

# Chapter 5

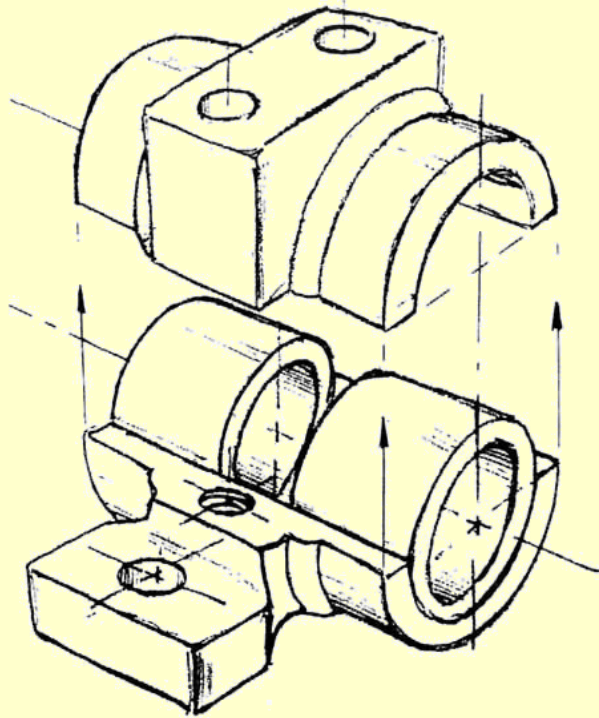
## Pictorial sketching



# Contents

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- Freehand sketching techniques
- Pictorial projections
  - Axonometric
  - Oblique
- Isometric projection vs isometric sketch
- Isometric sketch *from an orthographic views*
- Isometric sketch of an object
- Oblique sketch



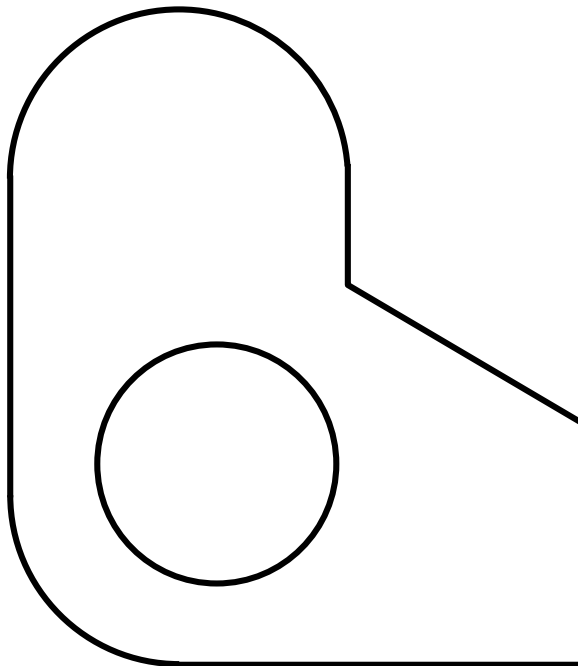
# Freehand sketching techniques

*Sketching is one of the primary modes of communication in the initial stages of the design process. Sketching also is a means to creative thinking. It has been shown that your mind works more creatively when your hand is sketching as you are engaged in thinking about a problem. [Lieu & Sorby 2009]*

# 2-D geometry

- A two-dimensional geometry is always composed of
    1. **Straight line** (Horizontal, vertical and Inclined)
    2. **Arc, circle and curve**
- 

## Example



### Suggestion for practicing

Use your experiences gained from the chapter “applied geometry”. Analyze **the composition** of 2-D geometry and list the **construction steps**.

# Tools preparation & recommendations

## 1. Pencil

- Sharpen the lead.
- Use different lead grades pencils for each required line weight.

## 2. Sketching paper

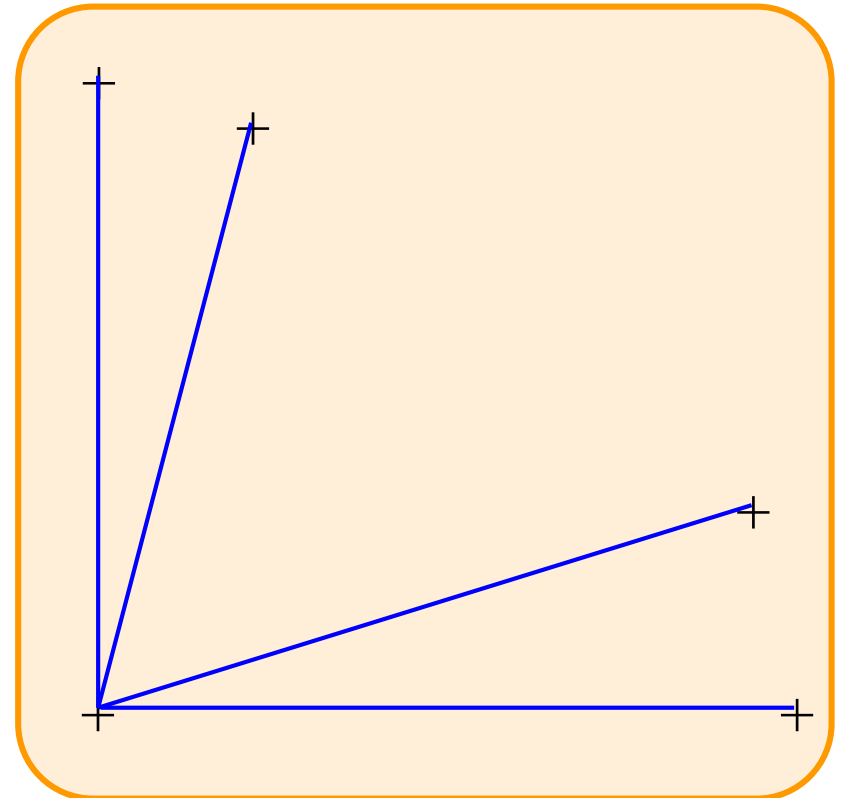
- You **don't** need to fix it to the table, i.e. let it moves and rotates freely while sketching.

## 3. Eraser

- Make sure it is clean.

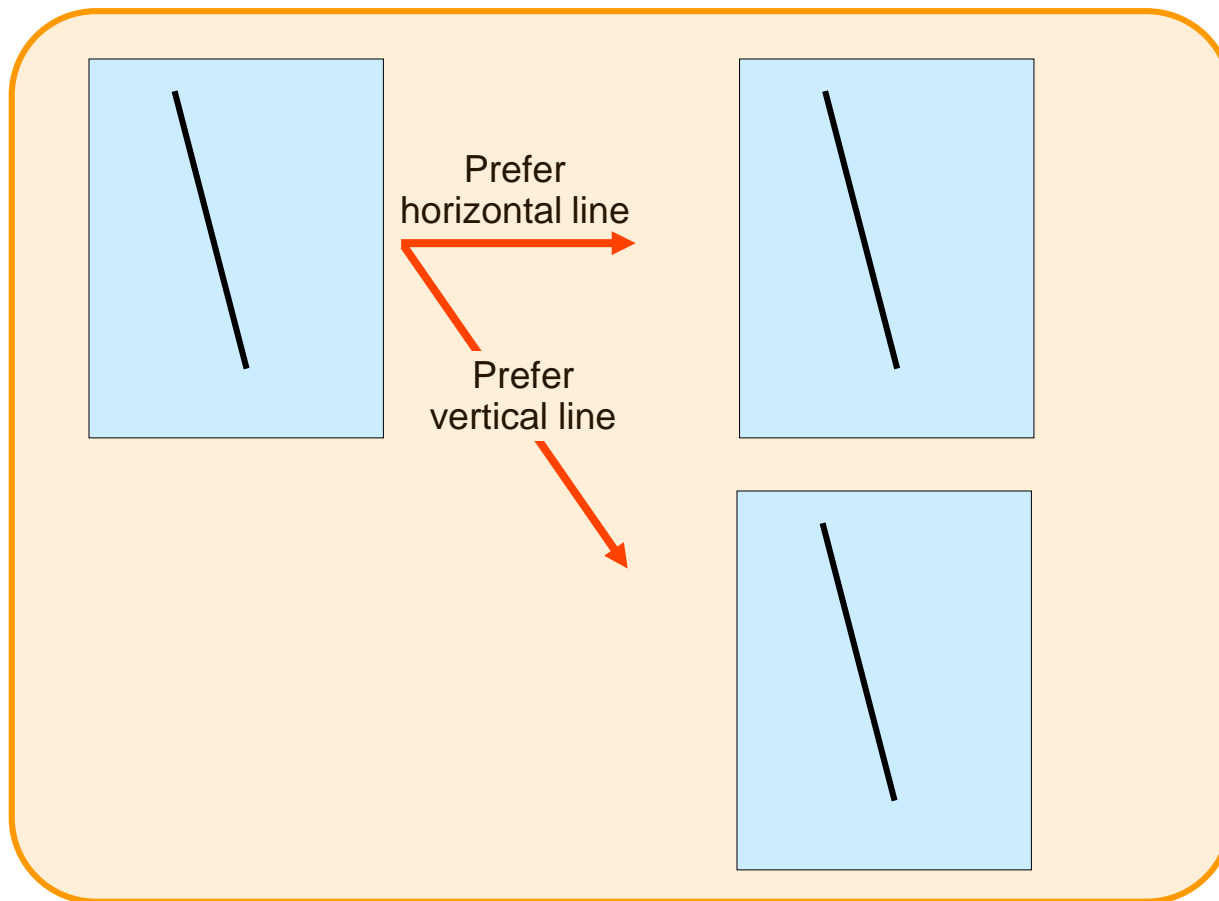
# Techniques : Sketching a line

- Focus on the **end** point.
- Sketch the line in the following directions
  - **Vertical lines** should sketch from **top** to **bottom**.
  - **Horizontal lines** should sketch from **left** to **right**.
  - **Inclined lines** that are **mostly vertical**, sketch them from **top** to **bottom**.
  - **Inclined lines** that are **mostly horizontal**, sketch them from **left** to **right**.



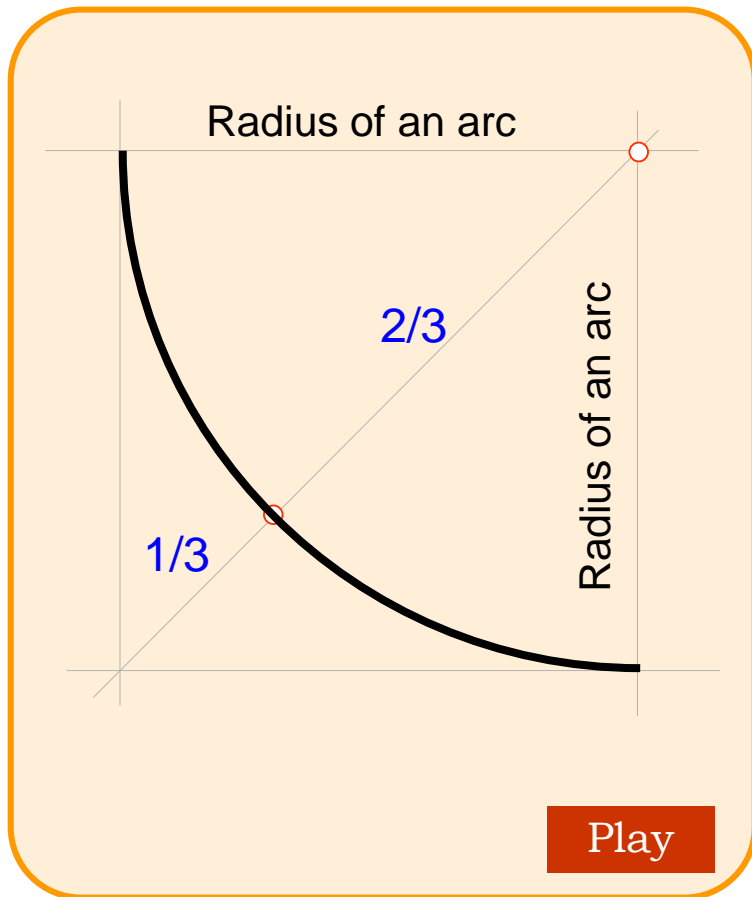
# Techniques : Sketching a line

- You can rotate the paper on the desk to suit your preferences line tracing direction.



# Techniques : Sketching an arc

- To sketch an arc of a given radius it is necessary to use construction lines to locate its **center** and its **tangent points**.



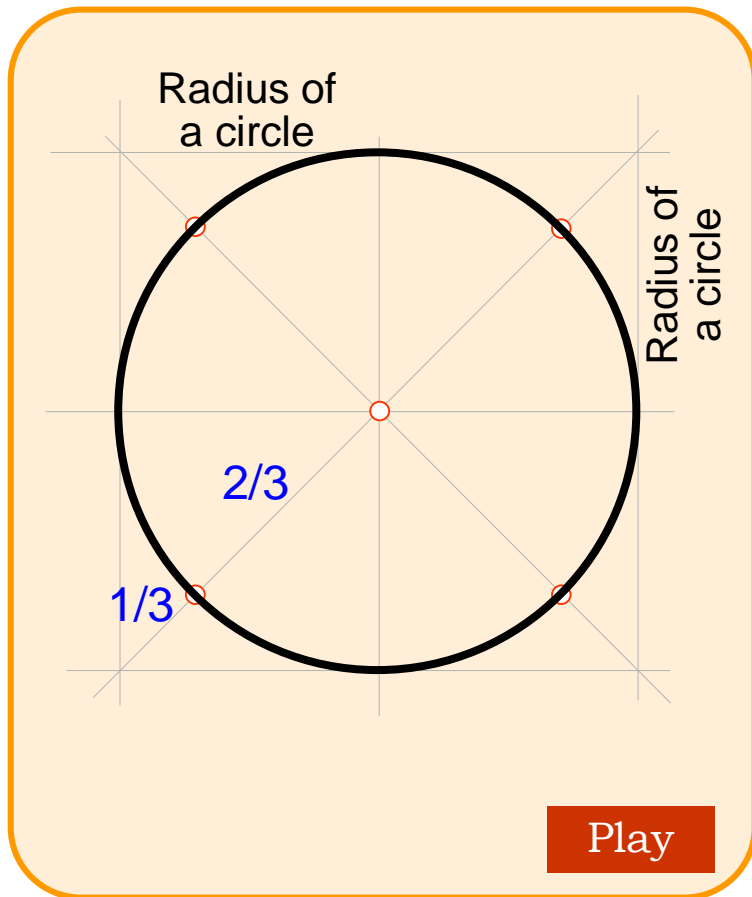
## Explanation

1. Sketch two lines intersect at the center of an arc.
2. Sketch a **square bounding box** with the length of its sides equal to radius of an arc.
3. Sketch a **diagonal line**. [option]
4. Mark the point on diagonal line far from the center of an arc for a distance  $2/3$  of the length of the line.
5. Sketch an arc through the tangent points and marked point



# Techniques : Sketching a **small** circle

- To sketch a circle of a given diameter it is necessary to use construction lines to locate its **center** and its **tangent points**.

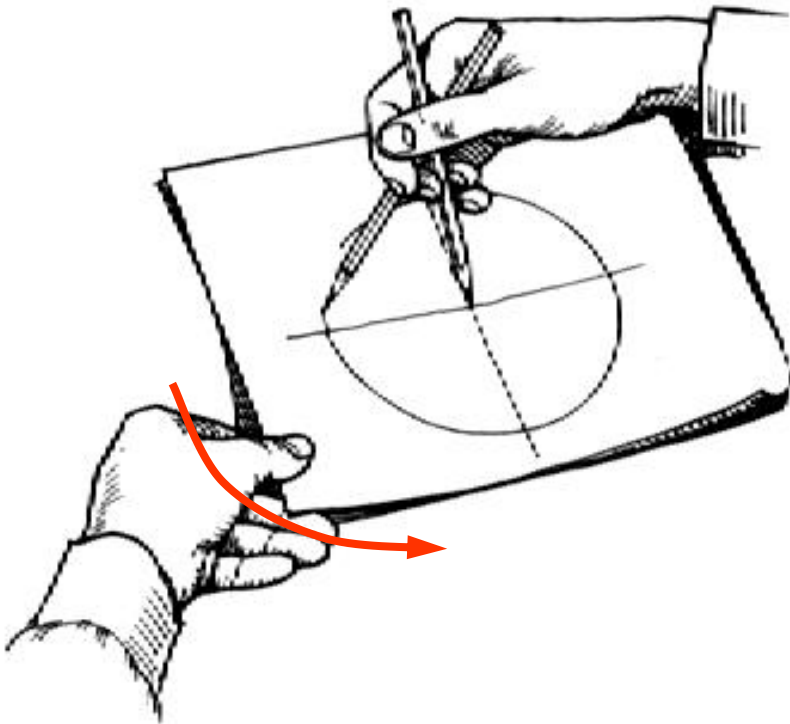


## Explanation

1. Sketch two lines intersect at the center of a circle.
2. Sketch a **square bounding box** with the length of its sides equal to radius of a circle.
3. Sketch the **diagonal lines**. [option]
4. Mark the point on diagonal line far from the center of a circle for a distance  $2/3$  of the **half**-length of the line.
5. Sketch a circle through all marked points and tangent points.

