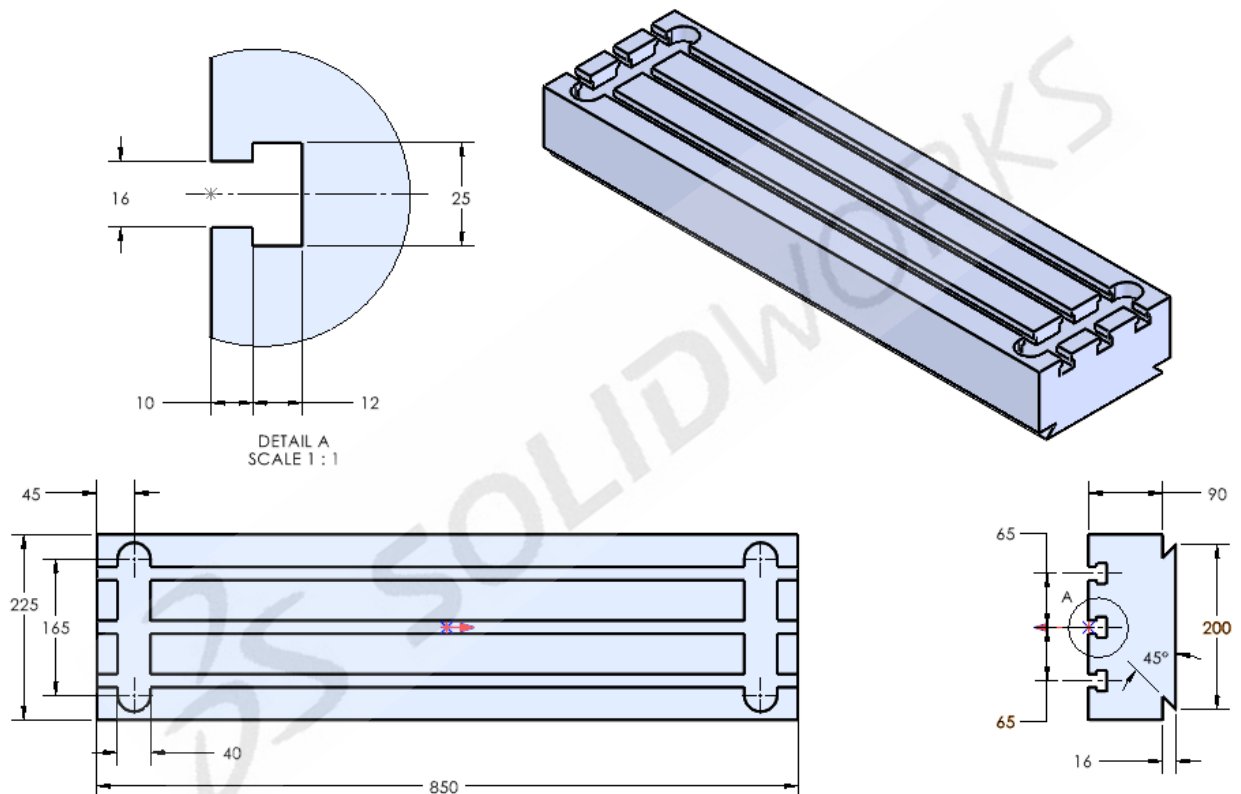# Practice Problem 7.9

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 35
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Rectangles
- Features: Extrude Boss, Extrude Cut, Fillets and Chamfers
- Patterns: Mirror

