Name _____ Date_____

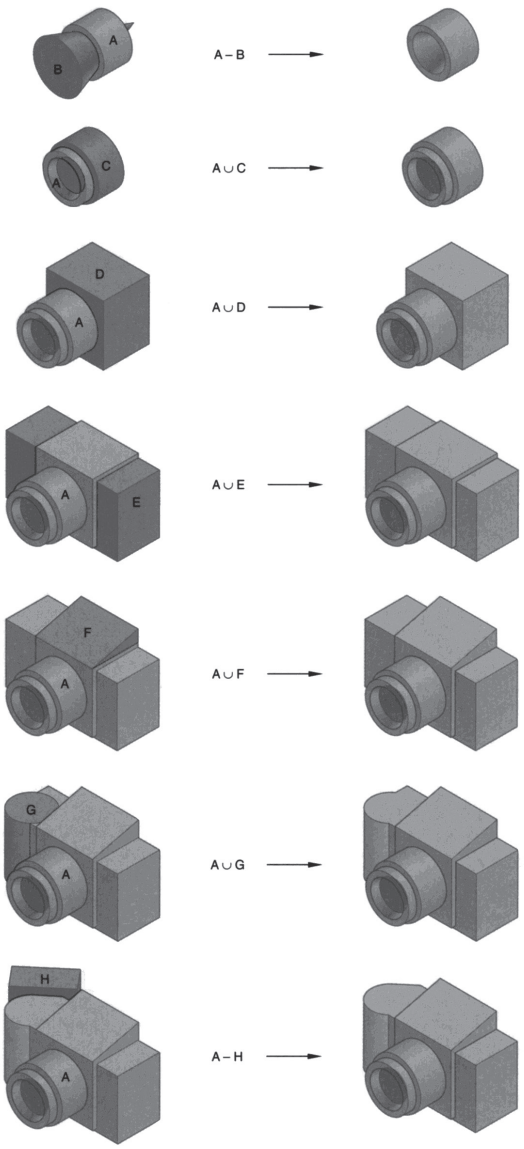
Visualization Chapter 4

3D Modeling

Three-dimensional (3D) modeling software is becoming more prevalent in the world of engineering design, thanks to faster computers and better software. Two-dimensional (2D) multiview drawings made using the techniques of orthographic projection can be automatically extracted from the 3D models to make production drawings. To create these 3D models, you need to be able to visualize what the object looks like from all sides and to break it down mentally into its basic components.

There are different types of modeling. Constructive solid geometry (CSG) modeling and parametric modeling, also called constraint-based modeling, are the most common. CSG modeling is based on the concept of creating complex shapes using Boolean operations to combine basic primitive shapes such as cylinders, cubes, spheres, and cones. Parametric modeling does not rely solely on combinations of primitive shapes. Instead, it uses parameters in the form of dimensions or equations to define geometric profiles that are extruded or revolved as positive or negative geometry.

In these exercises, you will visualize what profiles look like when they are extruded or revolved. You will also learn about creating complex shapes from primitive shapes using Boolean operations.



Exercises

CSG modeling using Boolean operations Using Boolean operations on primitive geometric shapes, you can create complex objects like the camera shown. Looking only at the finished object, can you imagine the process in reverse and break it down into its primitive geometric components? Engineers and designers need to be able to visualize both their final designs and how to create models of those designs.