# Techniques : Sketching a large circle

1. Place one pencil's tip at the center as a pivot, and set another pencil's tip at the radius-distance from the center.
2. Hold the hand in this position and rotate the paper.



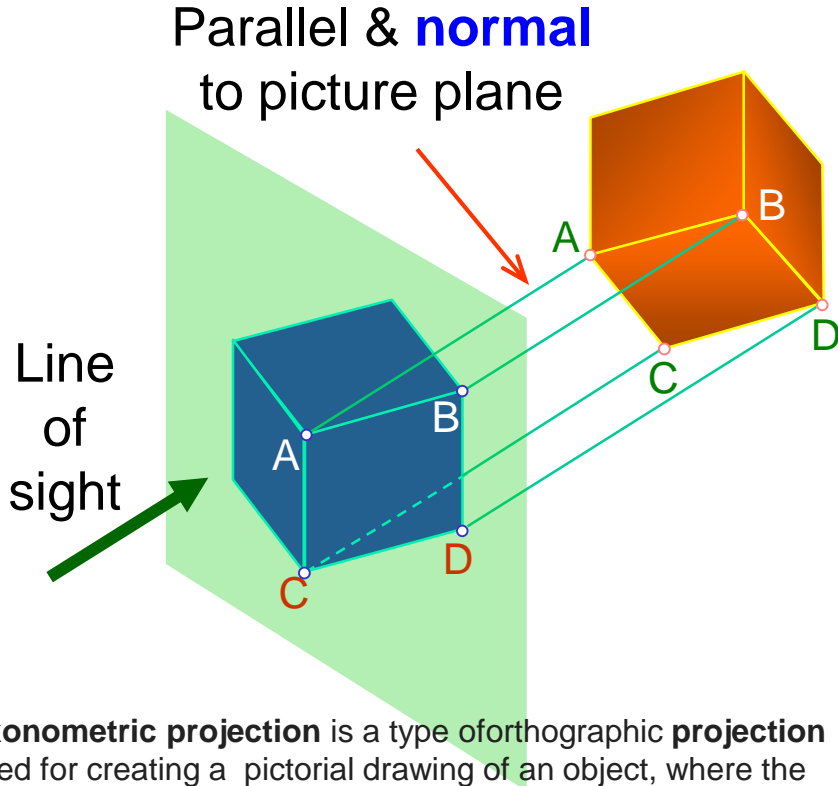


# Pictorial projection

[Contents](#)

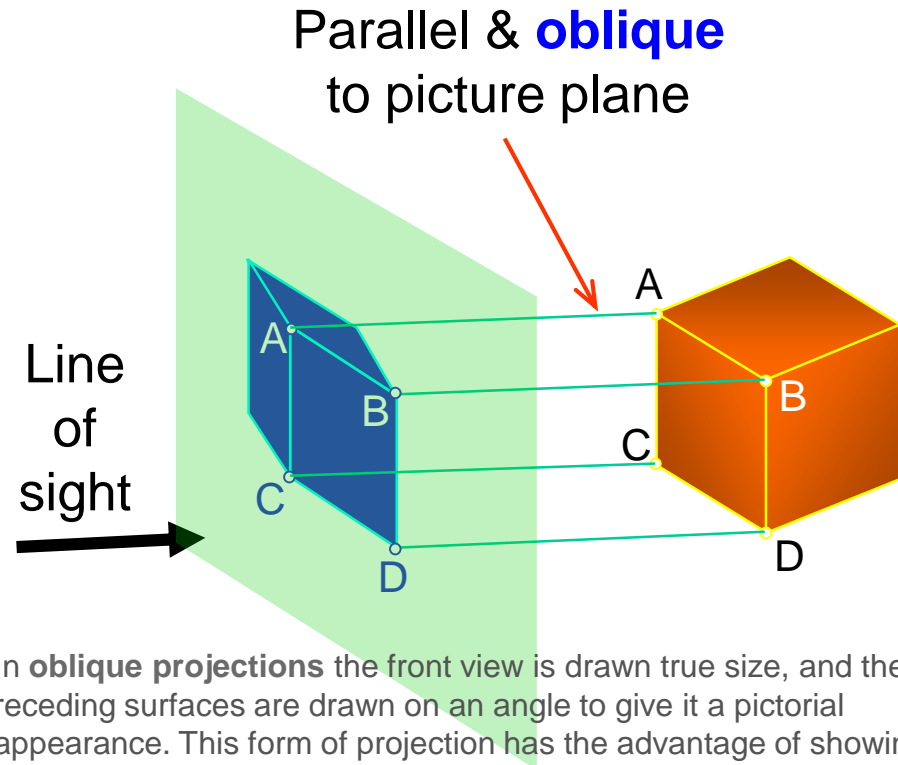
# Types of a pictorial projection

## Axonometric Projection



**Axonometric projection** is a type of orthographic projection used for creating a pictorial drawing of an object, where the lines of sight are perpendicular to the plane of **projection**, and the object is rotated around one or more of its axes to reveal multiple sides.

## Oblique Projection

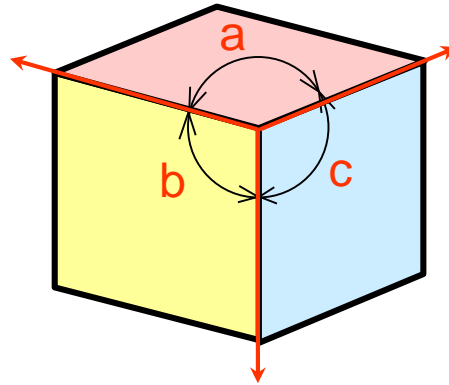


In **oblique projections** the front view is drawn true size, and the receding surfaces are drawn on an angle to give it a pictorial appearance. This form of projection has the advantage of showing one face (the front face) of the object without distortion. Generally, the face with the greatest detail faces the front.

# Type of an axonometric projection

## 1. Trimetric

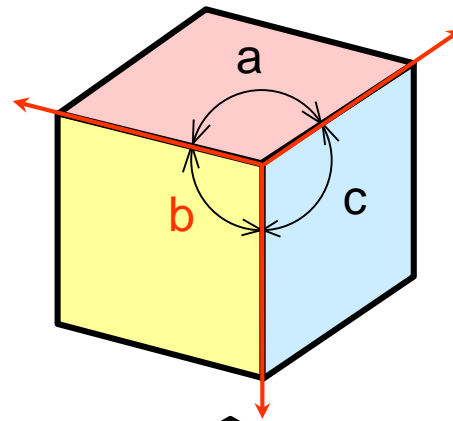
None of the angles are equal.



Axonometric axes

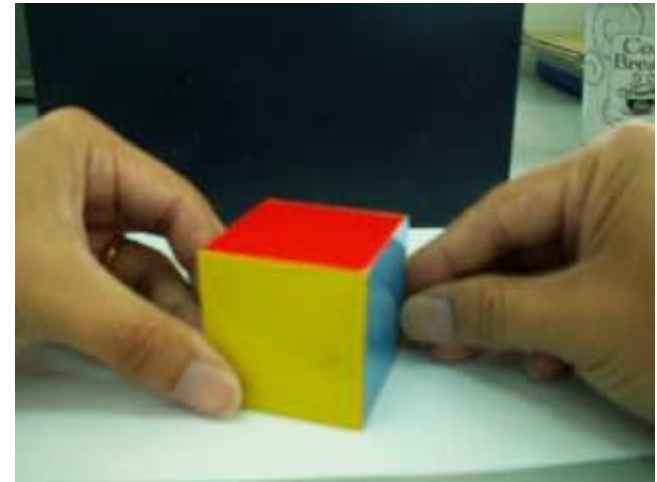
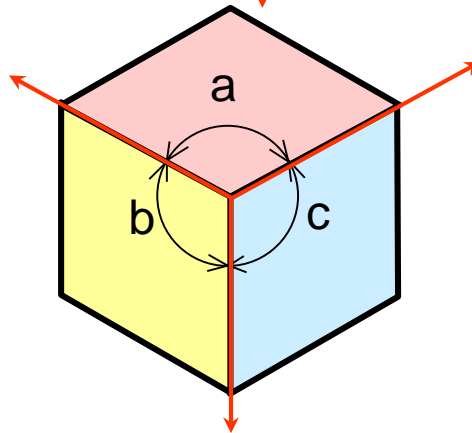
## 2. Dimetric

Two angles are equal.



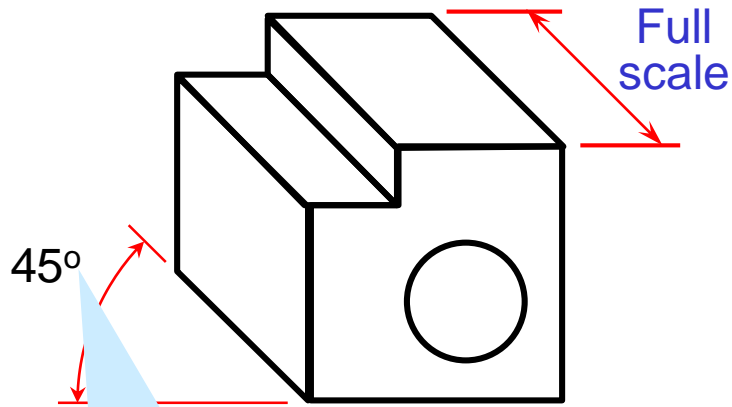
## 3. Isometric

All angles are equal.



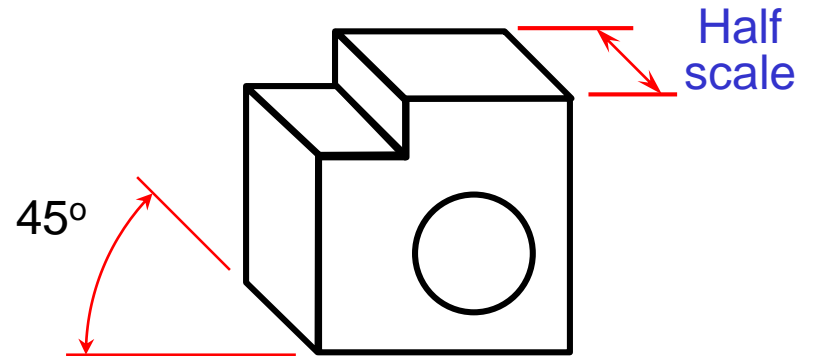
# Type of an oblique projection

## 1. Cavalier



This obliqued angle can be any angles but for convenient a 45° is chosen

## 2. Cabinet

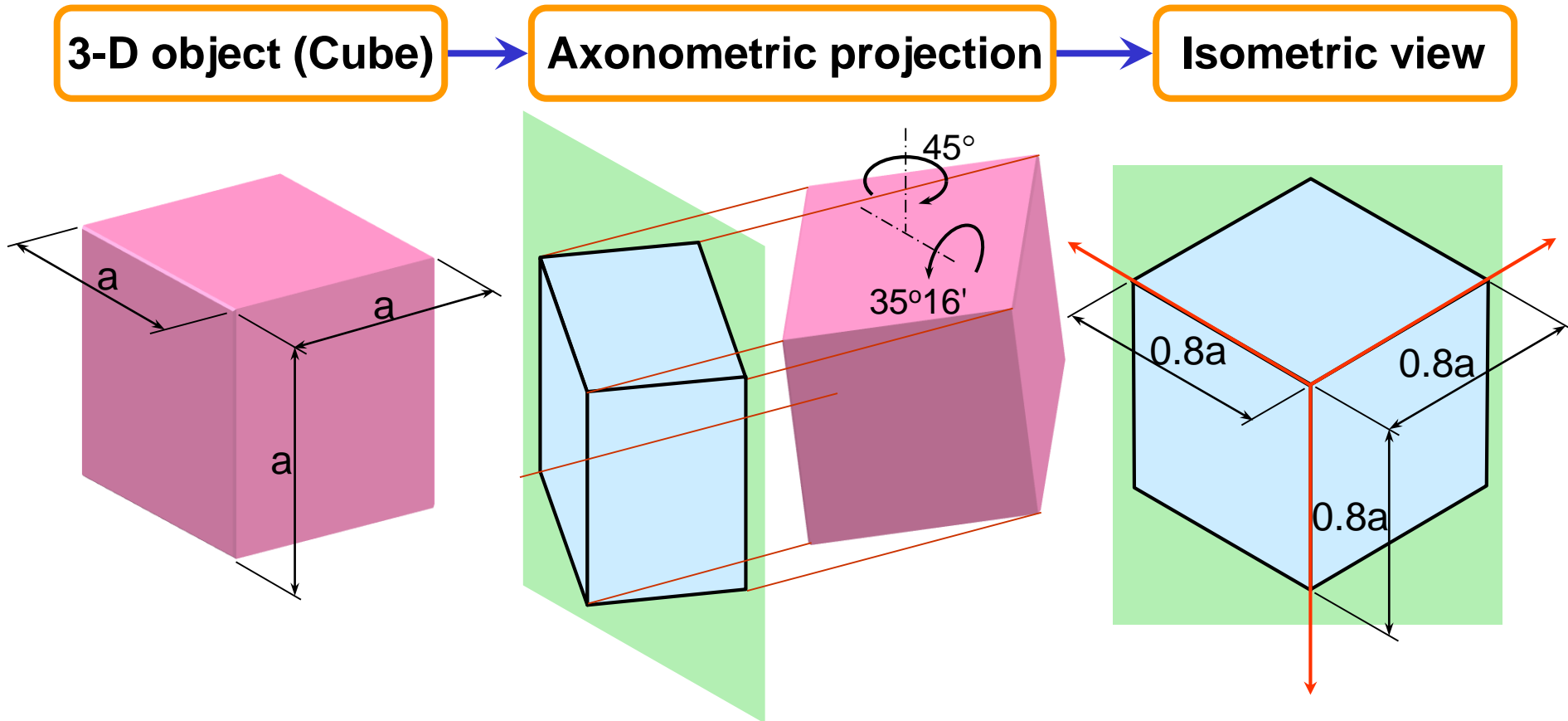




# **Isometric projection vs. Isometric sketch**

# Isometric projection

- The **projected lengths** of the edges parallel to the axonometric axes are approximately **81%** of their true length.