Volume: 21908 mm³

DETAIL B
SCALE 2 : 1

SECTION A-A

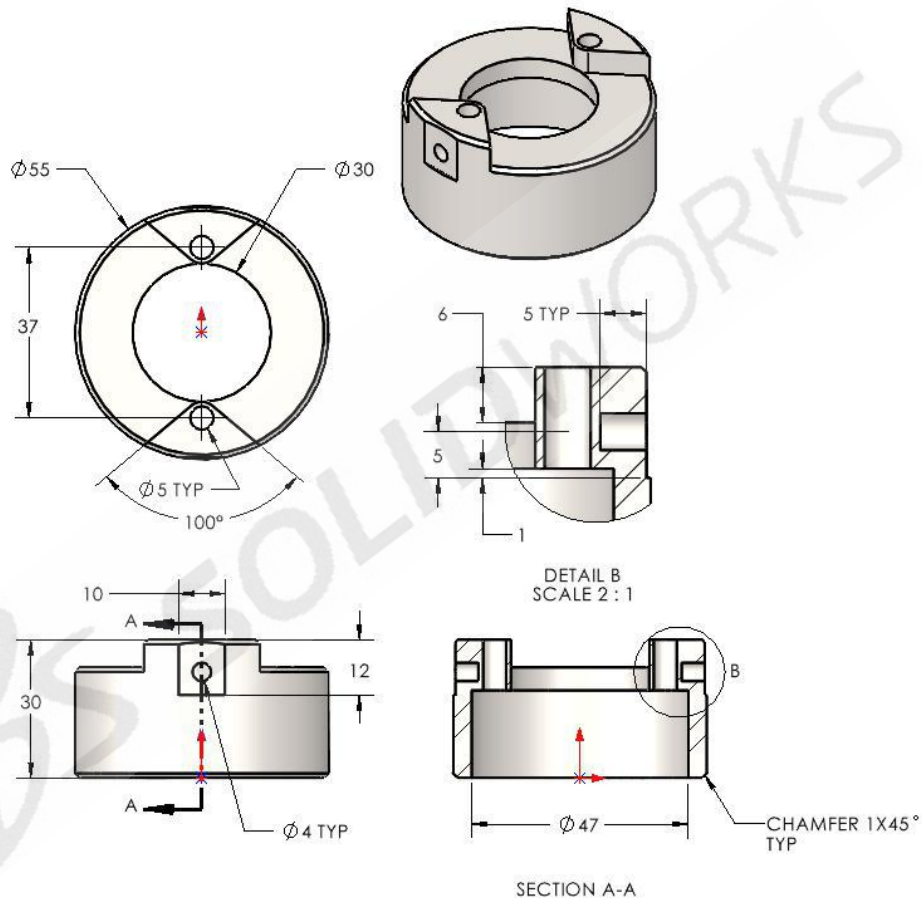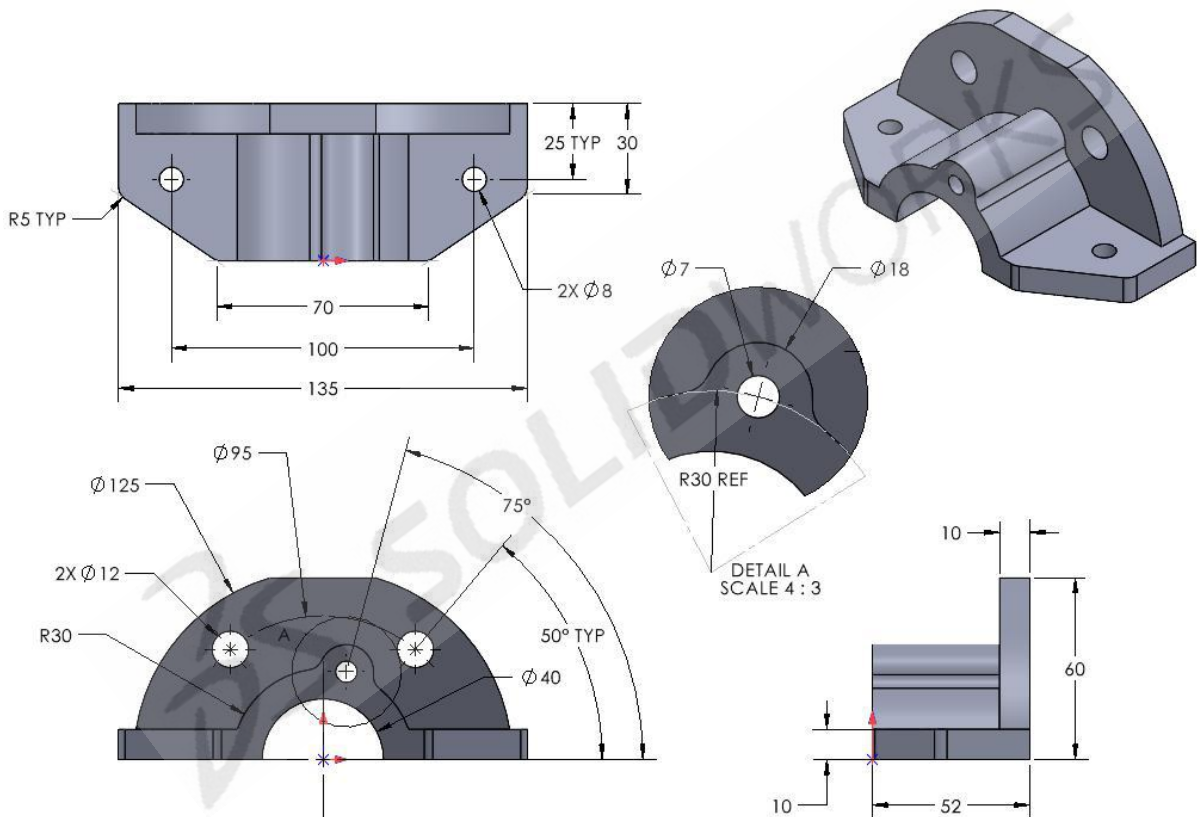# Practice Problem 7.10