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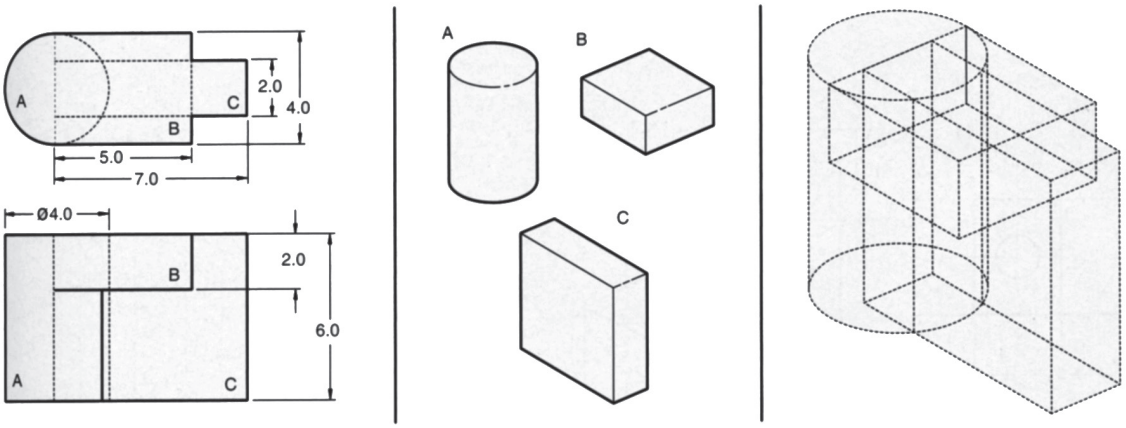
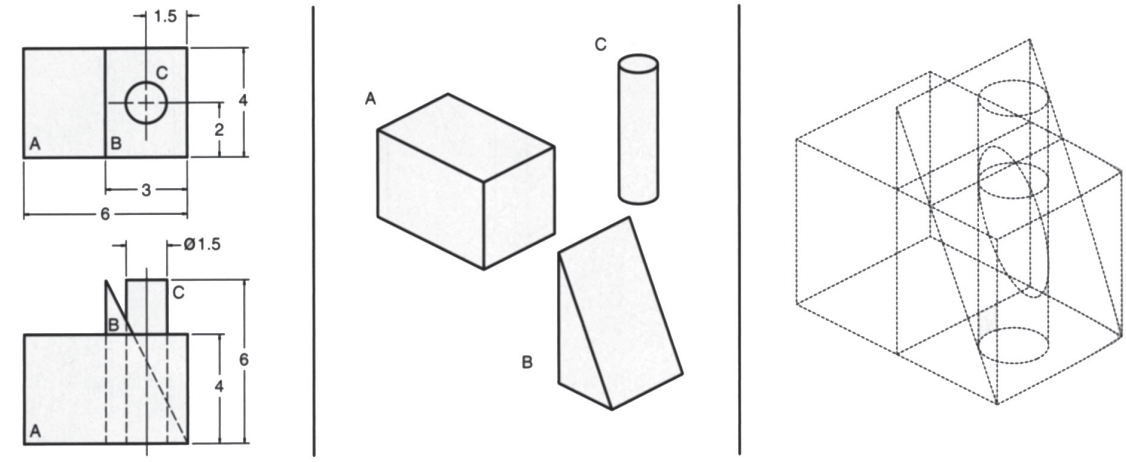
Visualization Chapter 4

3D Modeling

For practice in visualizing how primitive shapes can work together, print out copies of the following overlapping primitive shapes. Sketch the resulting composite shapes based on the Boolean operations assigned by your teacher.





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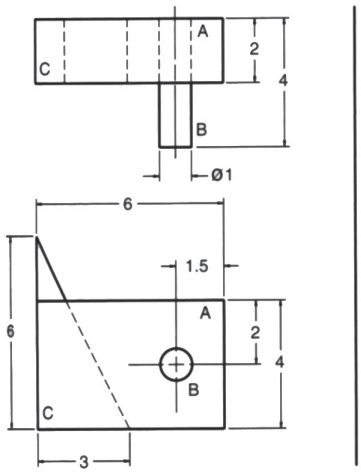
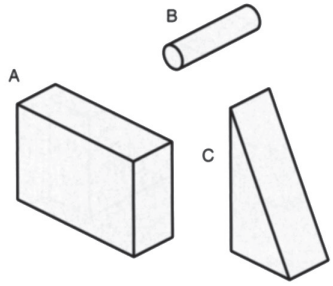
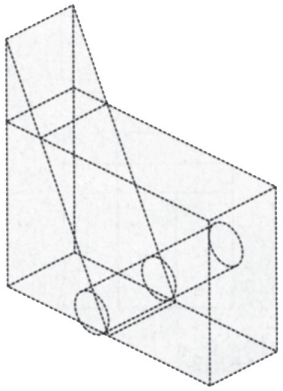
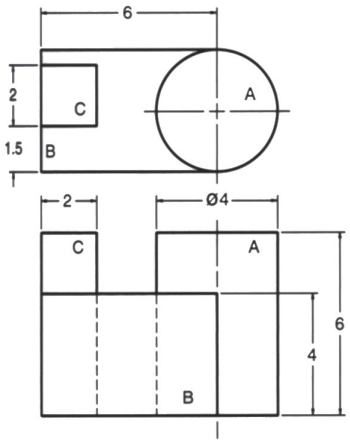
Visualization Chapter 4

