

# 18MES101L – Engineering Graphics and Design

Exercise - 7
Combination of Solids - 1



#### **Basic Definitions**

What is solid?

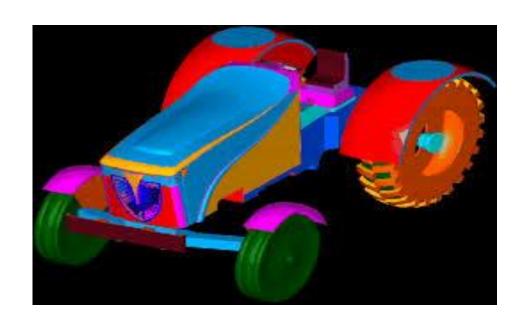
Solid is having three dimensions.

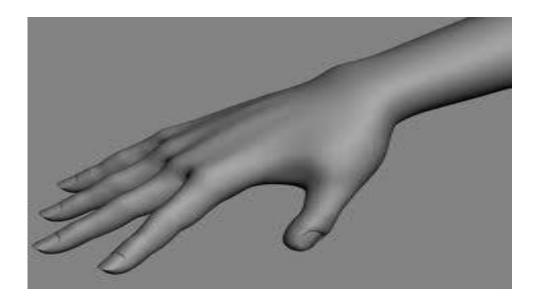
What is solid modeling?

Solid modeling (or modeling) is a consistent set of principles for mathematical and computer modeling of three-dimensional solids.



# **Solid modeling**











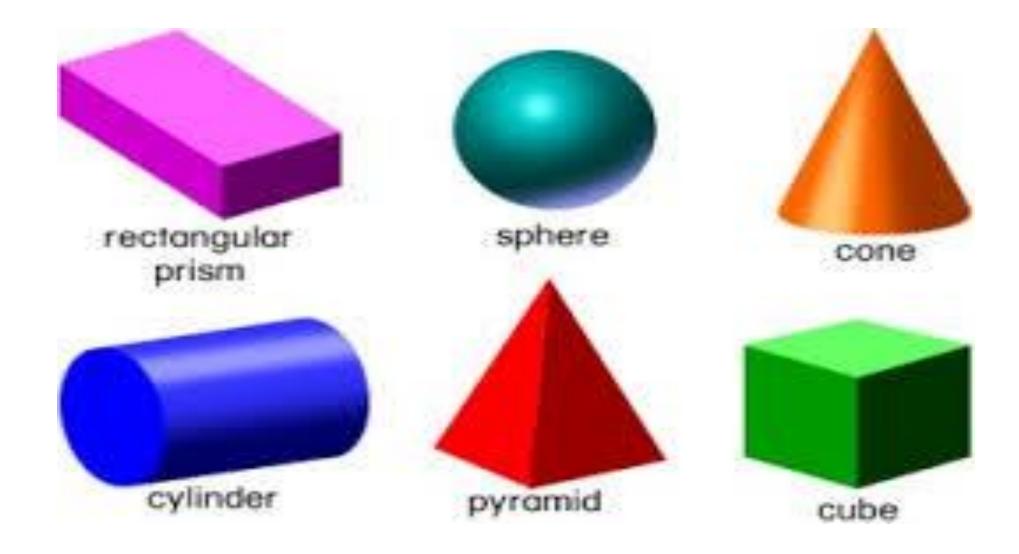
#### **Basic Definitions**

#### **Primitives:**

- Solid modeling packages having a CSG-compatible user input, and therefore, provide users with a certain set of building blocks, often called primitives.
- Primitives are simple basic shapes and are considered the solid modeling entities
  which can be combined by a mathematical set of boolean operations to create the
  solid
- The four most commonly used primitives are: block, cylinder, cone, sphere
- These are based on four natural quadrics, planes, cylinders, cones and spheres



#### **Solids**





- Solid models can consists of primitive shapes such as (Already used in Projection of Solids exercises)
  - Sphere
  - Cylinder
  - Cone
  - Pyramid
  - Cube
  - Box



#### **Boolean Operations**

- The Boolean commands work only on solids or regions.
- The first stage in a solid model creation consists in obtaining one or more primitives.
- The next stage consists in using Boolean operations of Union, Subtract or Intersect in order to create the solid model.



 Boolean operations are used to combine solid primitives to form the desired solid.

The available operators are

Union (U or +)

Intersection (∏ or I)

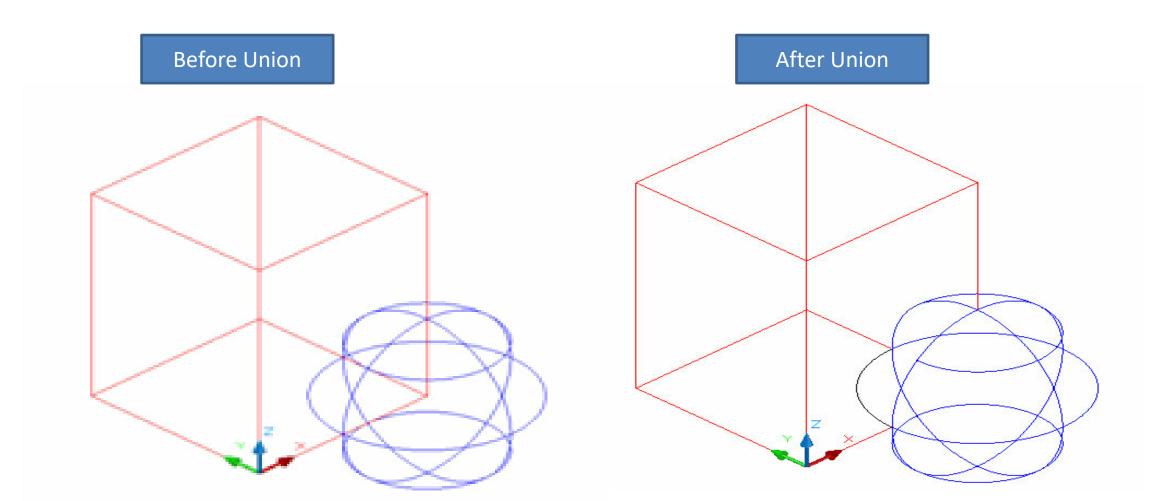
Difference or subtract ( - )