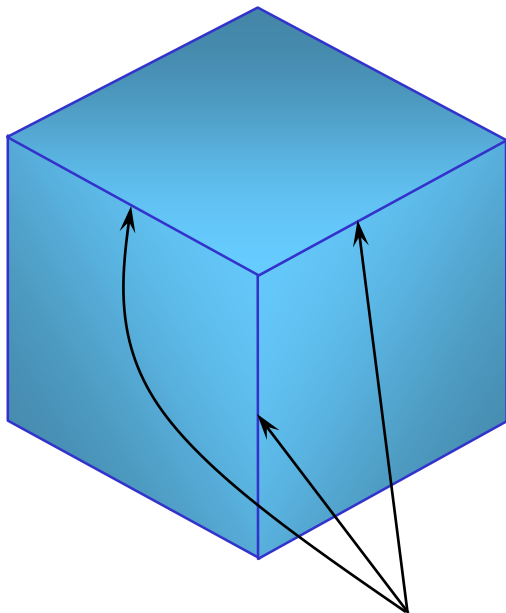




# Isometric sketch

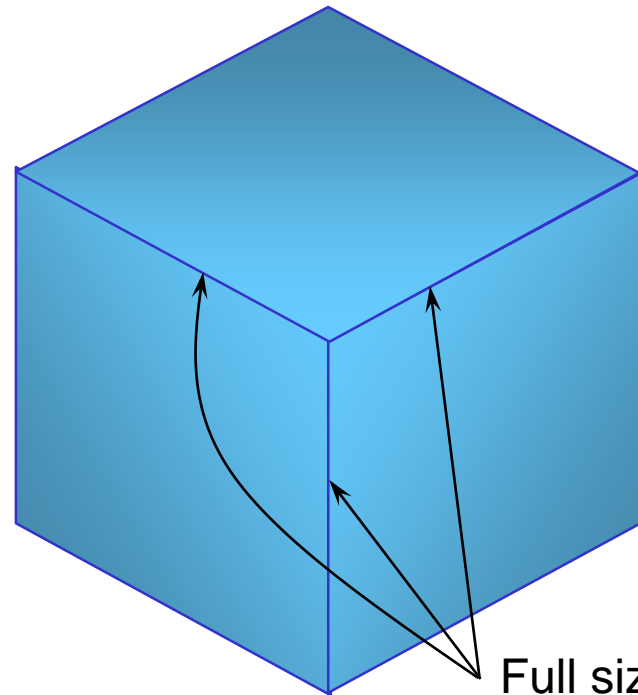
- Isometric sketch has a similar shape as an isometric projection view except that their edges parallel to the axonometric axes are drawn in *full size*.
- 

**Isometric projection**



Foreshorten

**Isometric sketching/drawing**

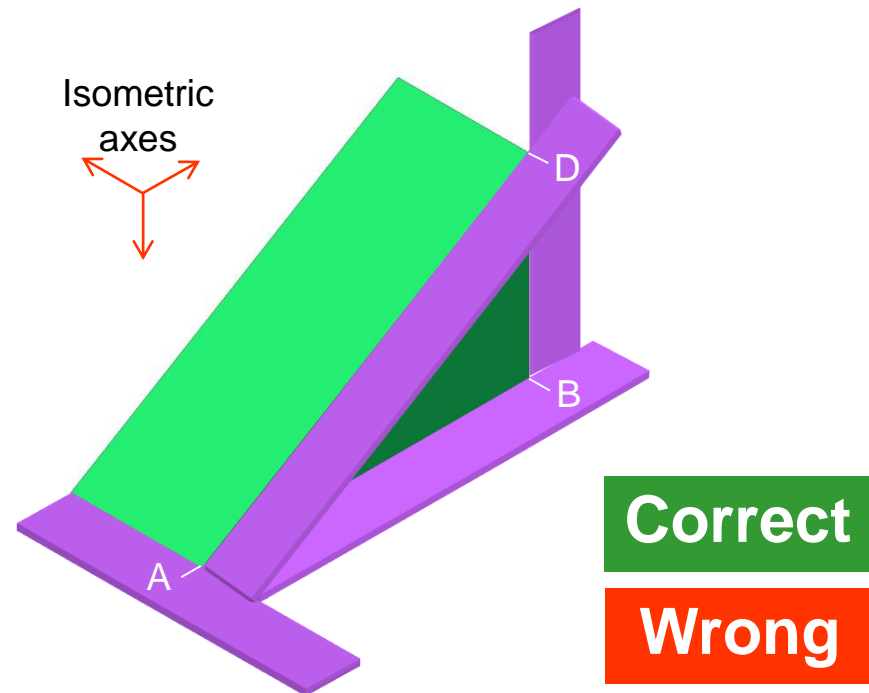
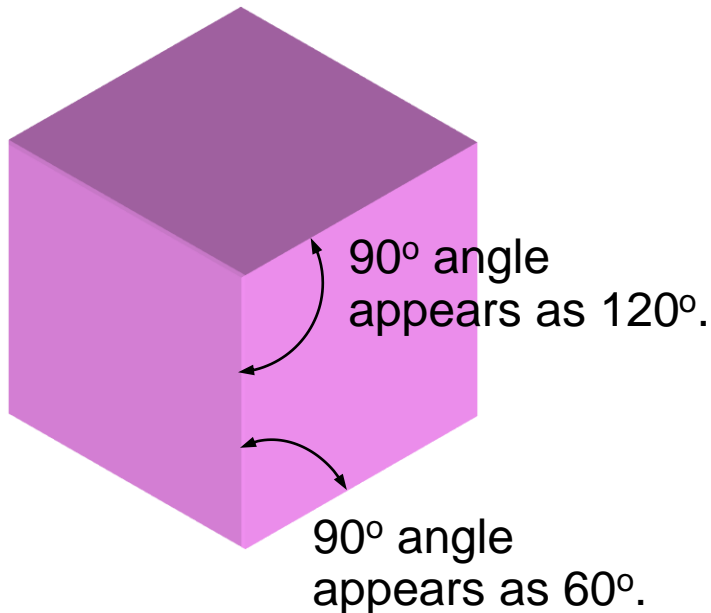


Full size

# Angle & distance in isometric sketch

- Angles in an isometric sketch **distort** from the actual angle found in the object.
- Actual or true distance can be measured along the isometric lines of the isometric sketch.

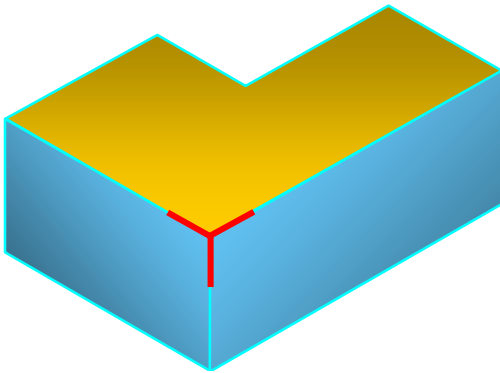
## Example



# Orientation of isometric axes

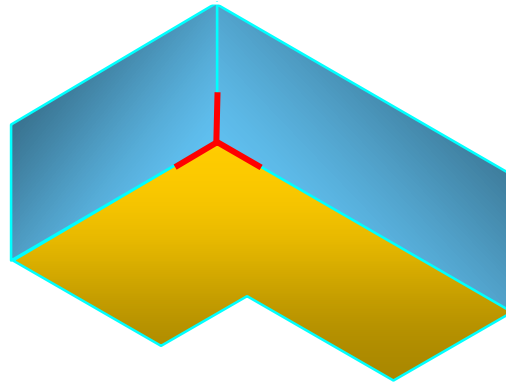
- Isometric axes can be arbitrarily oriented to create different views of a single object.
- 

**Regular  
isometric**



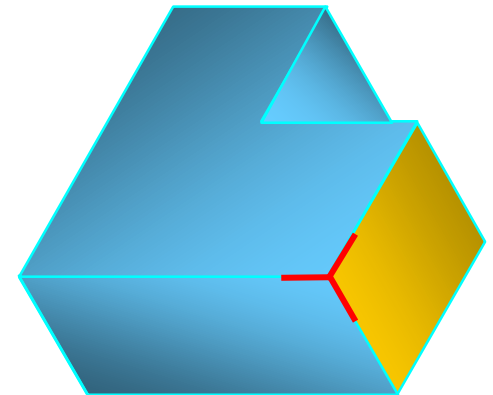
View point is looking down on the top of the object.

**Reverse axis  
isometric**



View point is looking up on the bottom of the object.

**Long axis  
isometric**

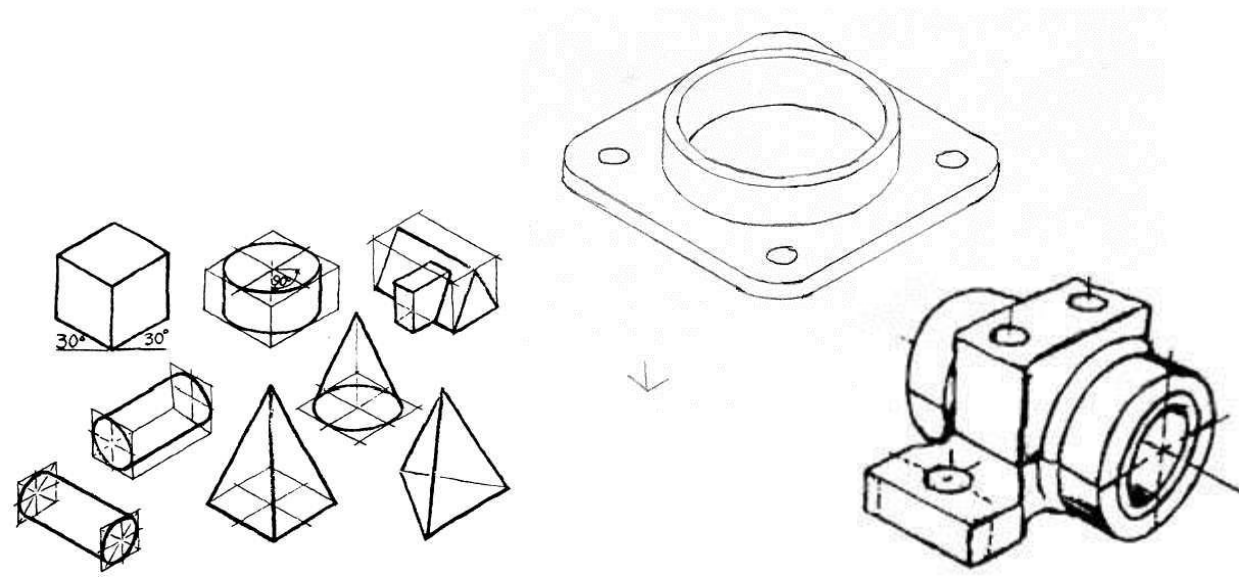


View point is looking from the right (or left) of the object.



# Isometric sketching

From an orthographic views



Contents

# Overview of the process

## Procedures

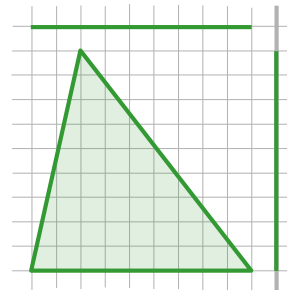
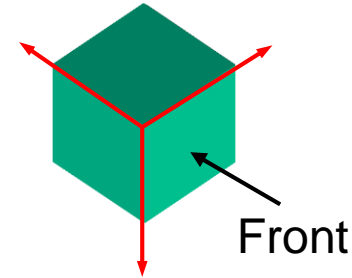
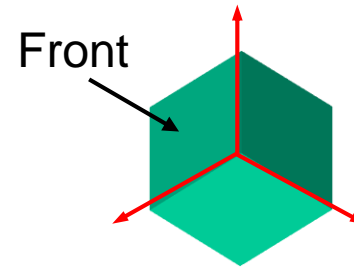
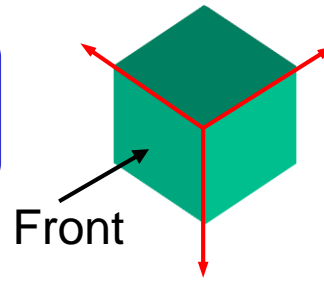
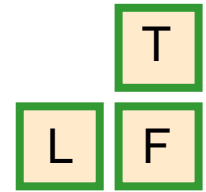
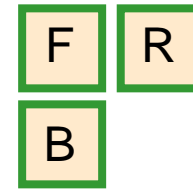
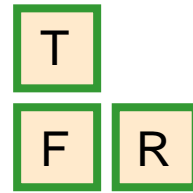
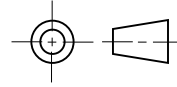
1. Analyze the alignment of a given orthographic views

2. Select a suitable orientation of isometric axes.

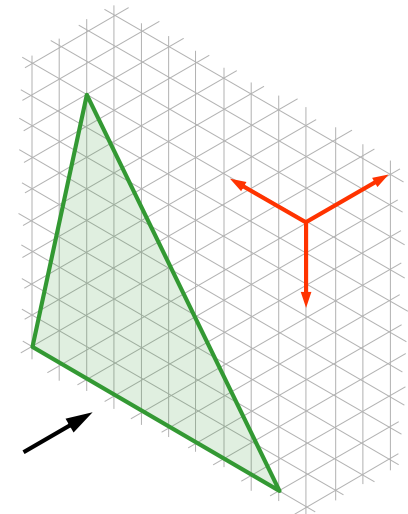
3. Interpret the lines/areas in orthographic views as a plane or surface.

4. Sketch that plane or surface in an isometric axes.

## Examples

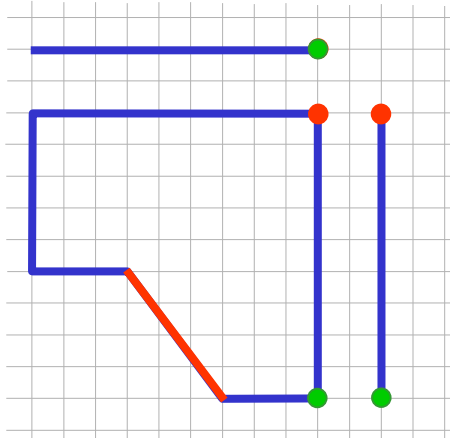


Normal plane



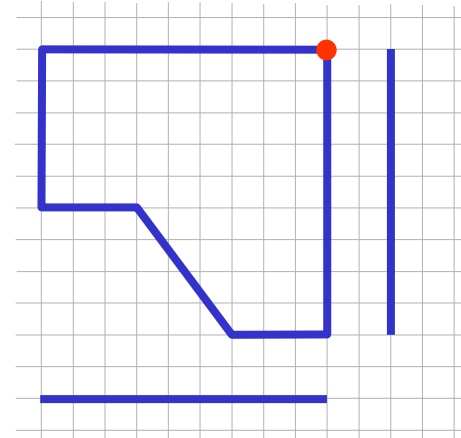
# Sketching a normal plane

Given

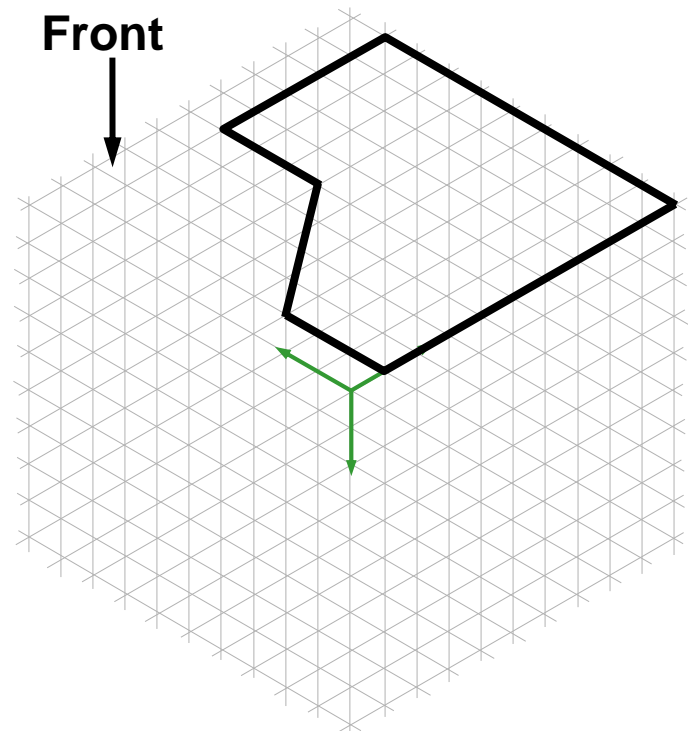
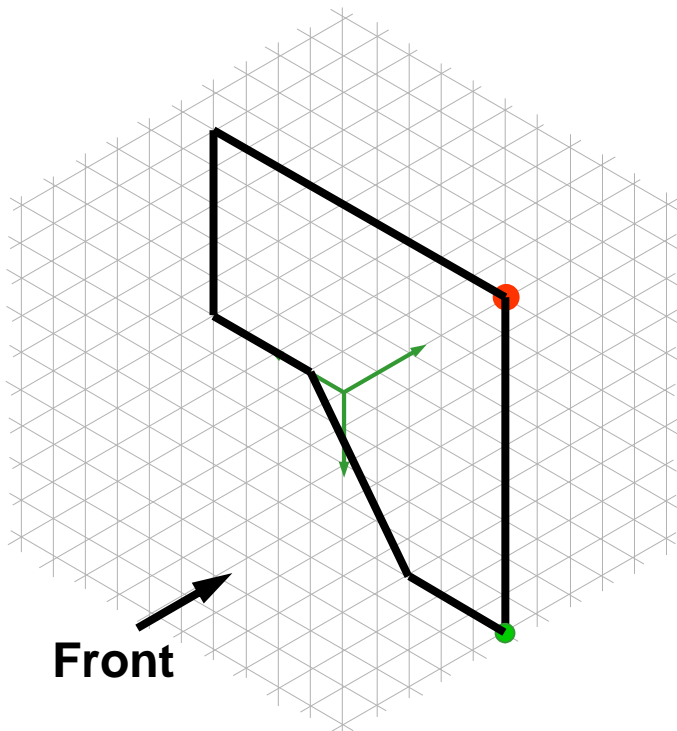