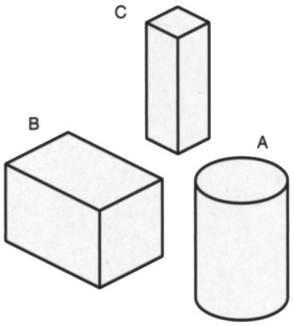
3D Modeling

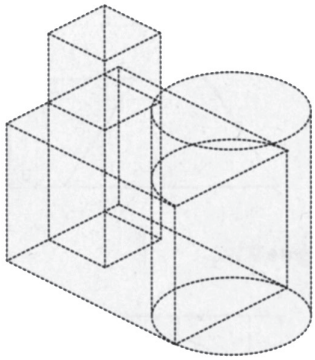


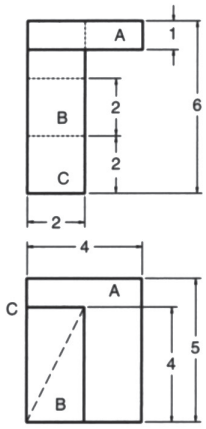


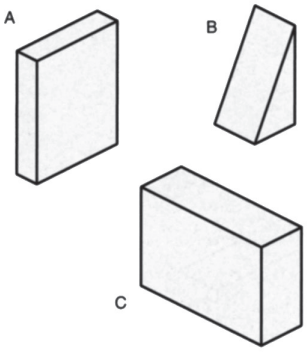


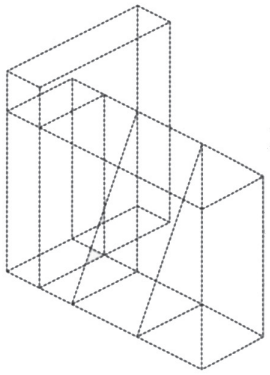












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3D Modeling

Keep this question in mind: Does the order of the operations matter? For example, does (A – B) + C create the same resulting composite shape as A – (B + C)? As in math, you should complete the operations in the parentheses first. Make sure you pay careful attention to the order of operations when sketching the composite shapes.

If you have appropriate solid modeling software available, create the primitive shapes with the given dimensions, perform the Boolean operations, and compare the results to your sketches.