- The Union operator (U or +): is used to combine or add together two objects or primitives.
- The Intersection operator ( $\prod$  or I): intersecting two primitives gives a shape equal to their common volume.
- The Difference operator (-): is used to subtract one object from the other and results in a shape equal to the difference in their volumes.

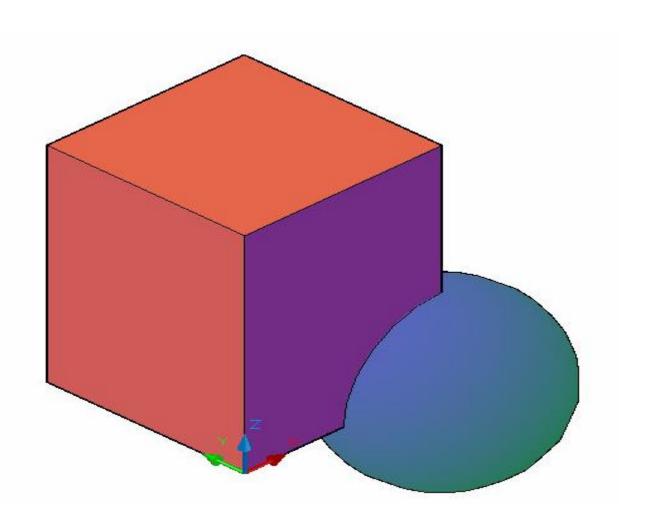


## Union



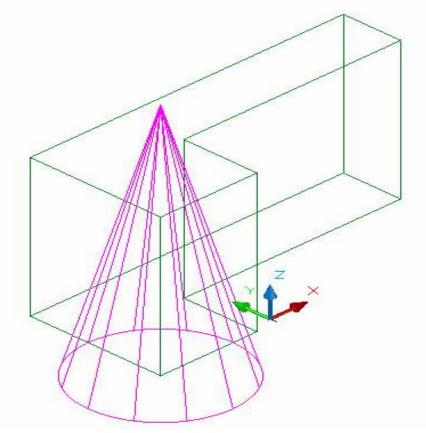


# Union

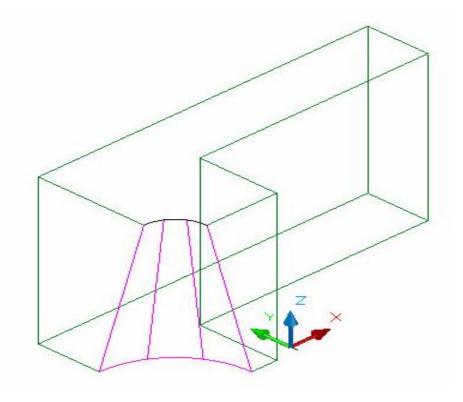




#### Before Subtract

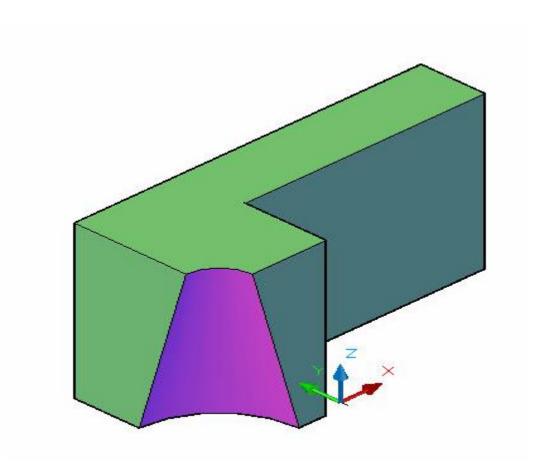


#### After Subtract





## **Subtract**

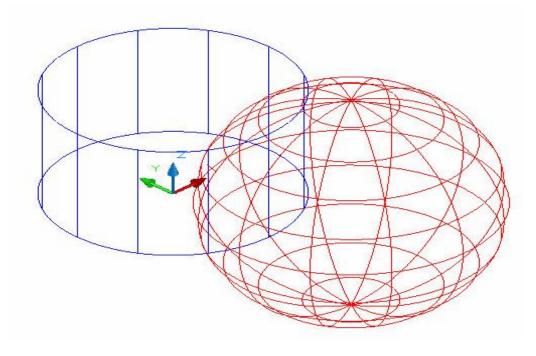


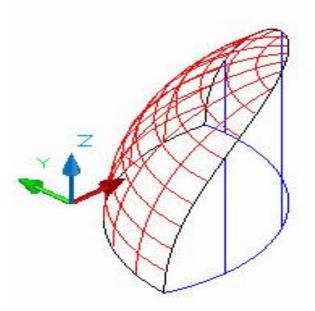


#### Intersection

Before Intersection

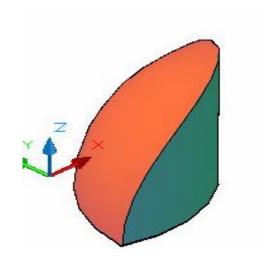
After Intersection







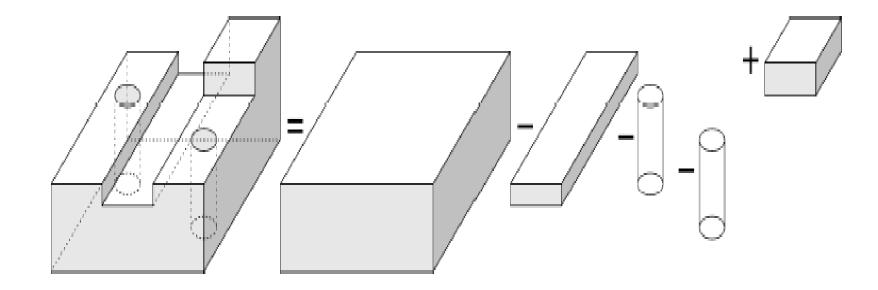
## Intersection





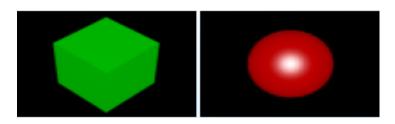
## **Constructive Solid Geometry**

- A CSG model is based on the topological notation that a physical object can be divided into a set of primitives (basic elements or shapes) that can be combined in a certain order following a set of rules (Boolean operations) to form the object.
- CSG combines solid objects by using three different boolean operations





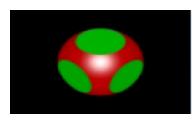
## **CSG Combine**



**CSG** - Union



**CSG** - Intersection

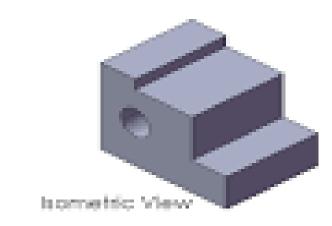


**CSG - Subtract** 

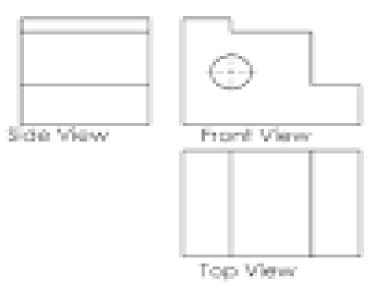




## Orthographic Vs Isometric projection



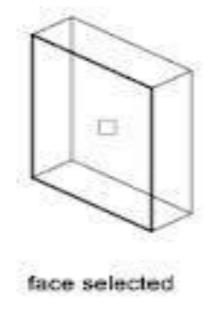
#### **Orthographic view**

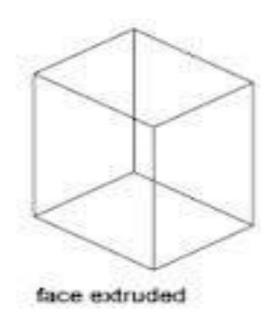




#### **Extrude**

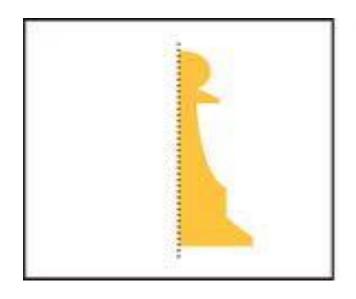
• The **Extrude feature** is one of the most common **features** .An **Extrude** is used to convert a 2D figure into a 3D object,