Front-Right-Top

Given

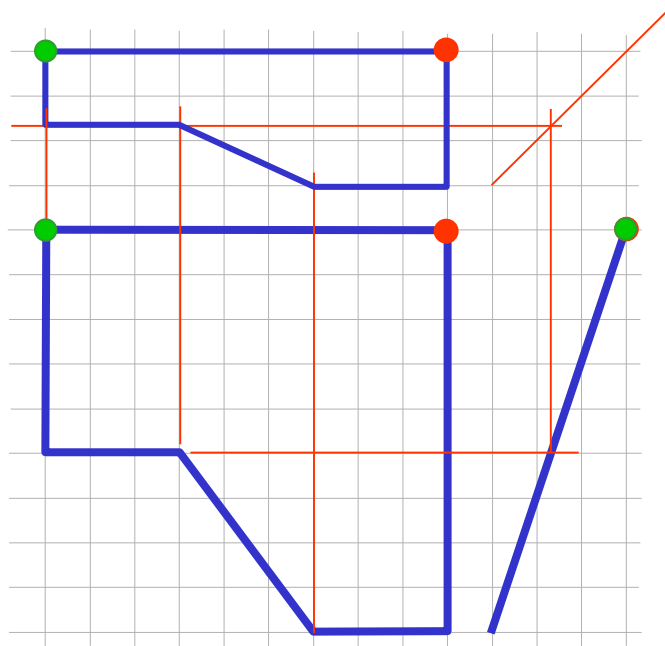


Front-Right-Bottom

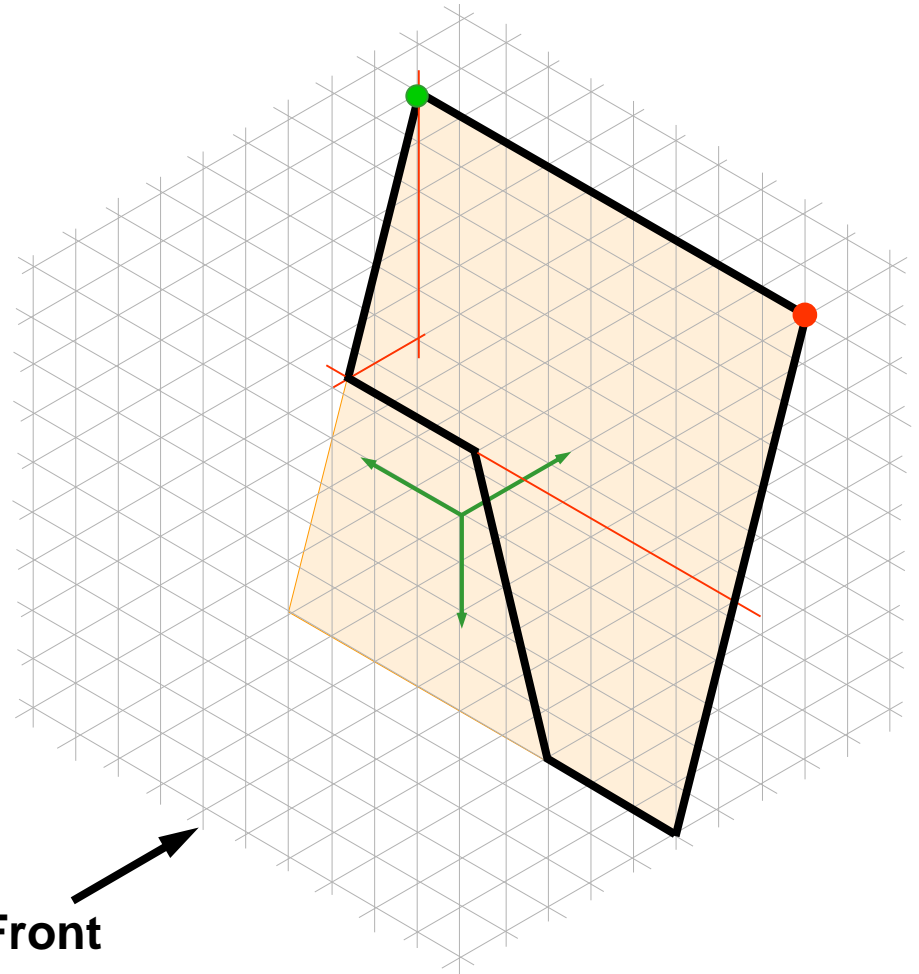


# Sketch an **inclined** plane

Given



**Front-Right-Top**



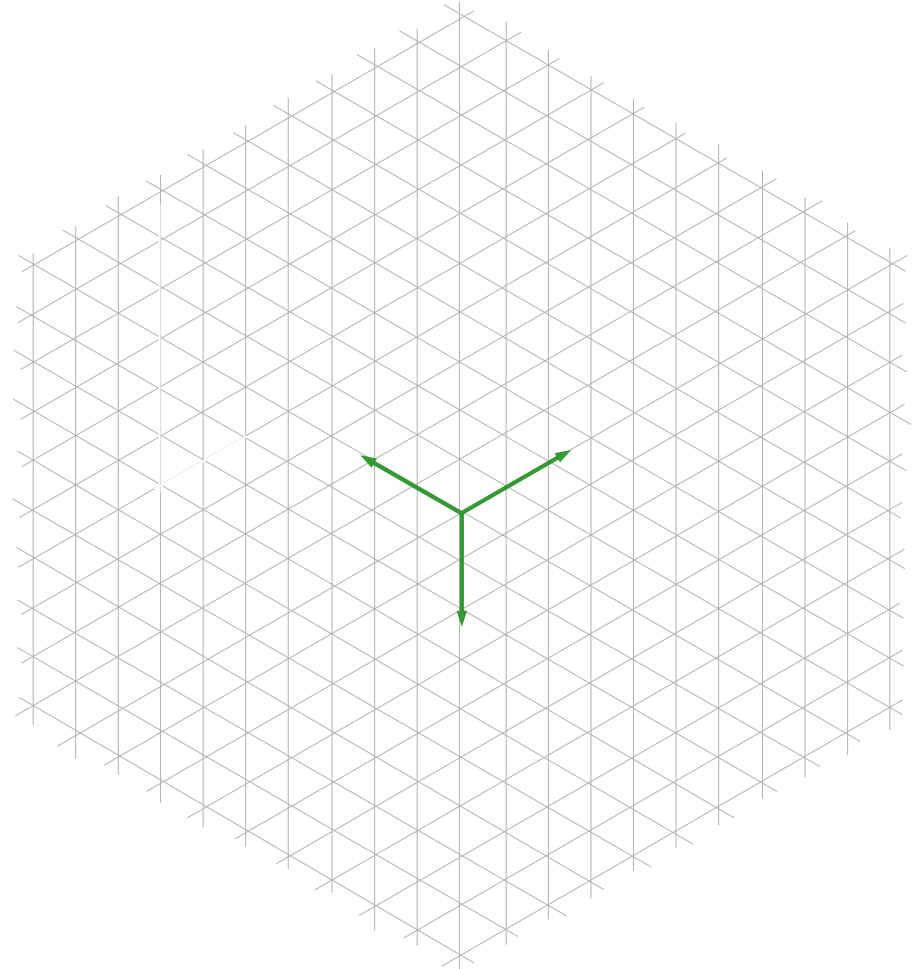
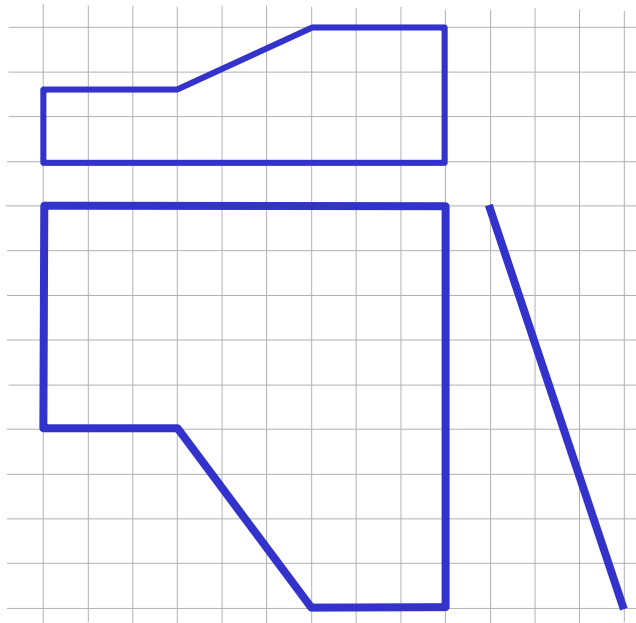
**Front**

- Did you see that the parallel lines in orthographic views still be the parallel lines in an isometric sketch?



# Class activity : Sketching an inclined plane

Given



1. View alignment is



3. Sketch the plane (1 min)

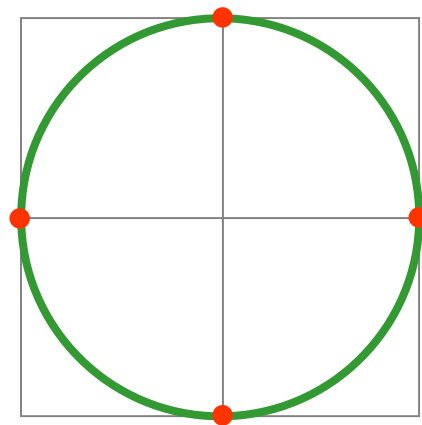
2. Identify the front view

Answer

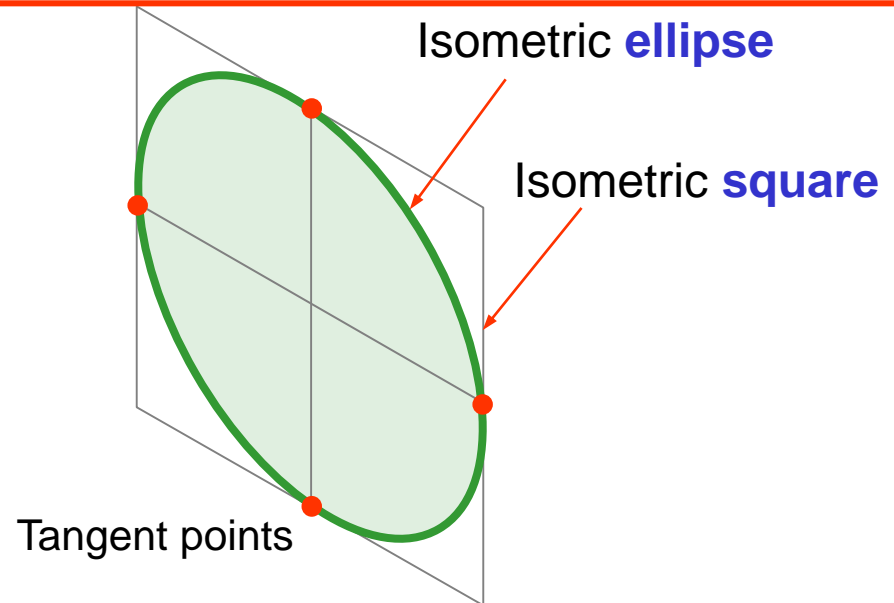
# Sketching a circle and an arc

(appeared on the normal plane)

- Circle appears as ellipse in a pictorial sketch.
- In case of isometric sketch, the ellipse is called “*isometric ellipse*”.
- The square that circumscribes an isometric ellipse is called “*isometric square*”.



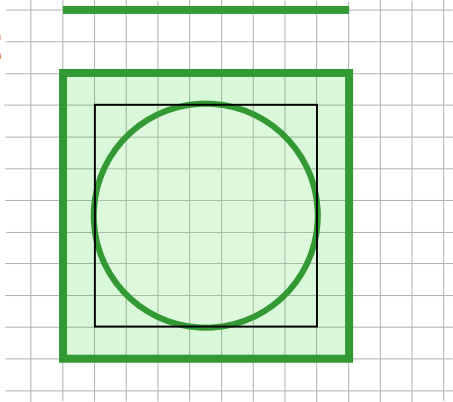
Tangent points



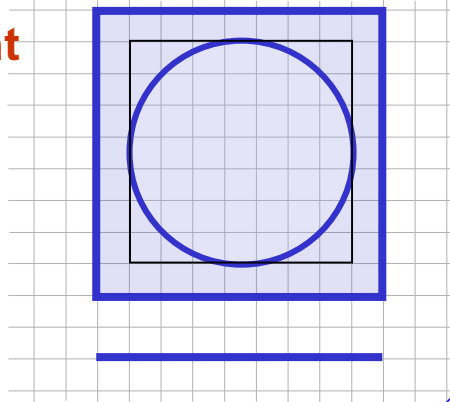
Tangent points

# Isometric ellipses : Their orientations

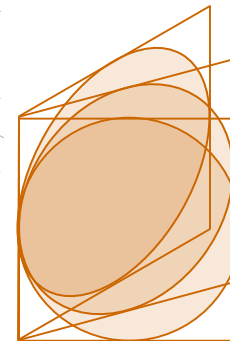
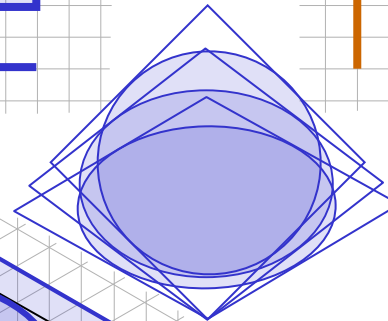
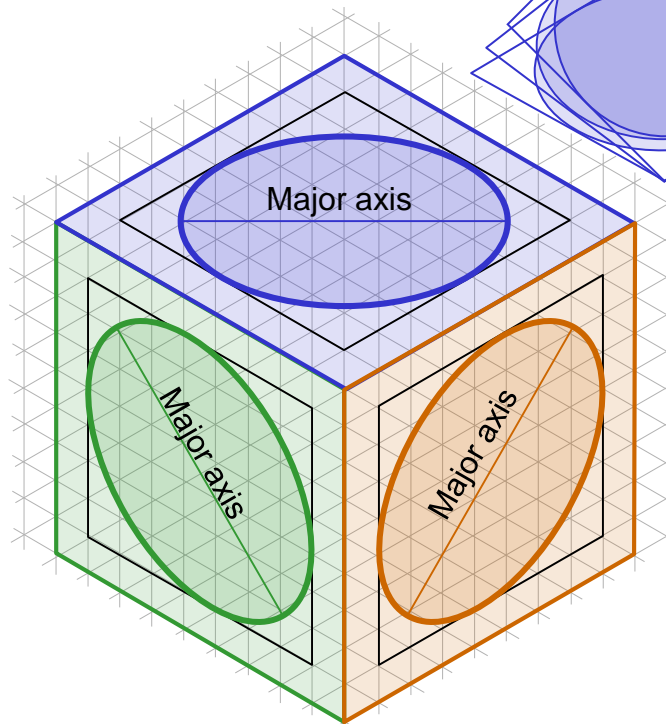
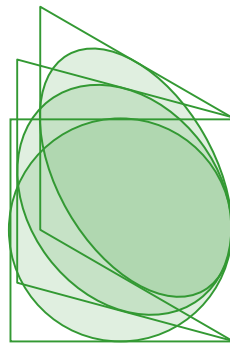
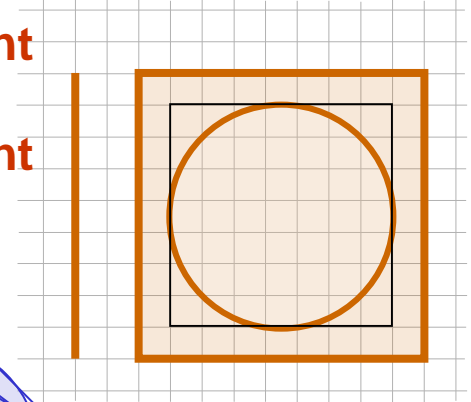
Front  
&  
Top