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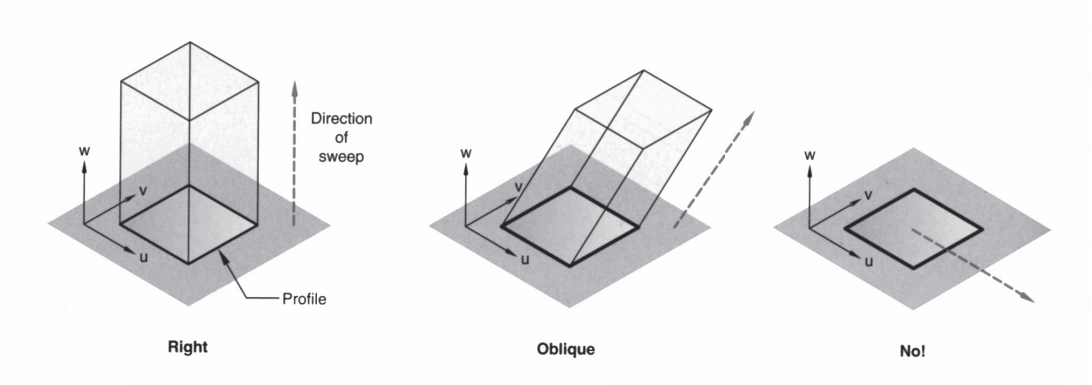
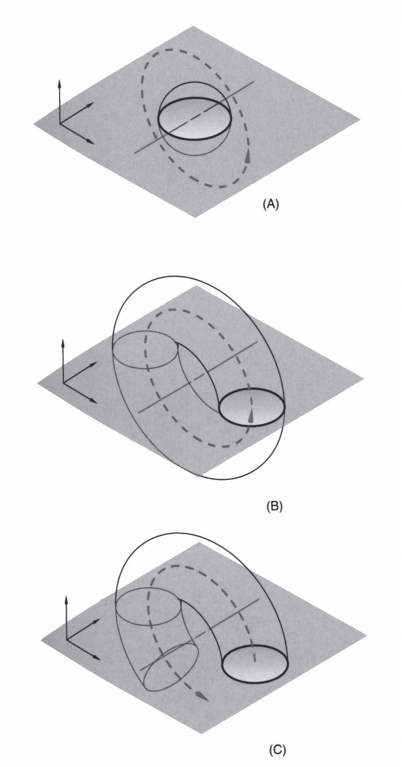
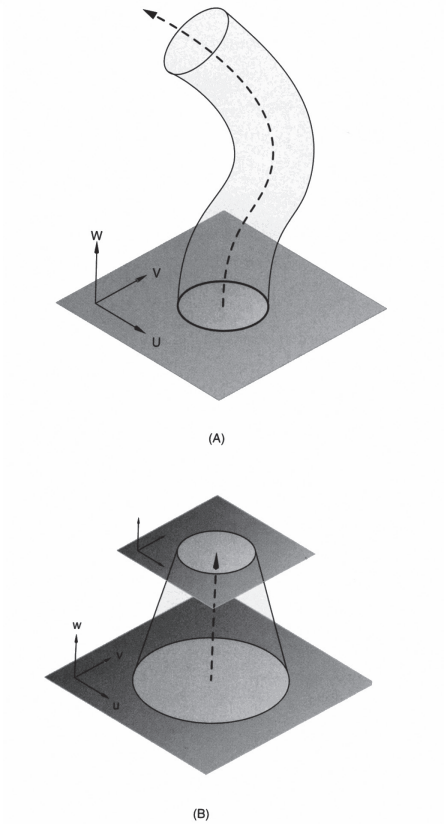
Visualization Chapter 4

3D Modeling

Parametric modeling and sweep operations A lot of the 3D geometry created using parametric modeling techniques is constructed by sketching profiles and either extruding them along a line or revolving them around an axis. These sweep techniques can range from simple to complex. The first example shows an operation that sweeps a square profile along a straight line. This process is commonly called an extrusion (in most modeling software). The second example shows an operation that sweeps a circular profile around an axis, commonly called a revolution. The third example shows a sweep along a curved path, and a blend operation (in which the profile changes in size from the beginning to the end of the sweep). In some modeling applications, it is also possible to change shape when creating a swept blend.