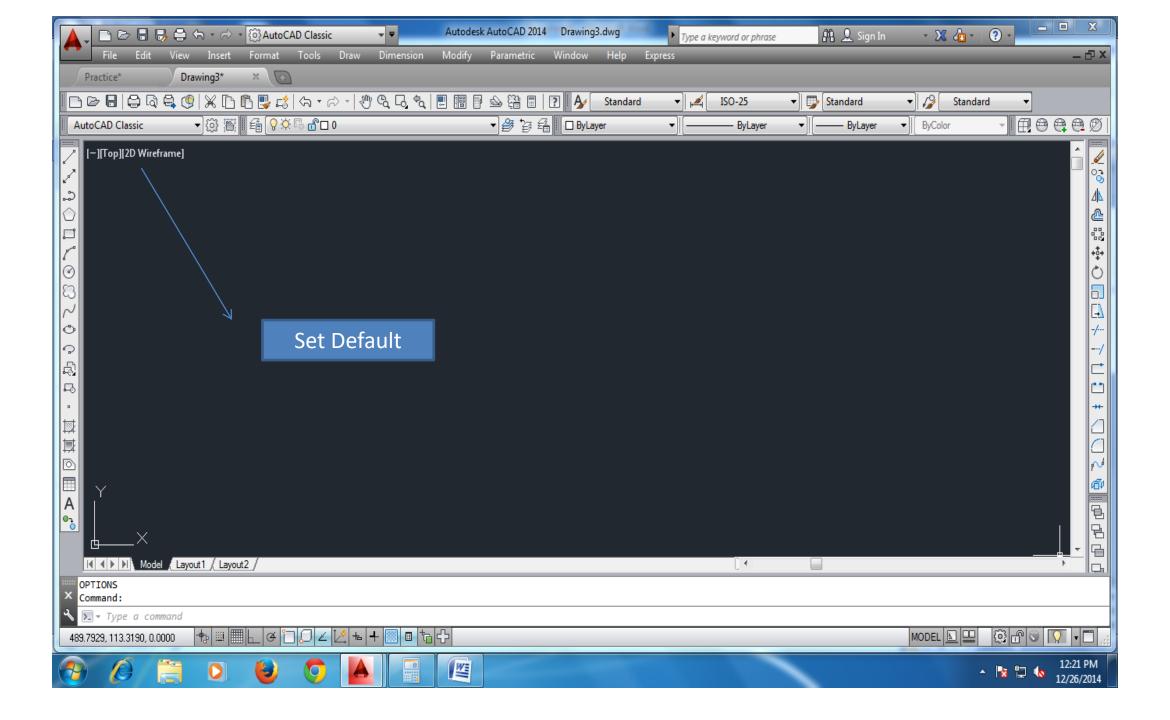


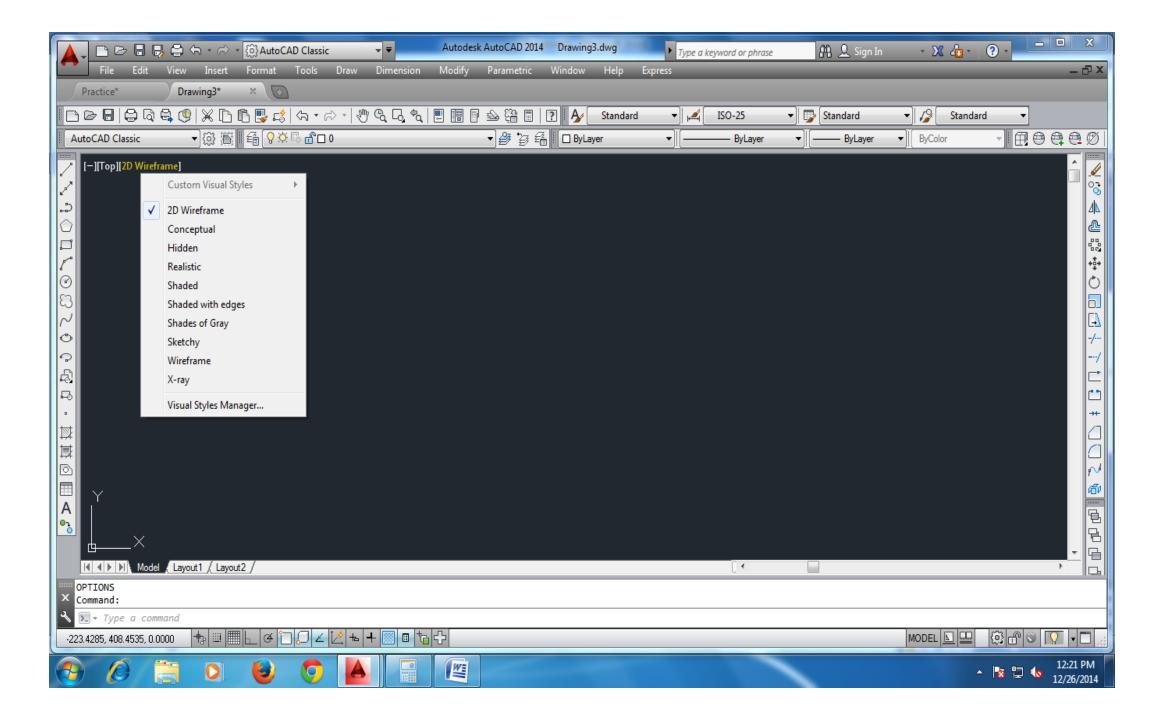


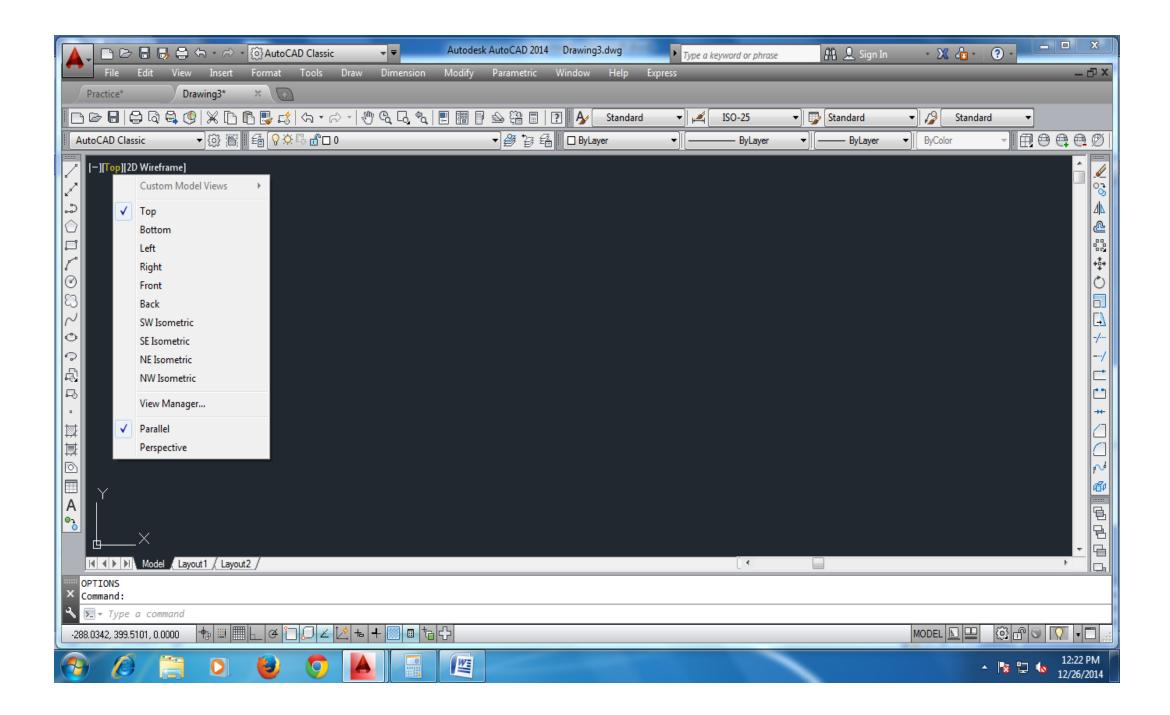
**Revolve:** The Revolve feature is created by revolving a sketched profile around an axis of revolution. The angle and direction can be controlled independent of the sketch.