Front  
&  
Top



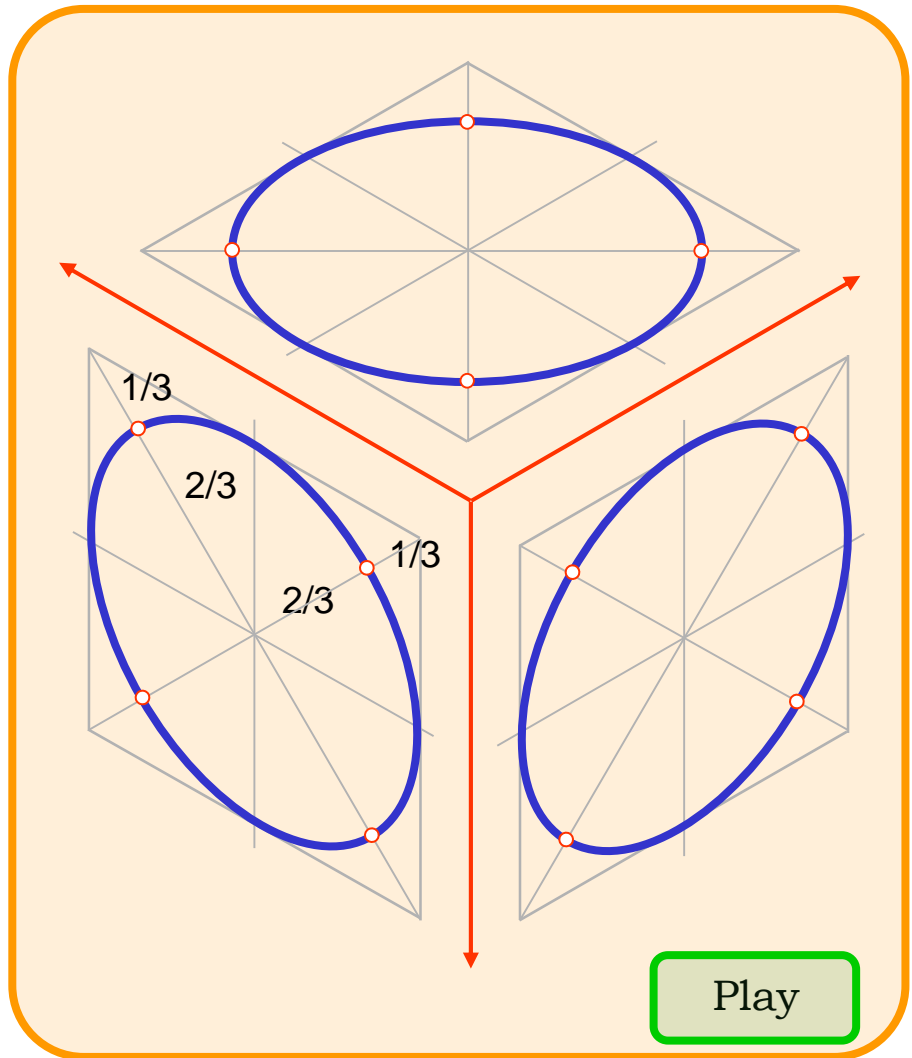
Front  
&  
Right



# Isometric ellipses : Sketching method

## Explanation

1. Locate the center of an ellipse by two isometric lines.
2. Sketch an isometric square.
3. Sketch diagonal lines.
4. Mark the point on diagonal line far from the center of an ellipse for a distance  $\frac{2}{3}$  of the half-length of the line.
5. Draw the arcs through the marked and tangent points.

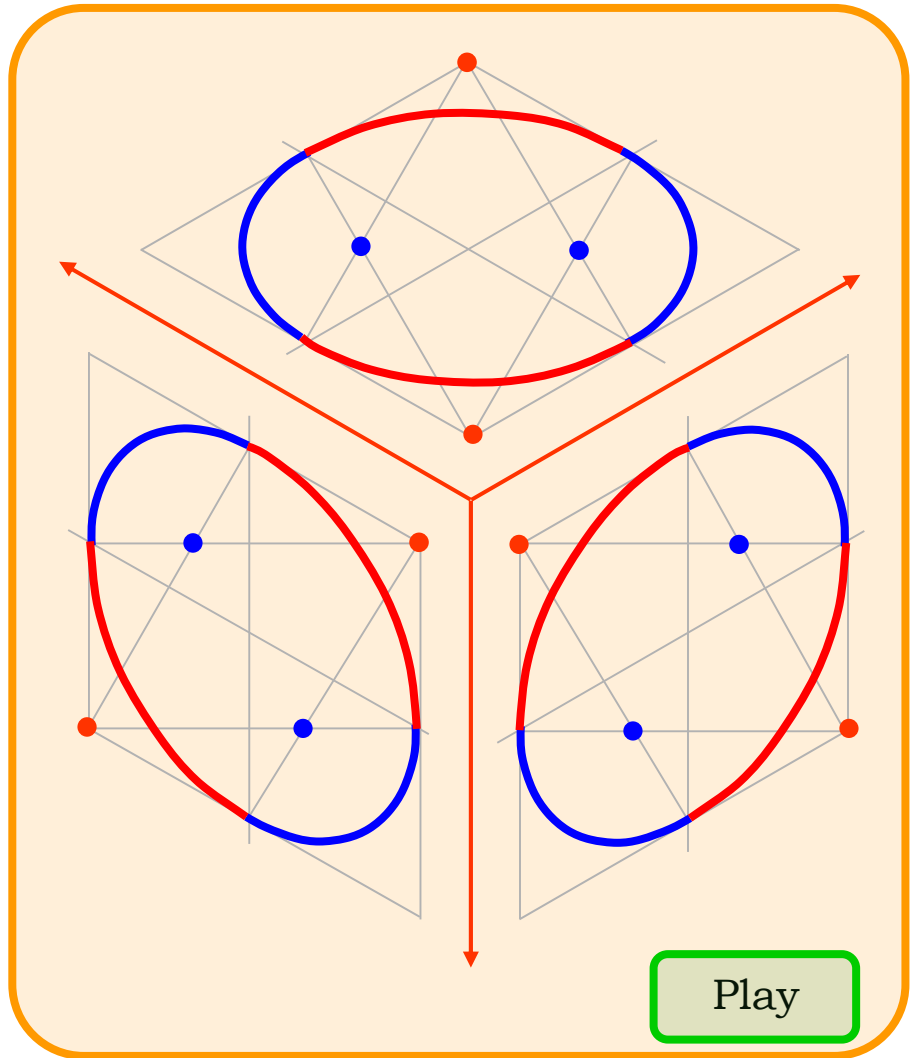


# Isometric ellipses : Four-center method

- Suitable for the case of instrumental drawing.

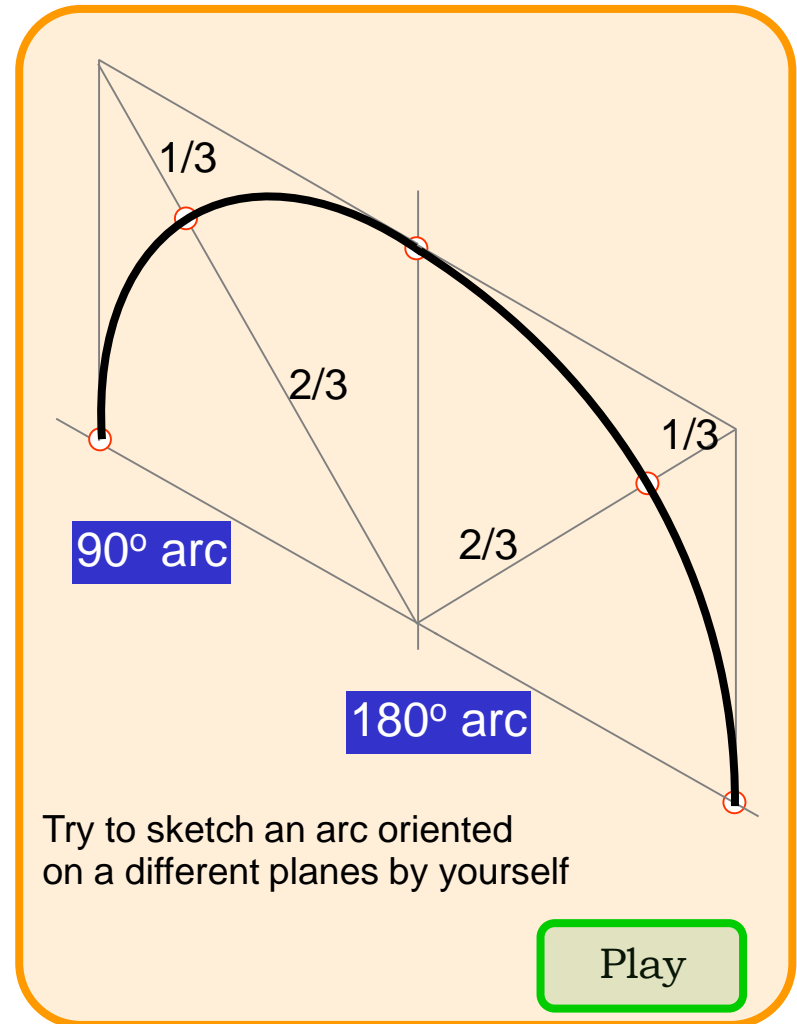
## Explanation

1. Locate the center of an ellipse.
2. Sketch an isometric square.
3. Construct a perpendicular bisector from each tangent point.
4. Locate the **four** centers.
5. Draw the arcs with these centers and tangent to isometric square.



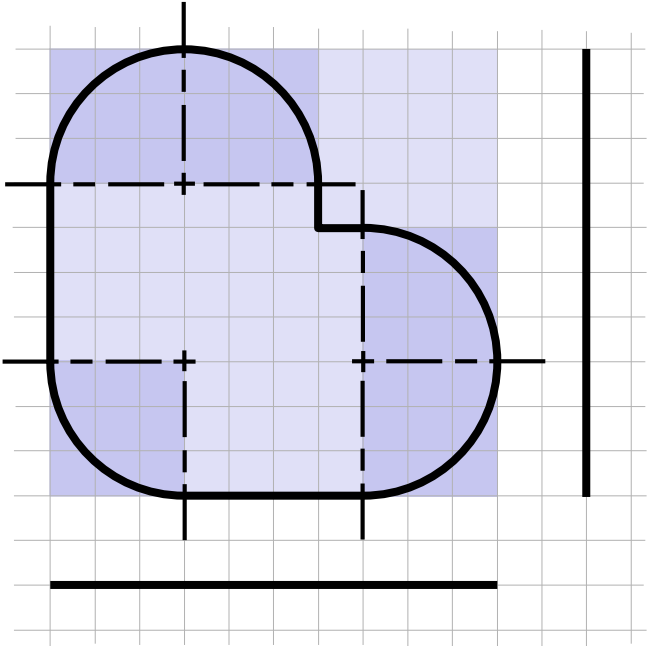
# Sketching an arc

- Isometric **arc** is a part of an isometric circle.
- Steps for sketching an isometric arc are
  1. Locate its center by two isometric lines.
  2. Create an isometric square circumscribes an arc.
  3. Draw a radial diagonal line.
  4. Divide the diagonal line into 3 equal parts.
  5. Sketch an arc.

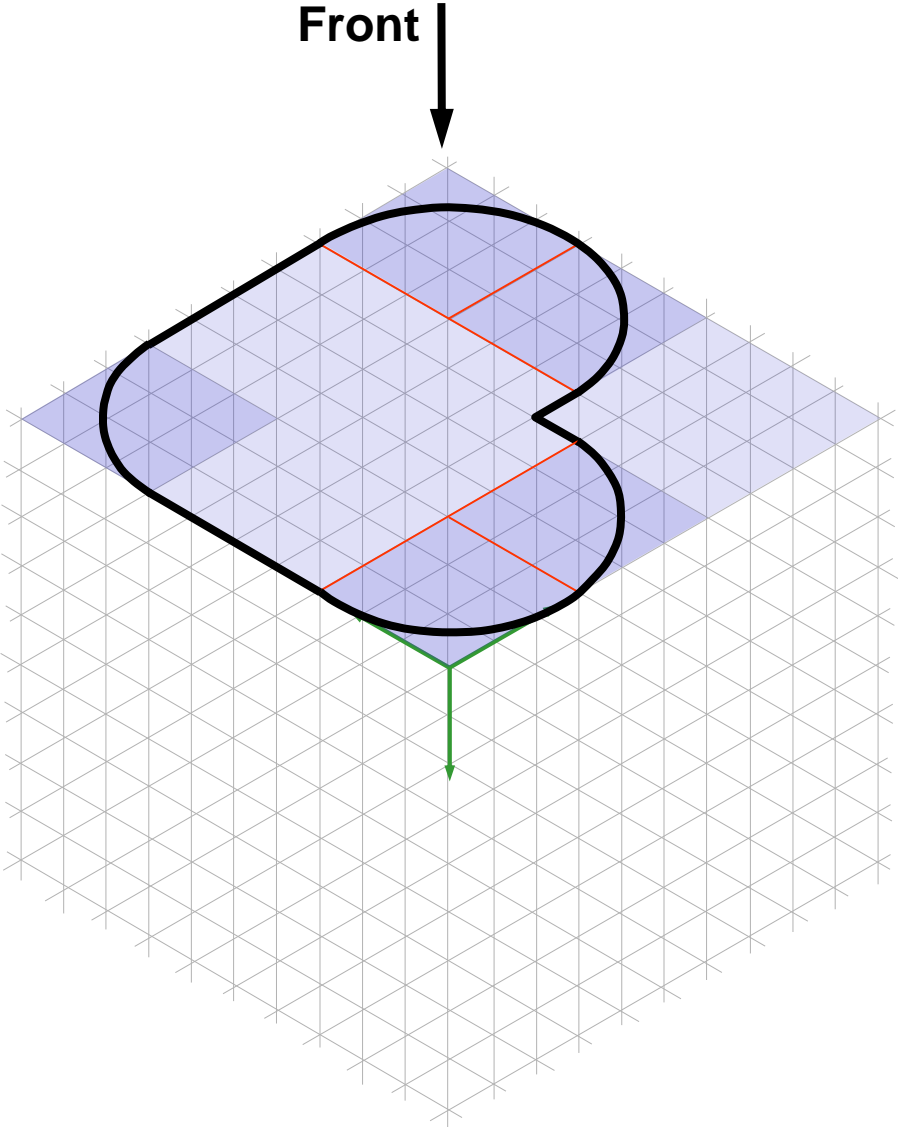


# Example

Given



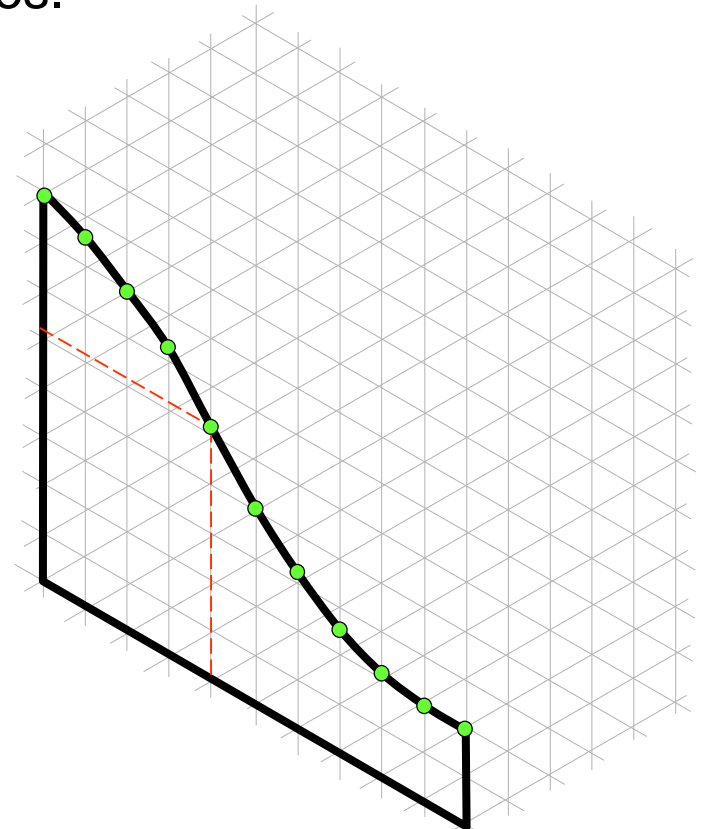
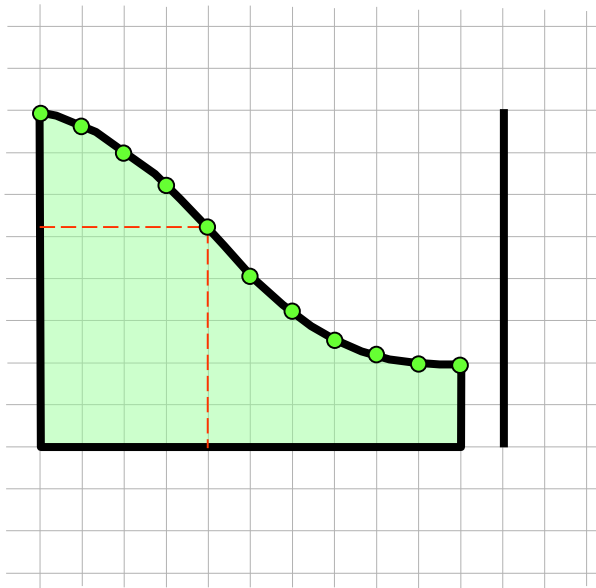
**Front-Bottom-Right**



# Sketching an irregular curve (appeared on the normal plane)

The concept used is similar to plotting a curve.