Feature Patterning (Level 7)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 45
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully-defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, ARcs
- Features: Extrude Boss, Extrude Cut, Revolves, Fillets and Chamfers
- Patterns: Mirror

Volume: 113890 mm³

25 TYP   30

R5 TYP

2X Ø8

70

100

135

Ø7   Ø18

R30 REF

DETAIL A
SCALE 4 : 3

Ø95

Ø125

75°

2X Ø12

R30   A

50° TYP

Ø40

10

60

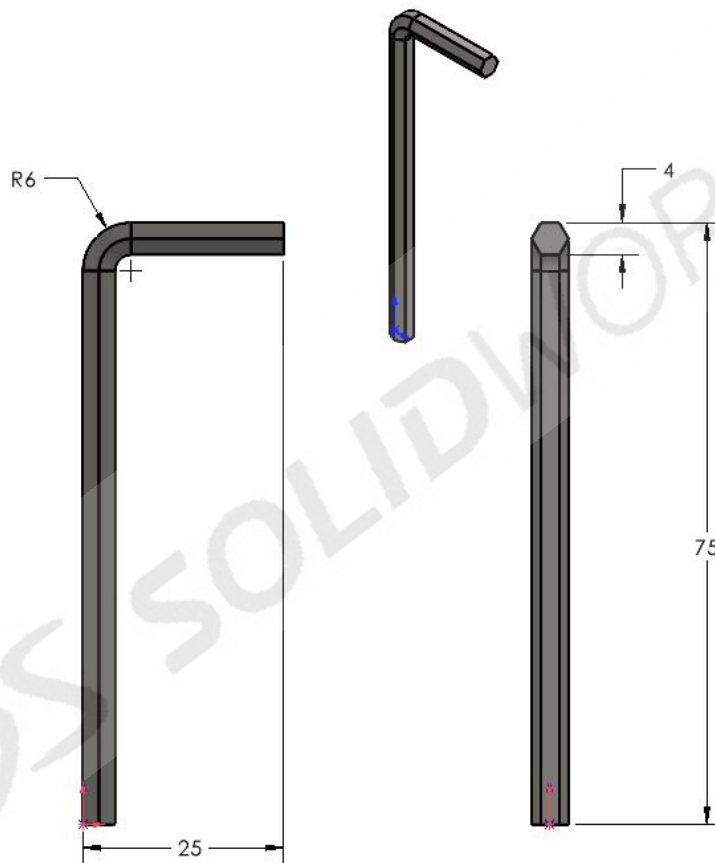10   52

Practice Problem 8.1

Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Polygons, Sketch Fillets
- Features: Sweeps