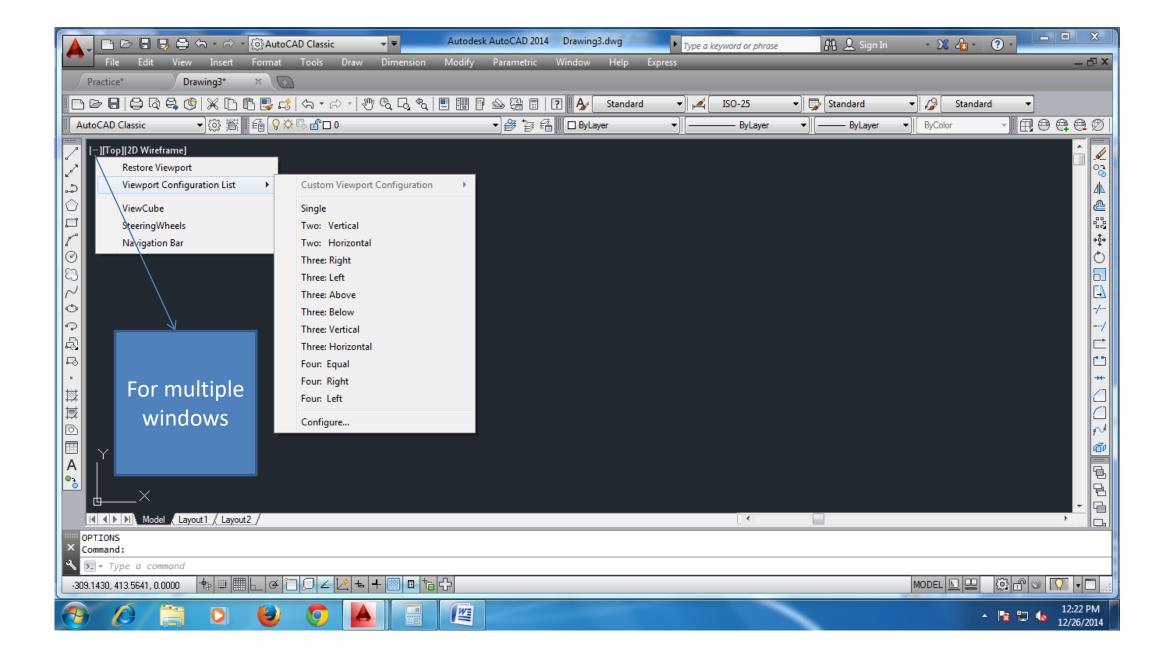


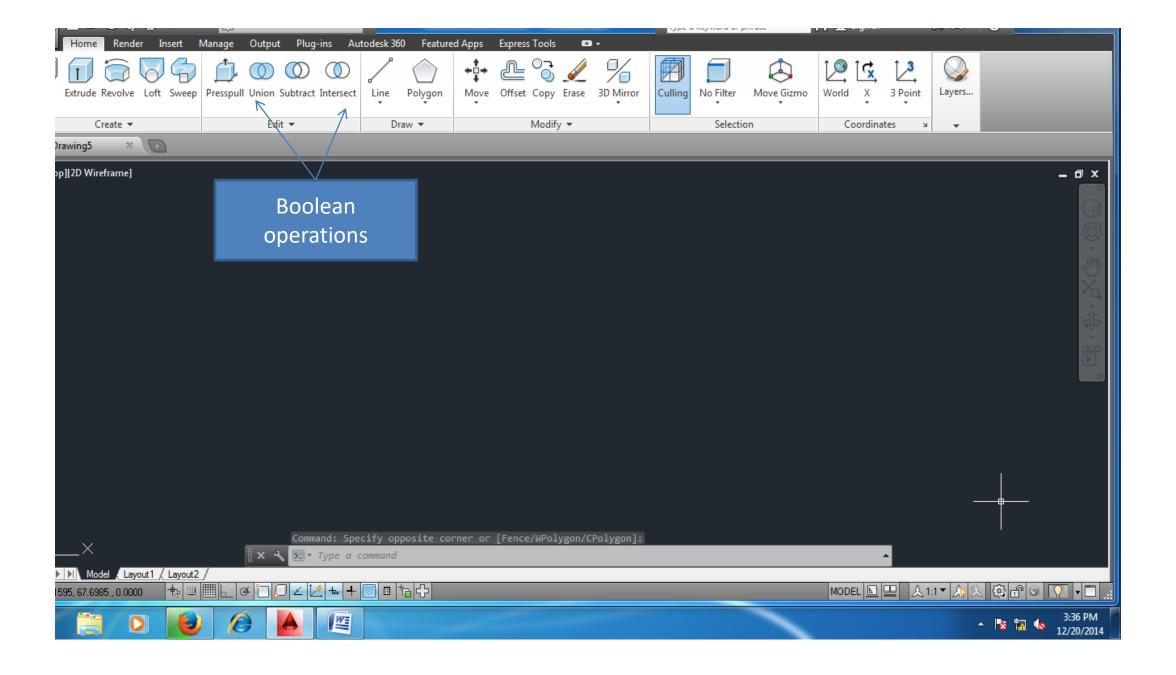


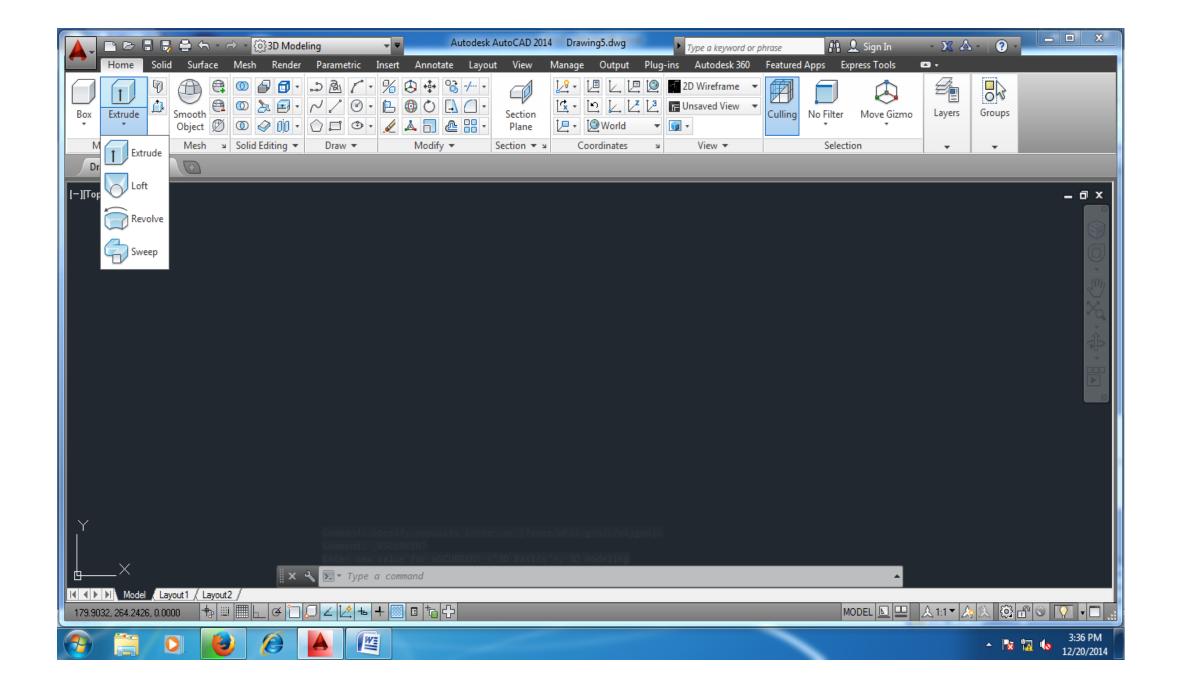






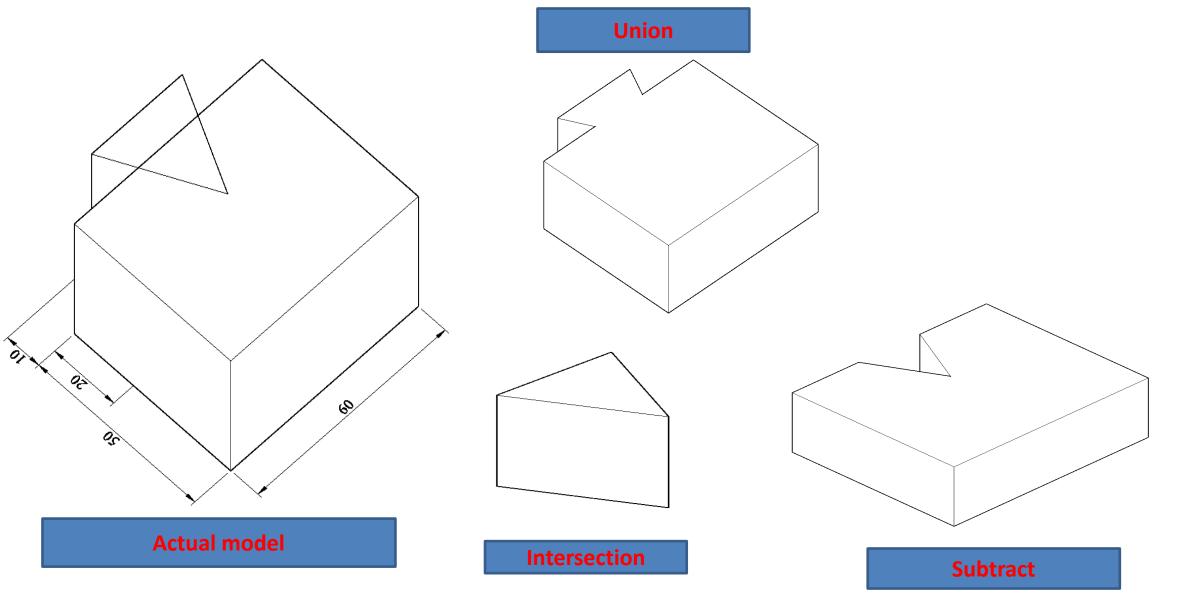








## Model basic boolean operations

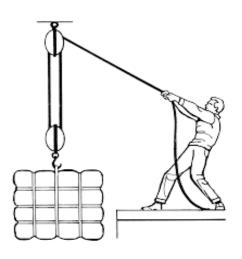


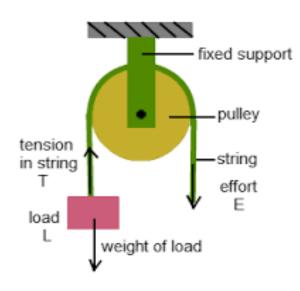