1. In orthographic views, choose a finite number of points along the curve.
2. Plot these points in the isometric axes.
3. Sketch the curve.







# **Isometric sketching of an object**

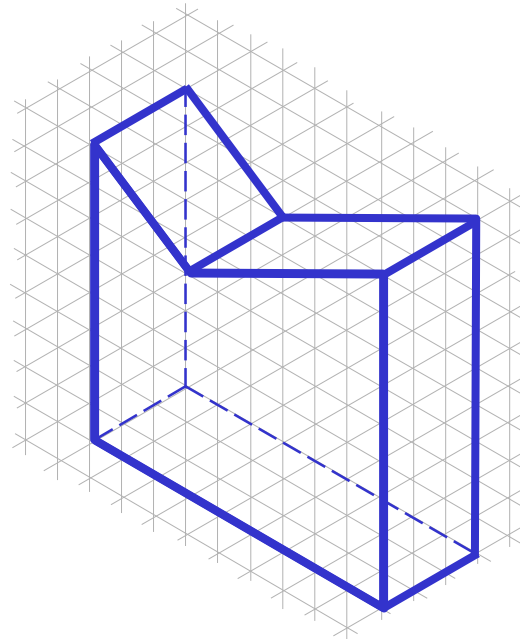
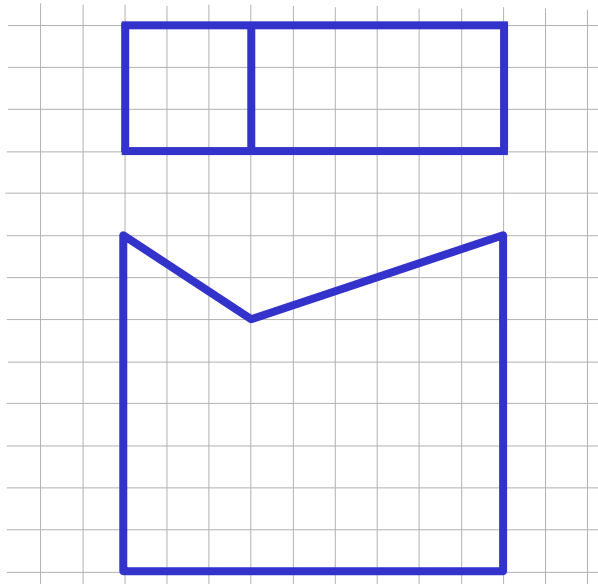
[Contents](#)

# Guidance 1

- A parallel line always parallel to each other regardless of the kind of views, i.e. orthographic and isometric views.
  - The third dimension of an object is created by extruding a 2D geometry or surface.
  - It helps us control the shape of the sketch.

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## Examples 1



### Explanation

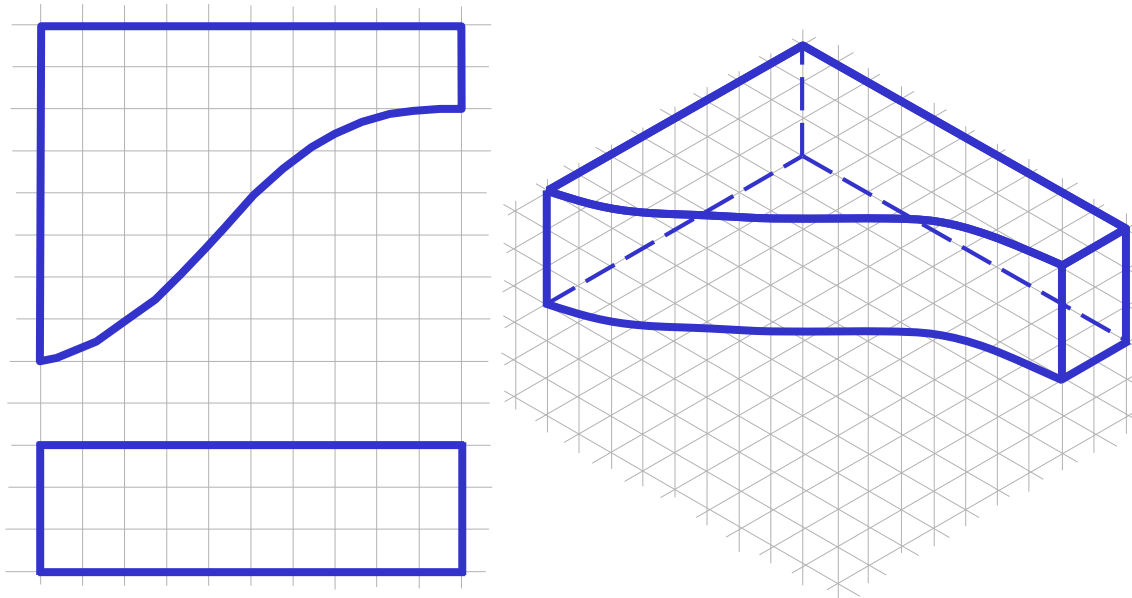
1. Sketch the front view
2. There are parallel lines along the depth direction.
3. Extrude the front surface
4. Sketch the rear surface.

In this example, hidden lines can be omitted.

# Guidance 1

- A **parallel line** always **parallel** to each other **regardless** of the kind of views, i.e. orthographic and isometric views.
  - The **third** dimension of an object is created by **extruding** a 2D geometry or surface.
  - It helps us control the shape of the sketch.

## Examples 2



### Explanation

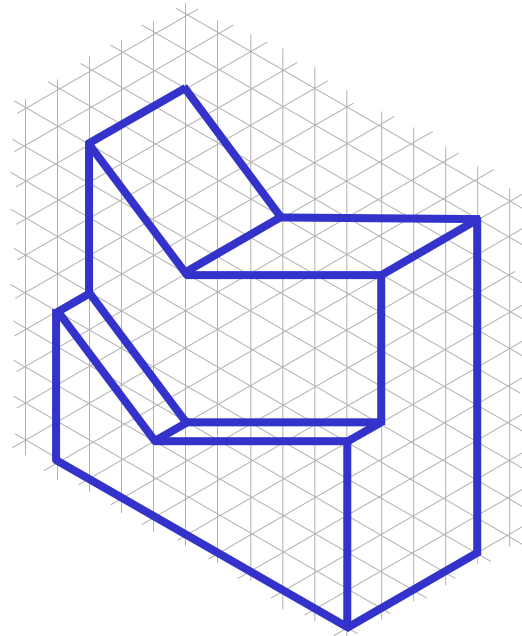
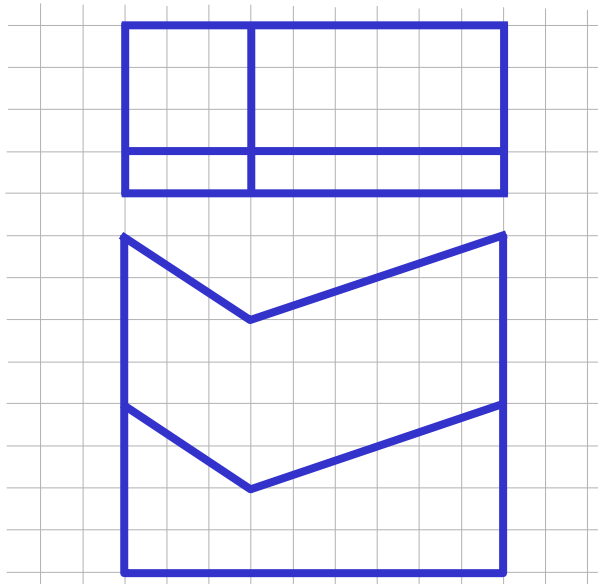
1. Sketch the top view
2. There are parallel lines along the height direction.
3. Extrude the top surface
4. Sketch the bottom surface.

**In this example, hidden lines can be omitted.**

# Guidance 1

- A parallel line always parallel to each other regardless of the kind of views, i.e. orthographic and isometric views.
    - The third dimension of an object is created by extruding a 2D geometry or surface.
    - It helps us control the shape of the sketch.
- 

## Examples 3



# Guidance 2

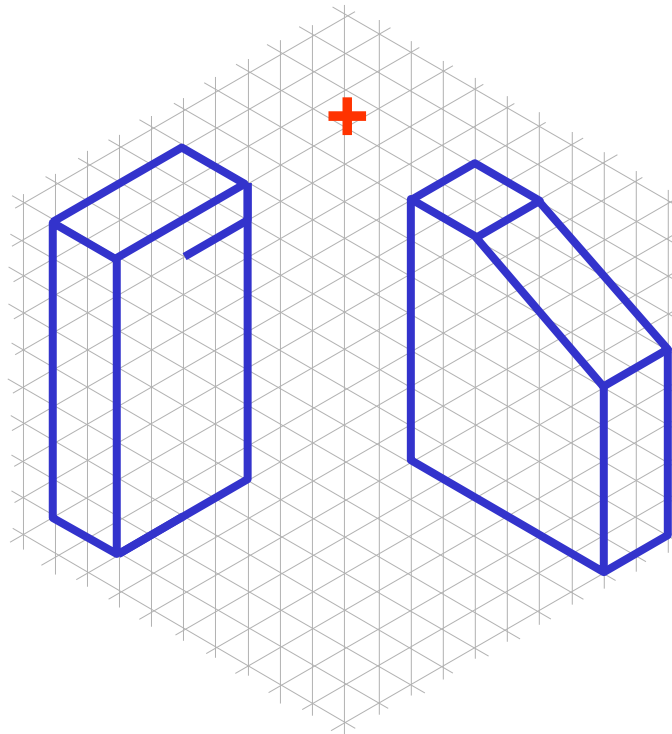
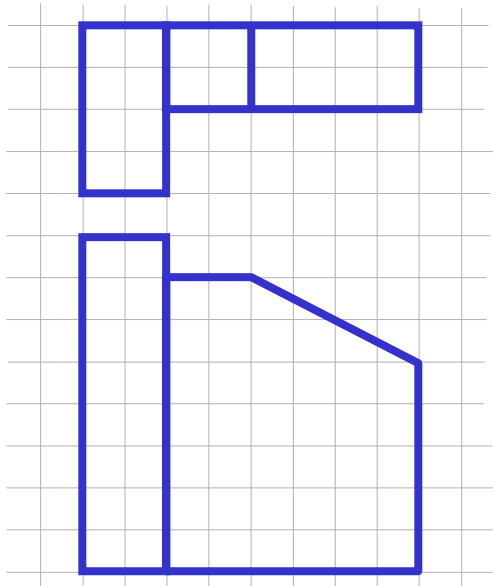
- Many of the complex shape objects come from a combination of a simple shape object.

**Strategy 1** : Sketch a group of simple objects before combining them.

**Strategy 2** : Sketch a main body of an object before gradually adding details or modifying.

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## Examples 4



Hidden lines are omitted because planes of each object becomes a single plane

# Guidance 2

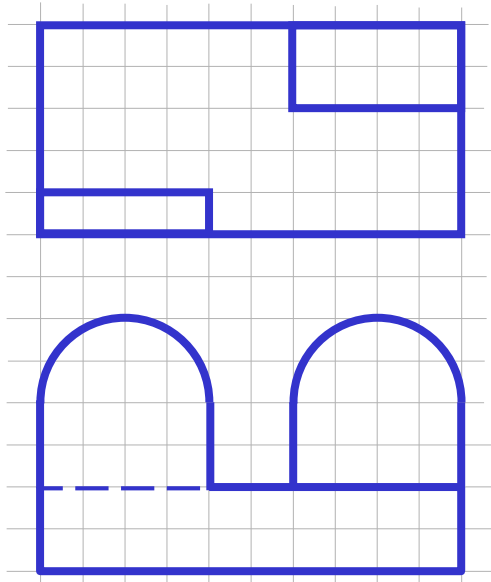
- Many of the complex shape objects come from a combination of a simple shape object.

Strategy 1 : Sketch a group of simple objects before combining them.

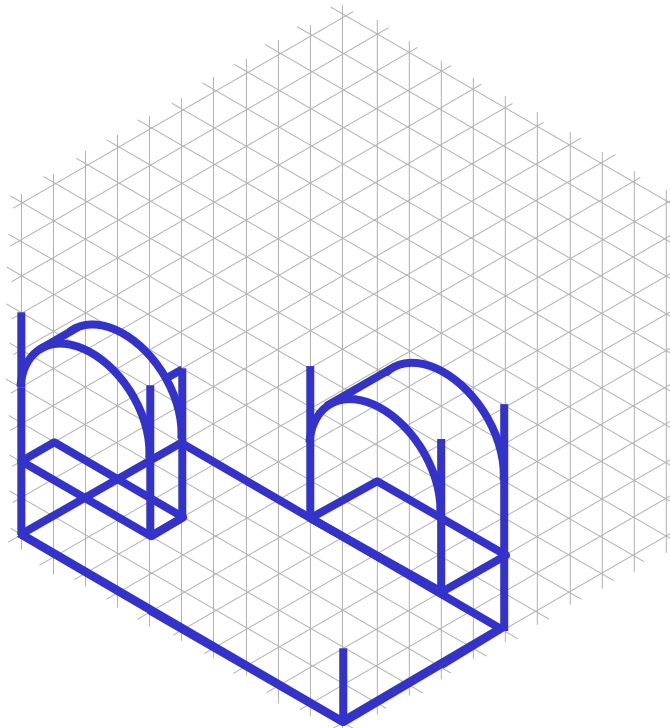
**Strategy 2** : Sketch a main body of an object before adding details or modifying.

---

## Examples 5



Omit center lines for clarity.