Volume: 1306 mm³

DS SOLIDWORKS

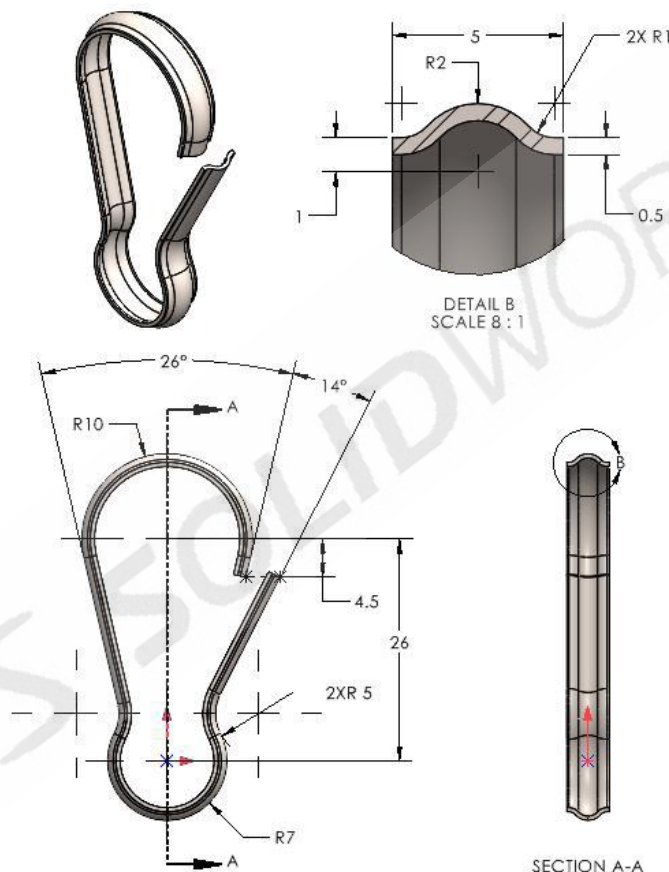3DEXPERIENCE

Practice Problem 8.2

Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 15
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Sketch Fillets
- Features: Sweeps

Volume: 288 mm³

DETAIL B
SCALE 8 : 1

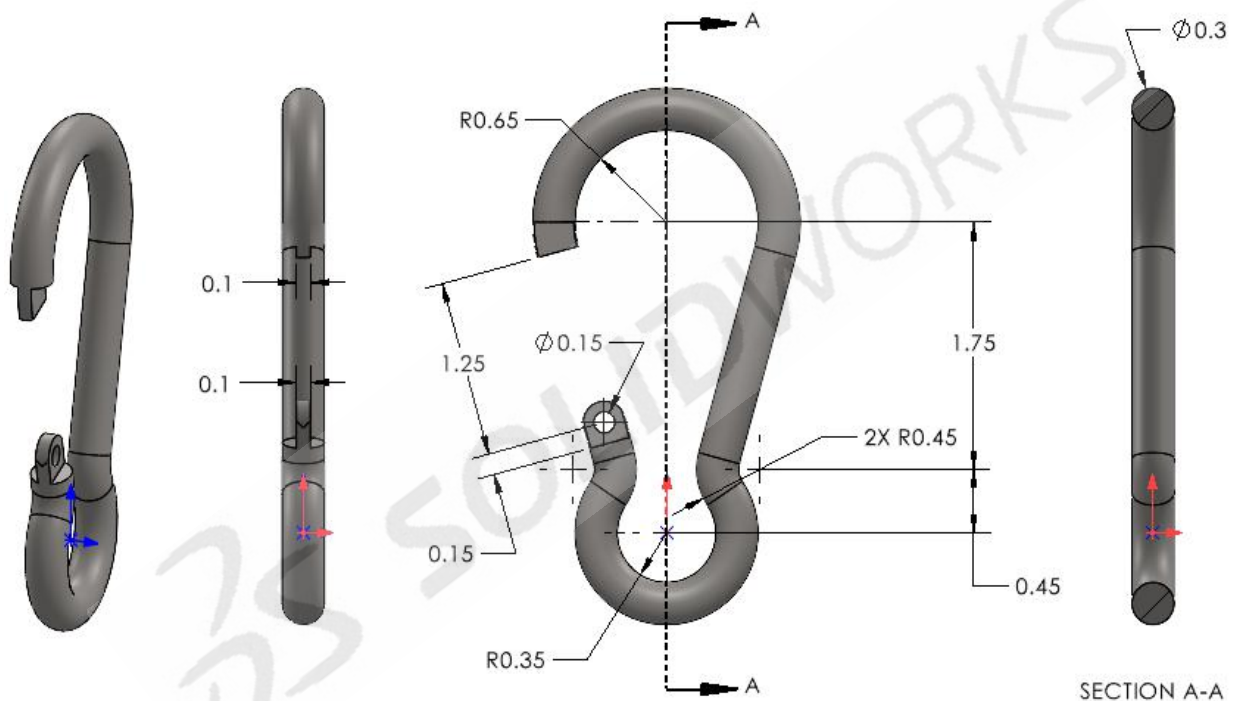SECTION A-A

DASSAULT SYSTEMES

Practice Problem 8.3

Sweep Boss/Cut (Level 8)
- Units: IPS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully defined.