# Model using drafting package Model a pulley:

A wheel with a grooved rim around which a cord passes, which acts to change the direction of a force applied to the cord and is used to raise heavy weights.

#### Pulley



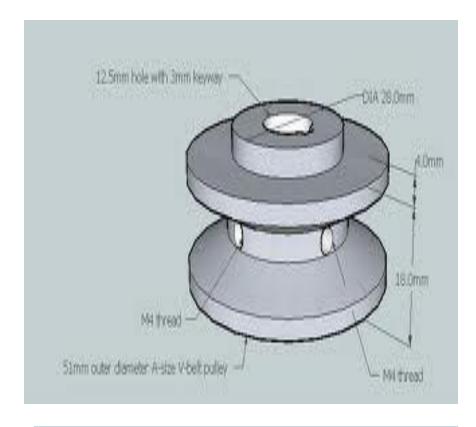


**2D** Command: Line, Circle, Rectangle

**3D Command :** Revolve, Subtract

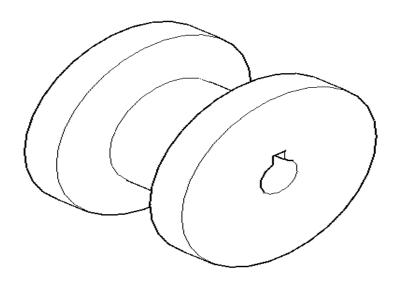
(OR)