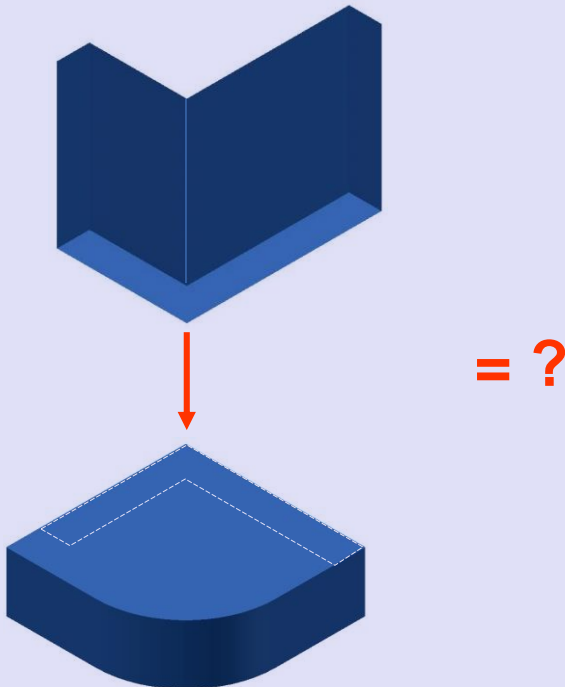
Hidden line  
can be omitted  
without losing  
object information

# Suggestion for practicing

## Strategy 1

1. Pick up 2 or 3 simple shape objects.
2. Choose a prefer combination method.
3. Sketch the result.

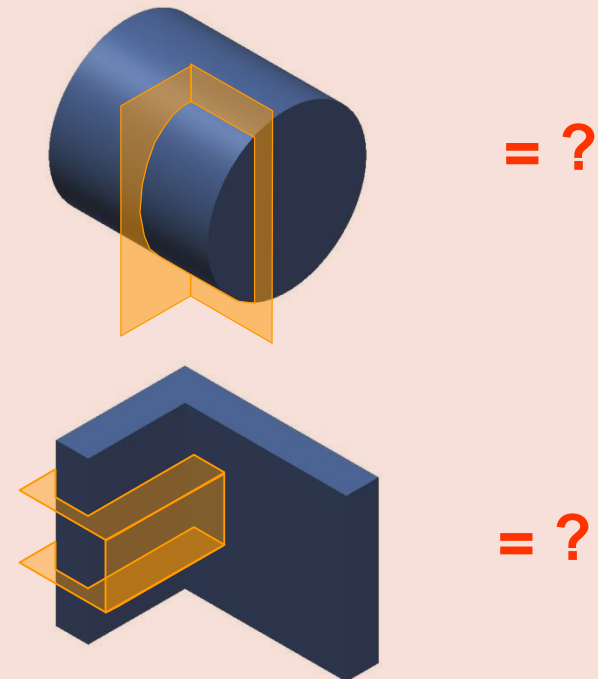
### Example



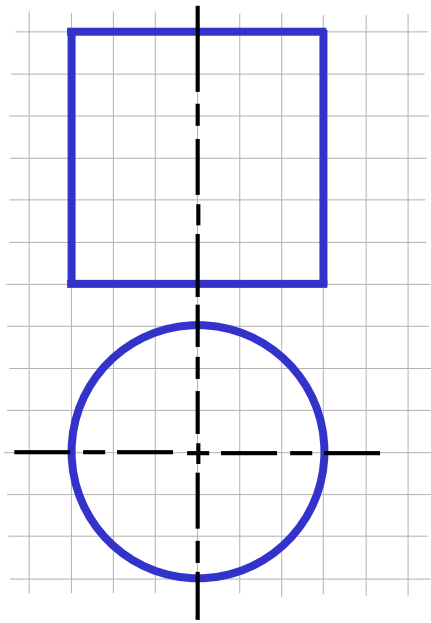
## Strategy 2

1. Pick up one simple shape object.
2. Identify a prefer modification.
3. Sketch the result.

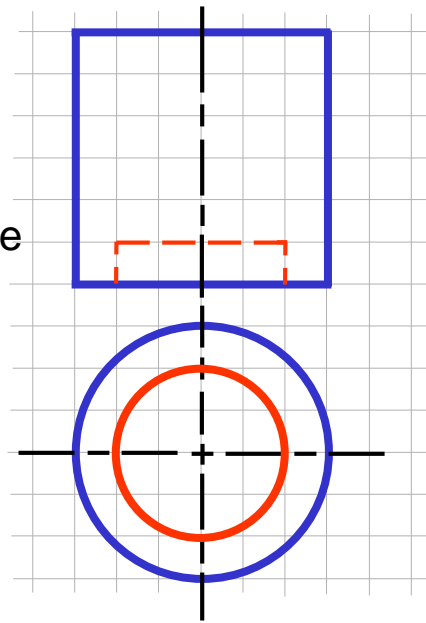
### Example



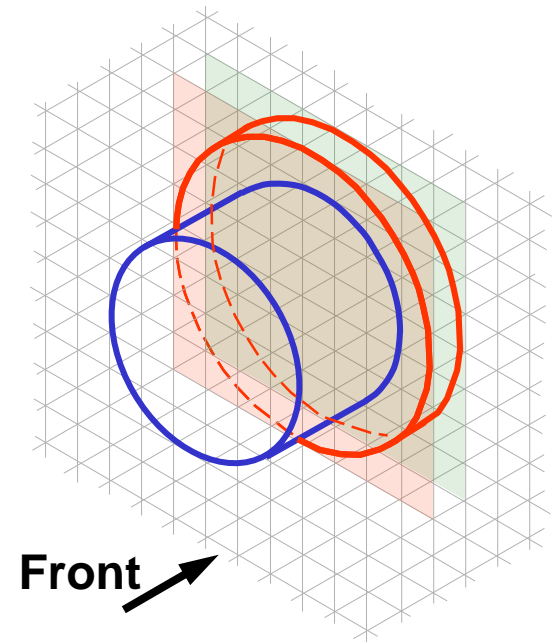
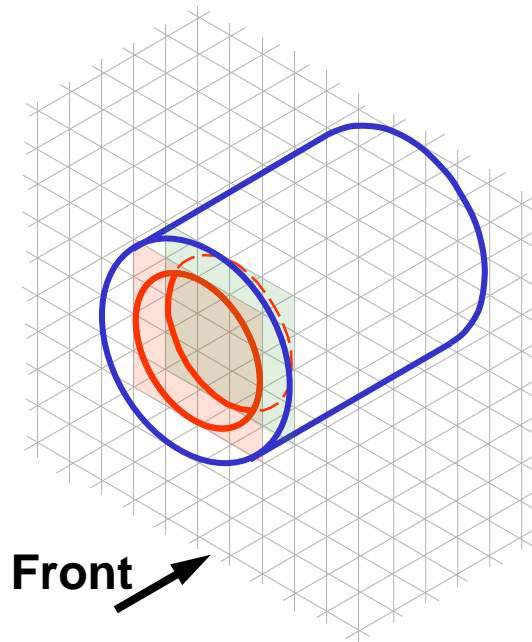
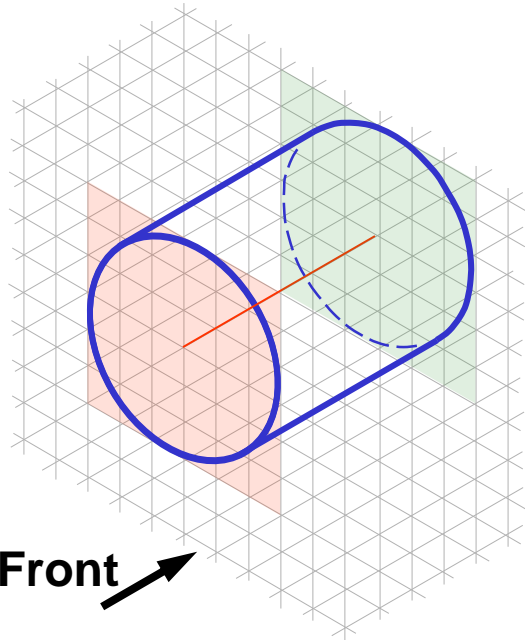
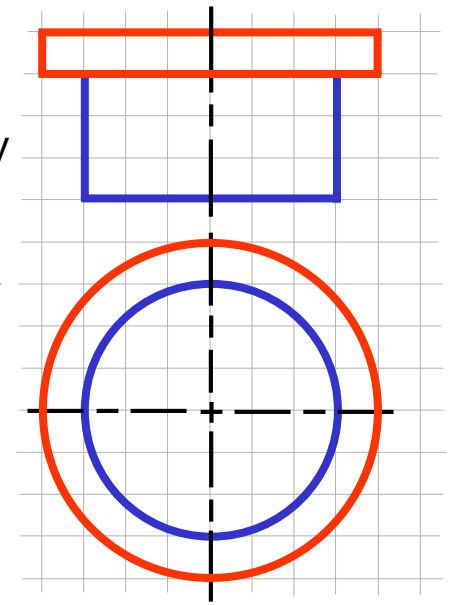
## Example : object modification (strategy 2)



Modify by  
adding  
a shallow hole



Modify by  
adding  
a base







# Oblique sketching

[Contents](#)

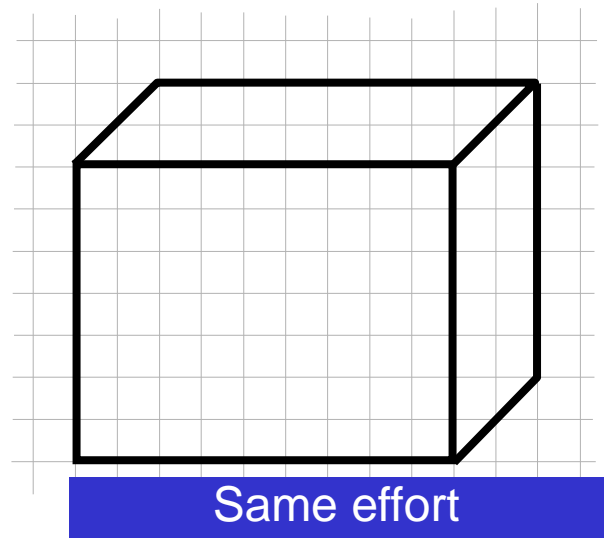
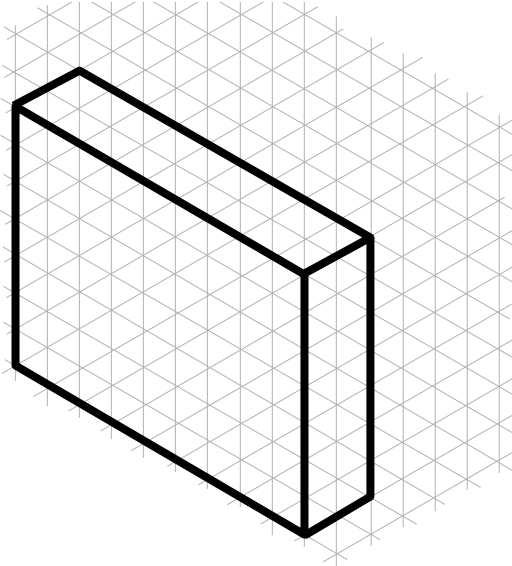
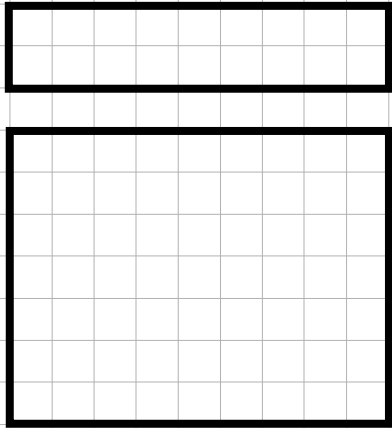
# Example : Advantage of an oblique sketch

**Orthographic**

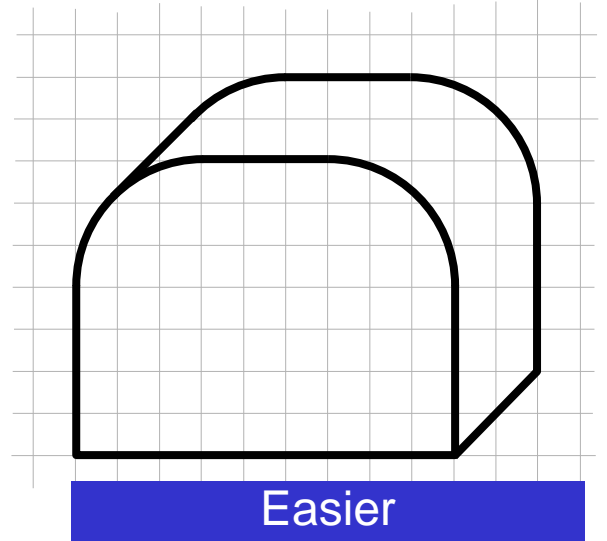
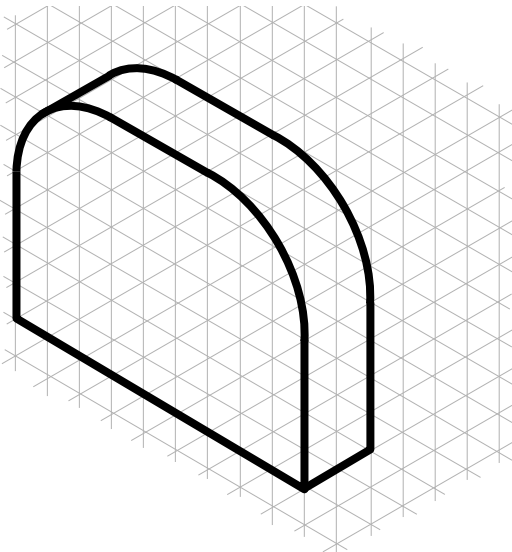
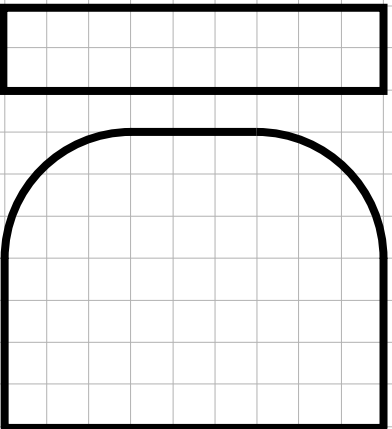
**Isometric**

**Oblique (cavalier)**

1



2



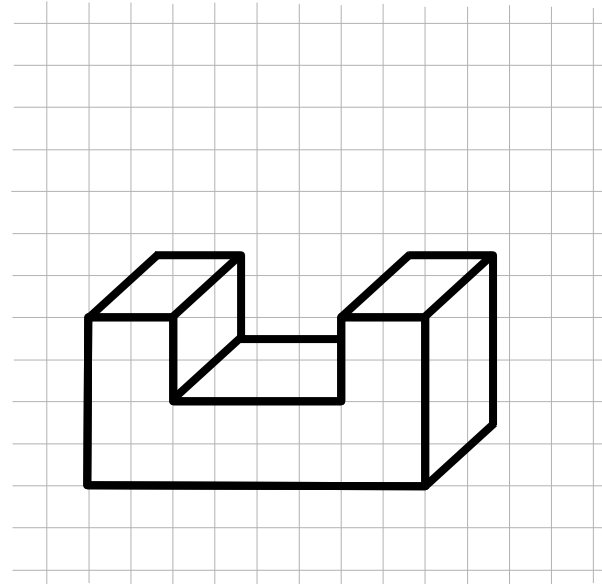
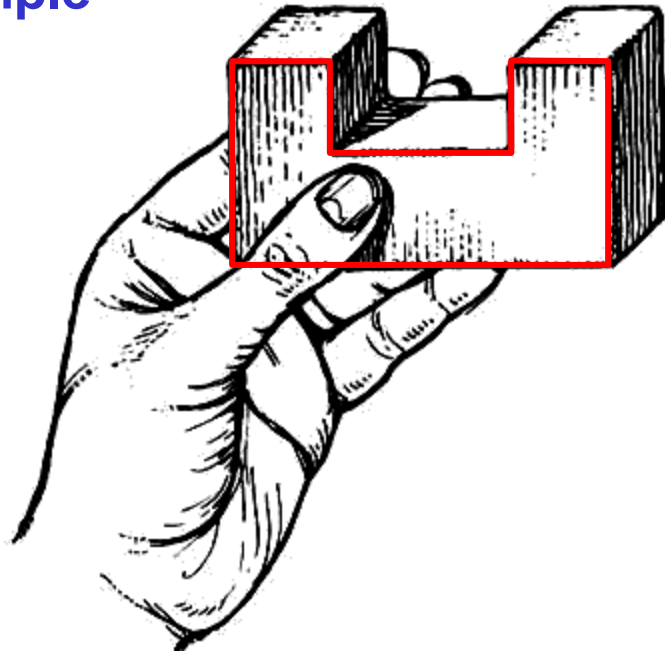
# Sketching concept

1. Sketch a **true** size and shape of a selected face on a square grid paper.
2. Extrude that surface to a required depth in a prefer inclined direction, e.g.  $45^\circ$ .

**Note** For a complex shape object, the above processes must be repeated until all features are sketched.

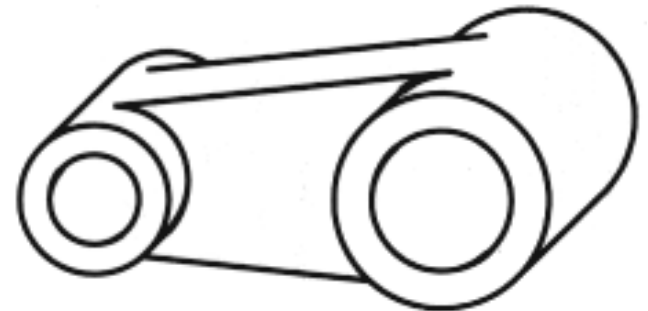
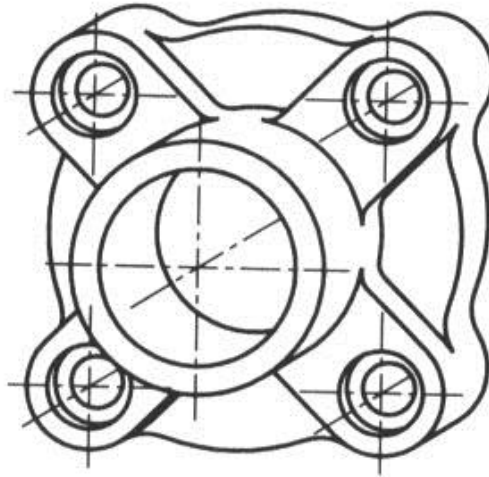
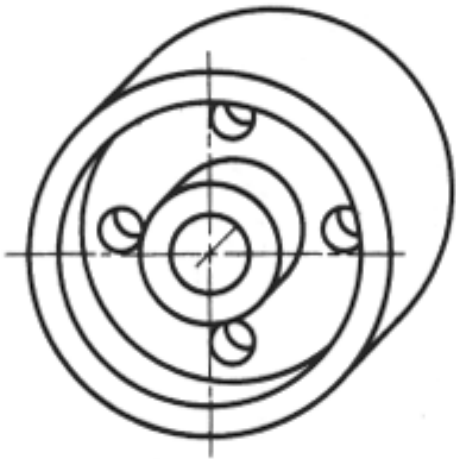
---

## Example



# Guidelines

- The front face of an oblique sketch should display majority of the features of an object.
  - The longest dimension of an object should be parallel to the frontal plane.
  - Circular features should be parallel to the frontal plane.
- 



# Class activity

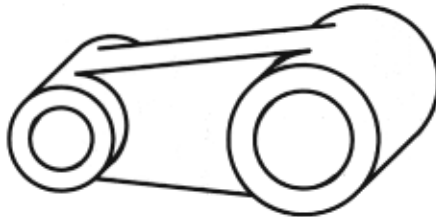
Which one is an appropriate oblique sketch?