Suggested Sketch Tools / Features
- Sketch: Lines, Circles, Centerlines, Arcs
- Features: Revolves, Sweeps, Fillets and Chamfers

HINT: Extend sweep into sphere.

Volume: 269 in³

Ø1.4

A

A

60°

2X R2.5

3.2

3X R.5

10.3

3.05

R3.95

SECTION A-A

DASSAULT SYSTEMES

Practice Problem 8.4

Sweep Boss/Cut (Level 8)

- Units: IPS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 20
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines
- Features: Sweeps, Extrude Cut
- Patterns: Mirror

Volume: 0.51 in³

R0.65

Ø0.3

0.1

0.1

1.25

Ø0.15

1.75

0.15

2X R0.45

0.45

R0.35

SECTION A-A

Practice Problem 8.5
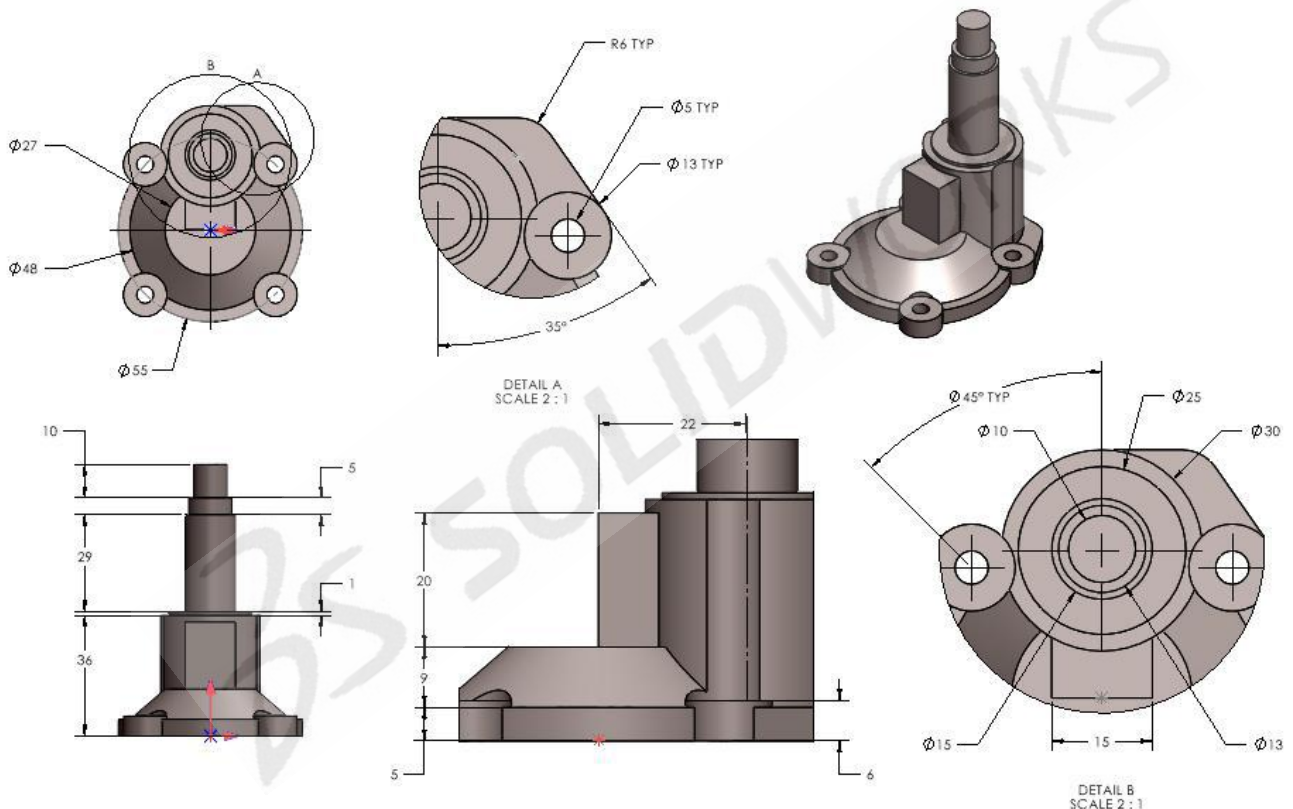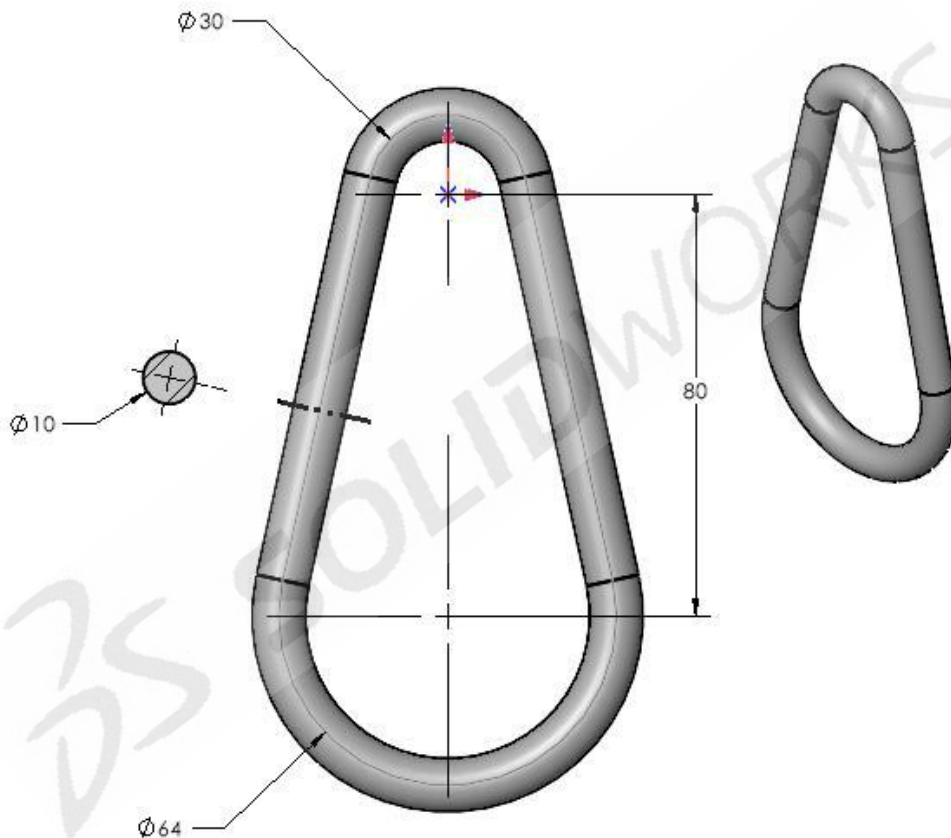
Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Hard
- Certification: CSWA
- Duration (min): 40
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is *asymmetric*.
  - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines
- Features: Lofts, Extrude Boss, Extrude Cut
- Patterns: Circular