**2D Command :** Circle, Rectangle **3D Command :** Extrude, Subtract

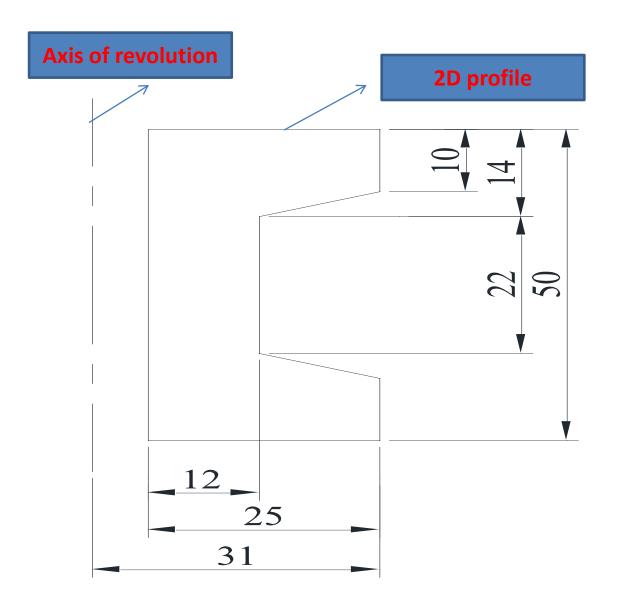


Question-1





**After revolve** 





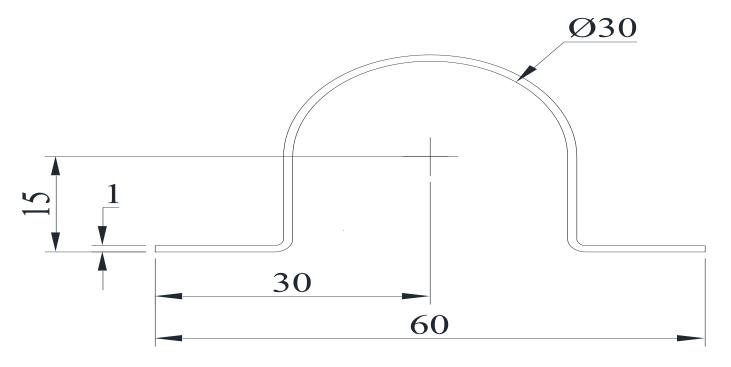
**2D Command**: Line, Arc, Fillet,

Circle, Trim

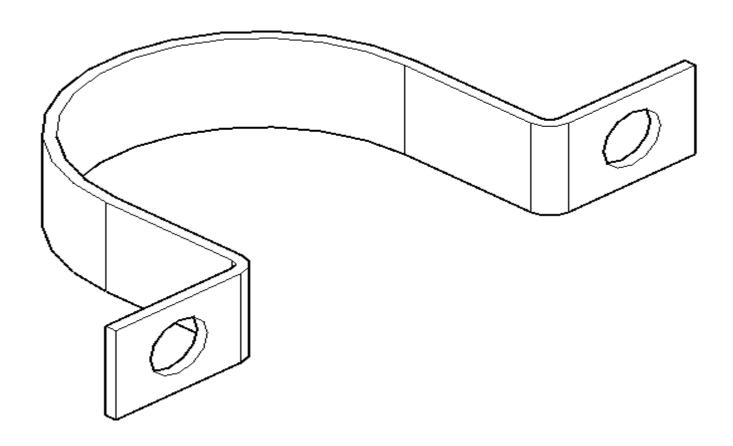