1



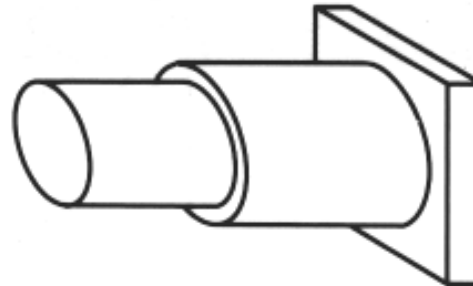
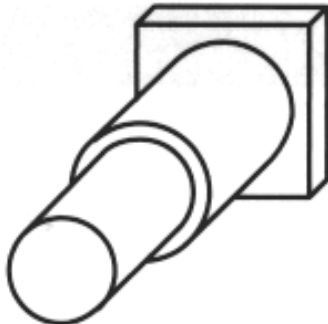
Answer

2



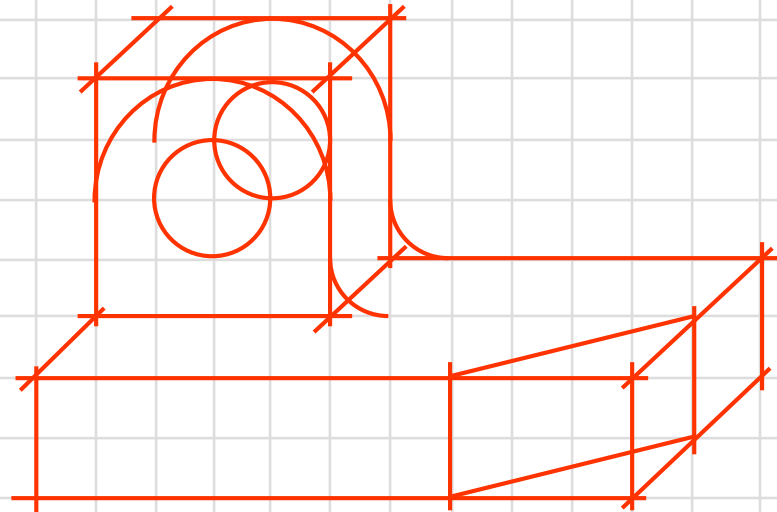
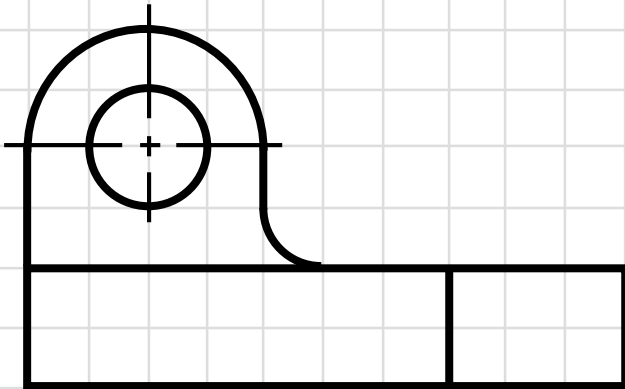
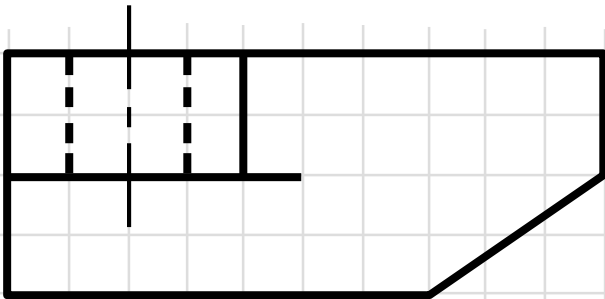
Answer

3

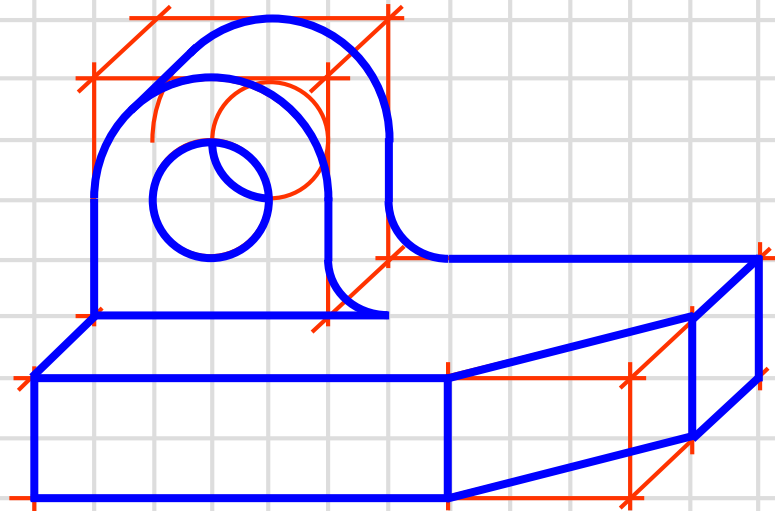
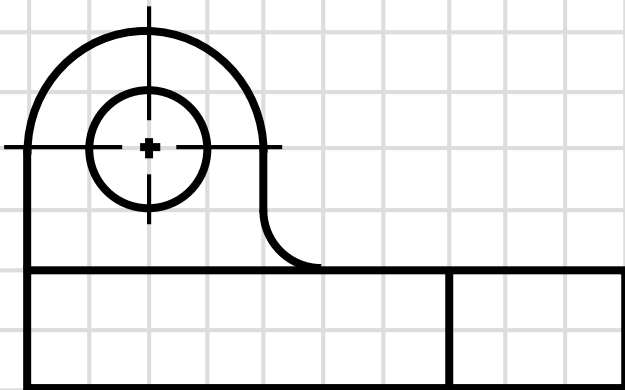
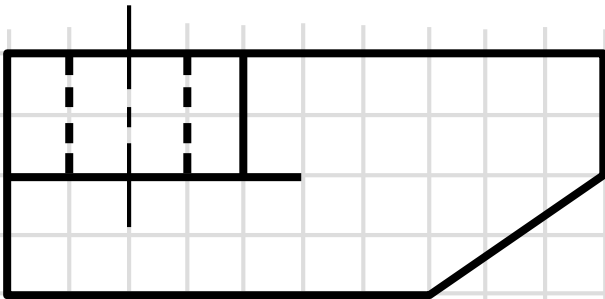


Answer

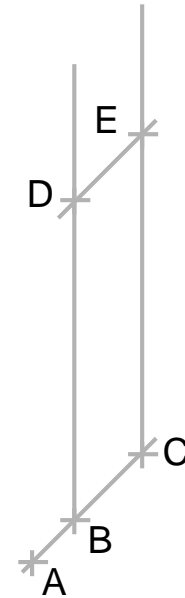
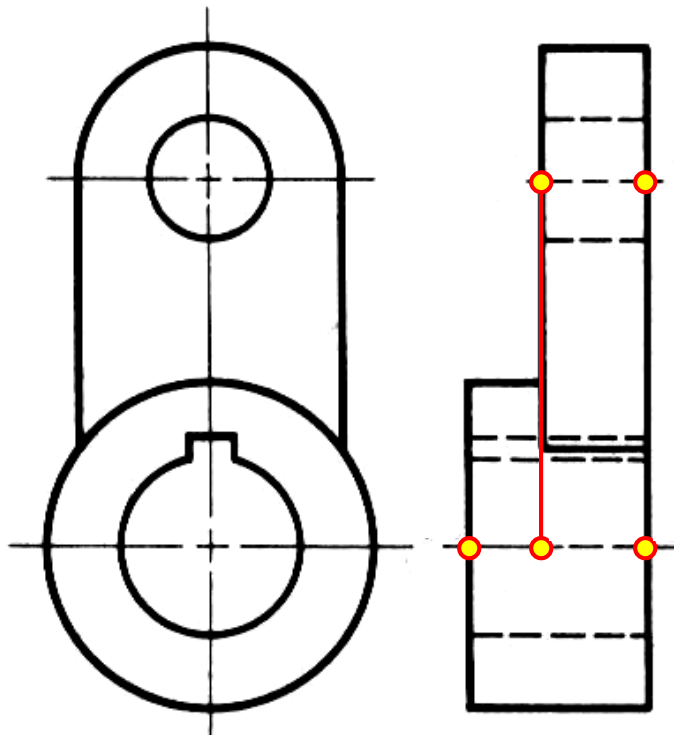
## Example 1 : Oblique sketch of an object (cabinet) 1/2



## Example 1 : Oblique sketch of an object (cabinet) 2/2

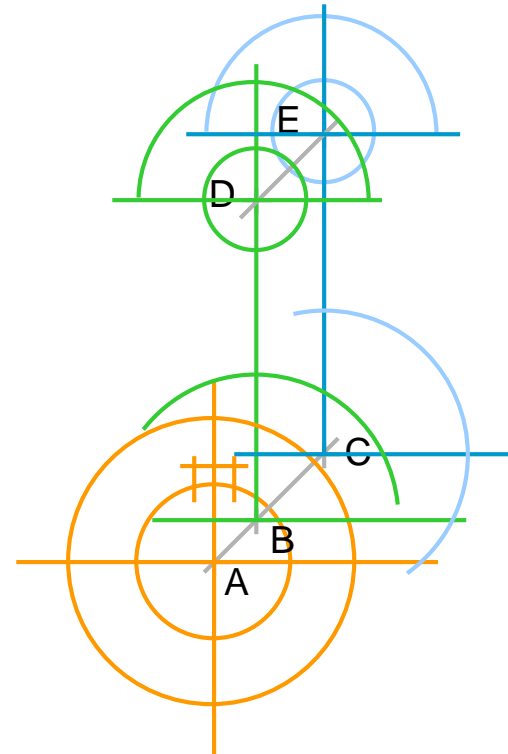
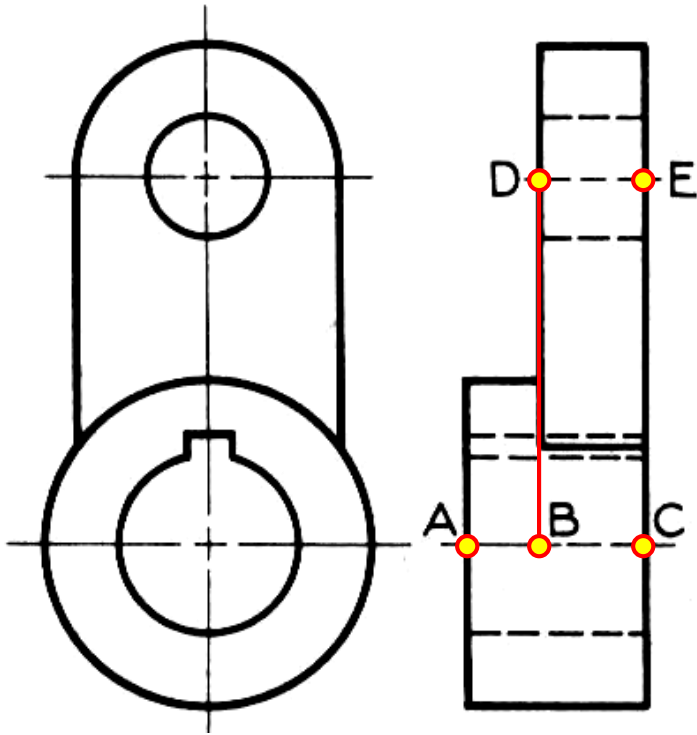


## Example 2 : Oblique sketch of an object (1/4)

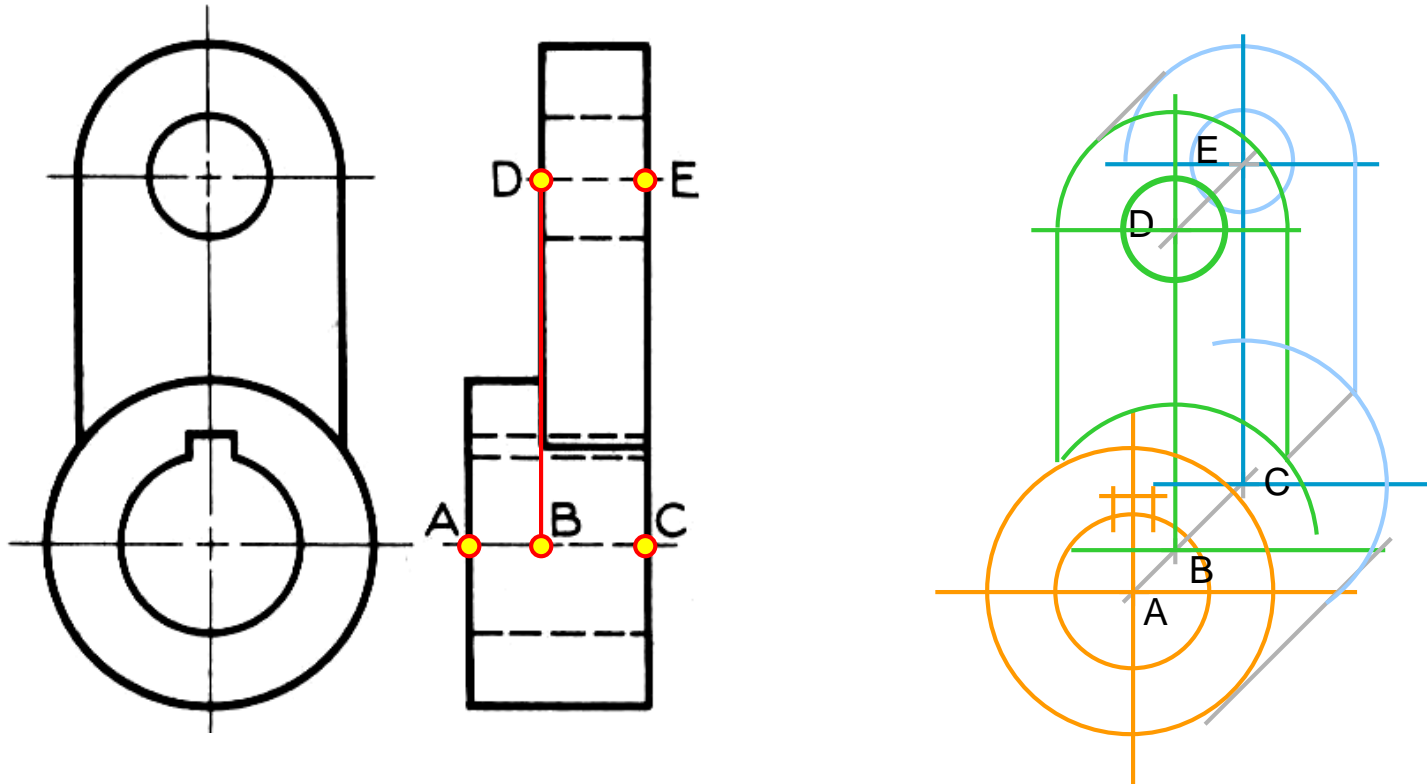




## Example 2 : Oblique sketch of an object (2/4)



## Example 2 : Oblique sketch of an object (3/4)



## Example 2 : Oblique sketch of an object (4/4)