HINT: The loft is between two circles.
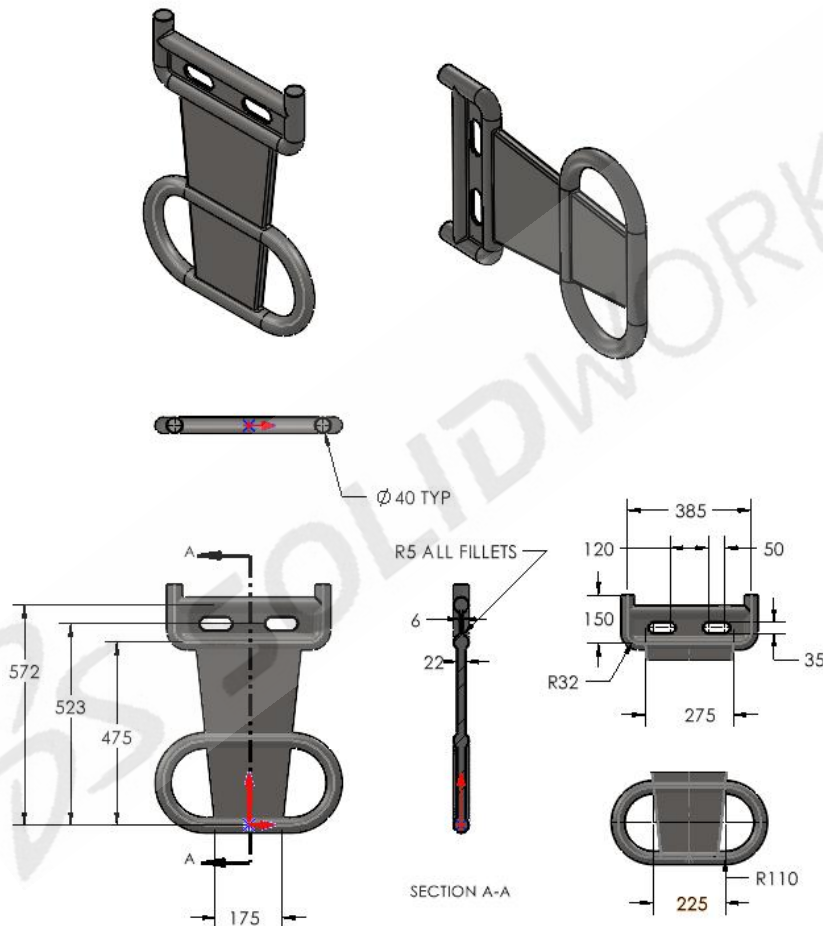
Volume: 53816 mm³

Practice Problem 8.6

Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 5
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Arcs
- Features: Sweeps

HINT: The Sweep can use the Circular Profile option.

Volume: 24448 mm³

Ø30

Ø10

Ø64

80

Practice Problem 8.7
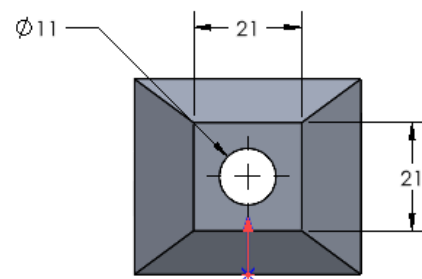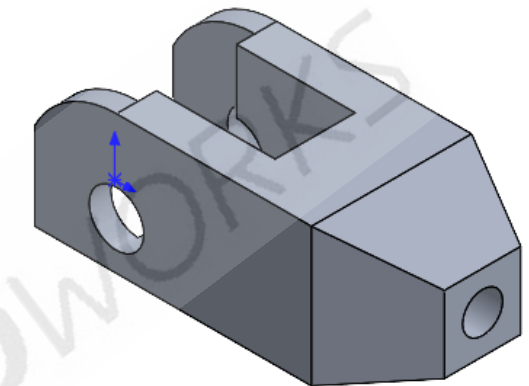
Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 20
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Arcs, Centerlines, Slots, Trim
- Features: Extrude Boss, Sweeps, Fillets and Chamfers
- Patterns: Mirror