**3D Command : Region, Extrude,** 

**Subtract** 

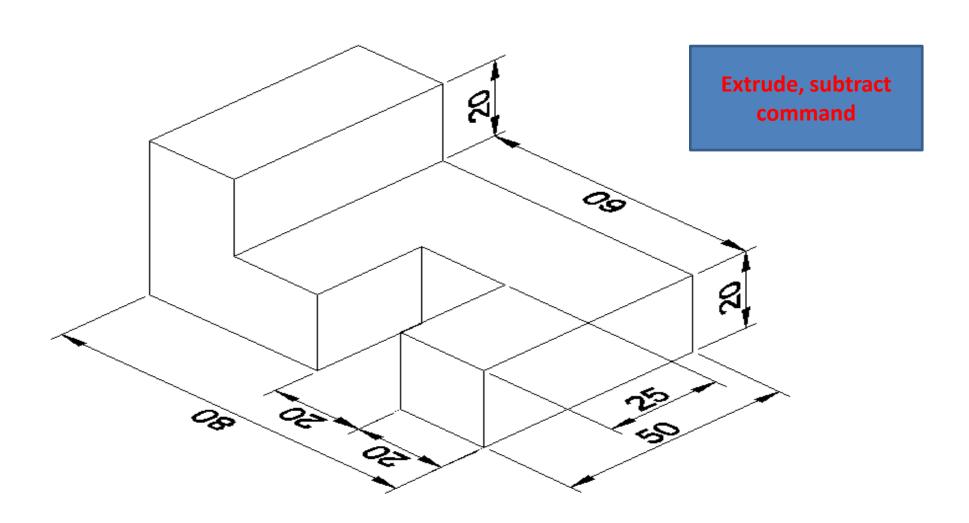




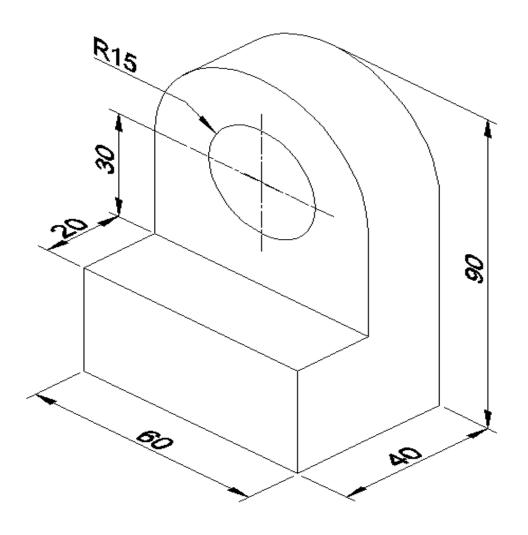






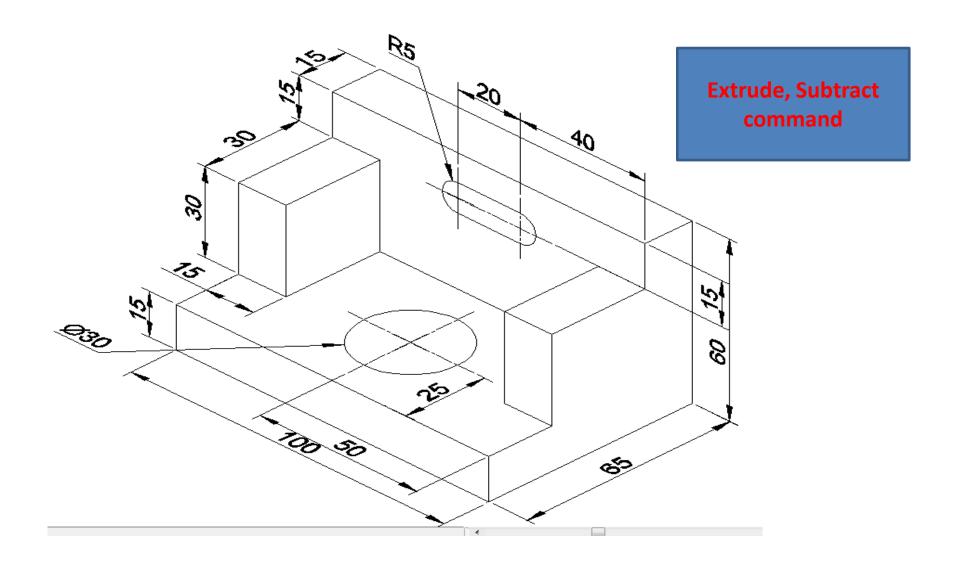




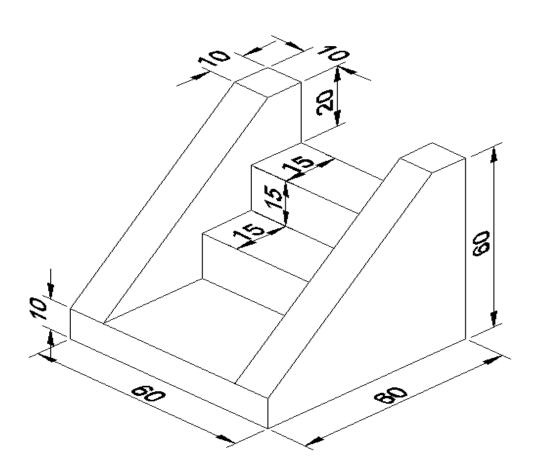


Extrude, Subtract command









Extrude, Subtract command