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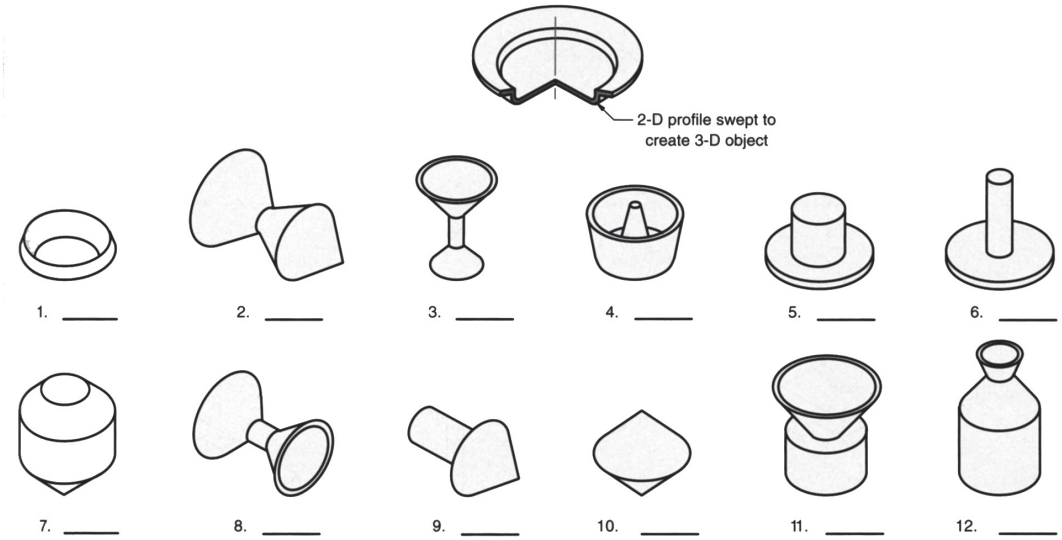
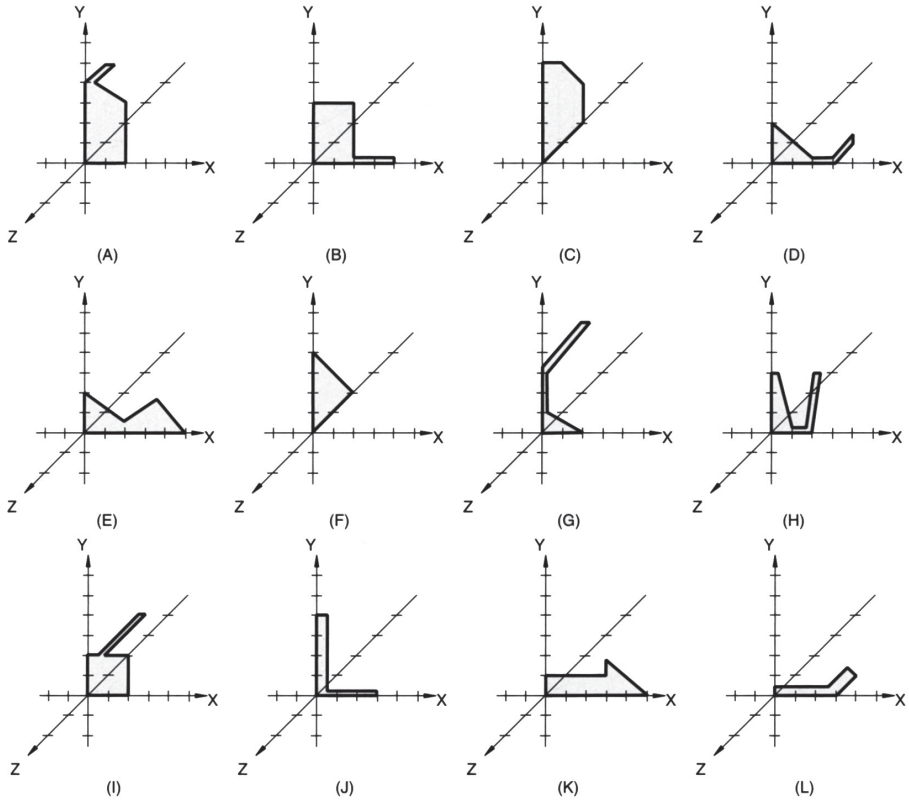
Visualization Chapter 4

3D Modeling

The revolved profiles are often considered more difficult to visualize than other sweep operations. For practice in visualizing this sort of sweep, complete the following matching exercises.





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