Volume: 4764321 mm³

Ø40 TYP

R5 ALL FILLETS

SECTION A-A
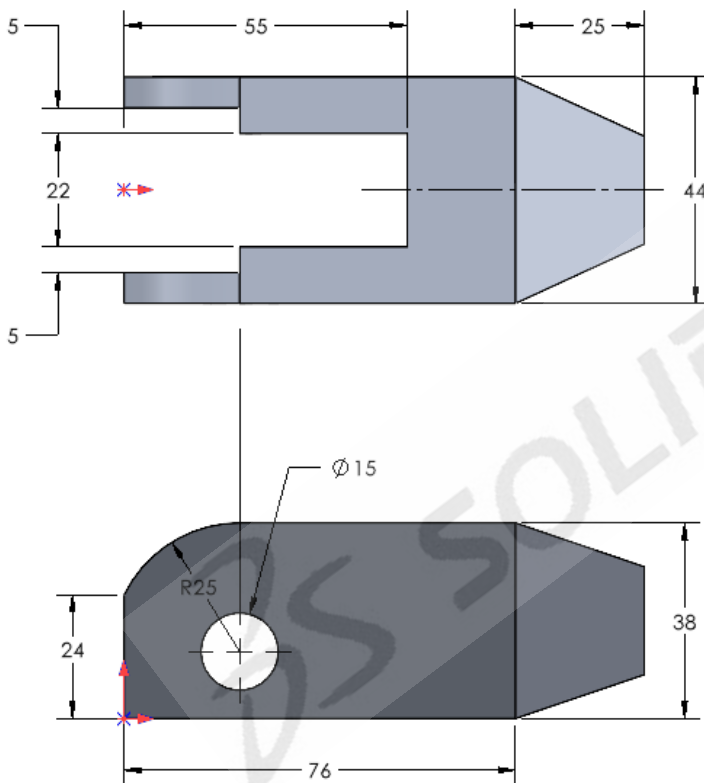
Practice Problem 8.8

Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
  - The part's origin location is indicated in red.
  - The part is symmetric.
  - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines, Arcs, Rectangles, Sketch Fillets
- Features: Lofts, Extrude Boss, Extrude Cut
- Reference Geometry: Planes

HINT: Loft between a square sketch and a planar face.

Volume: 88897 mm³

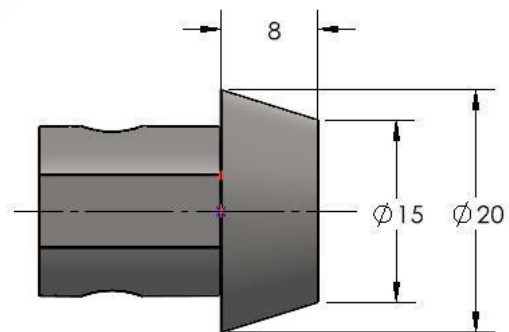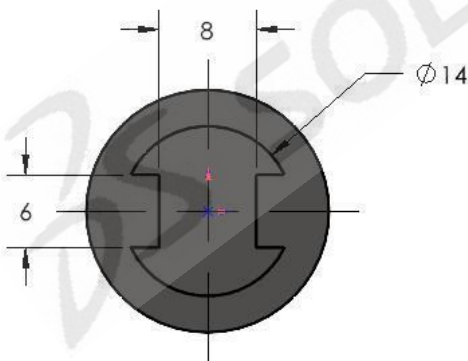**3S DASSAULT SYSTEMES**
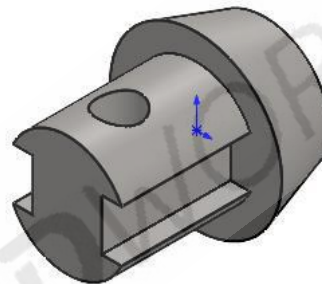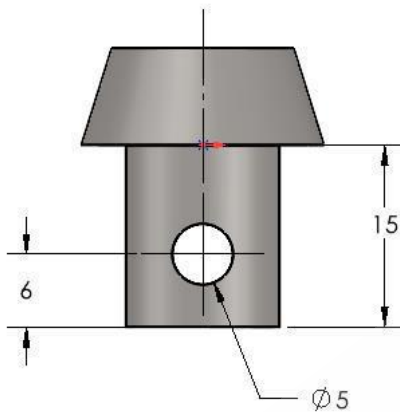
Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Medium
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully defined.

Suggested Sketch Tools / Features

- Sketch: Lines, Circles, Centerlines
- Features: Lofts, Extrude Boss, Extrude Cut
- Reference Geometry: Planes

HINT: The cap is lofted.

Volume: 3476 mm³

Practice Problem 8.10

Sweep Boss/Cut (Level 8)

- Units: MMGS
- Difficulty Level: Easy
- Certification: CSWA
- Duration (min): 10
- Design Intent:
    - The part's origin location is indicated in red.
    - The part is symmetric.
    - All sketches are fully-defined.
    - All fillets on the path are equal.

Suggested Sketch Tools / Features

- Sketch: Lines, Centerlines, Circles
- Features: Sweeps
- Reference Geometry: Planes

Volume: 46575 mm³