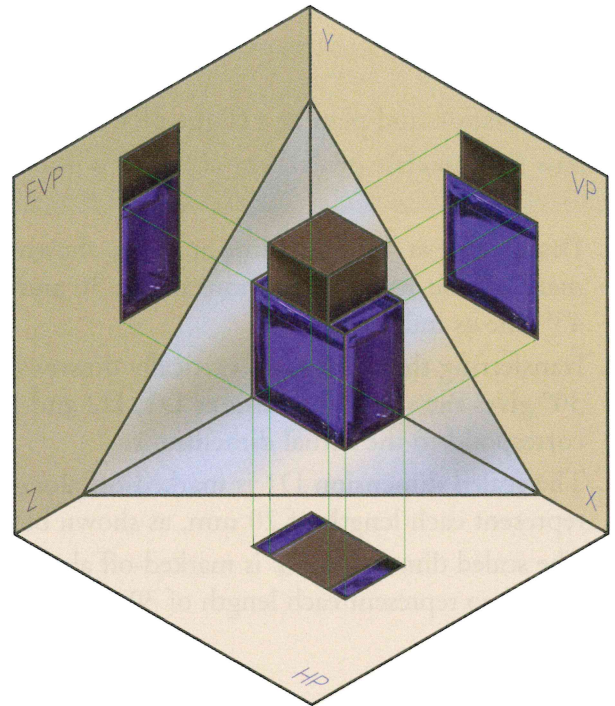# Isometric Projection using the Axonometric Plane

The figure over shows a pictorial view of an **eau de toilette** bottle and its projections on the three principal planes of reference. Also shown is a fourth plane which has been positioned so that it is **equally inclined** to each of the planes of reference. If points on the object are projected perpendicularly onto this plane, the result is an **isometric projection**.

This type of projection is known as **axonometric projection** and the plane of projection is called an **axonometric plane**.

If the principal planes of reference are rotated into the **axonometric** plane, as shown across, then all four planes will appear in true shape.

In this arrangement the plan is orientated at 45° and the elevations are orientated at 15°. This facilitates an efficient method for constructing an axonometric projection of an object as shown overleaf.
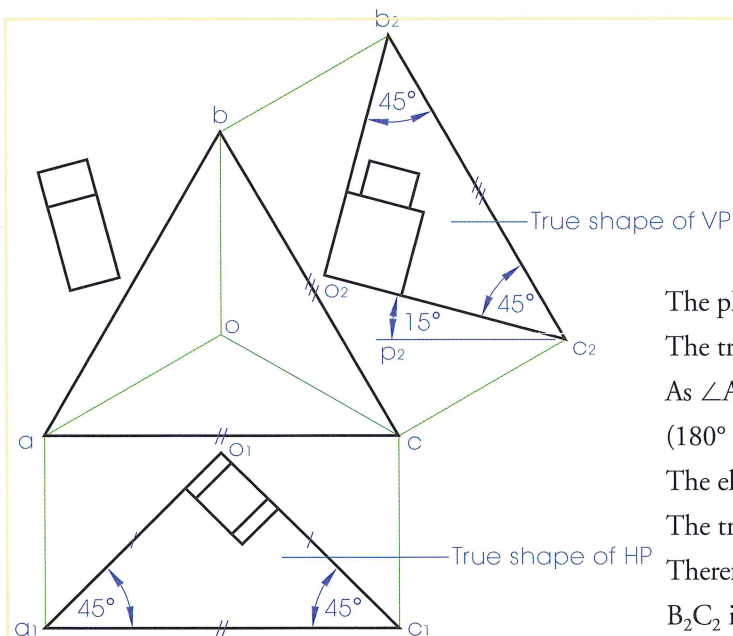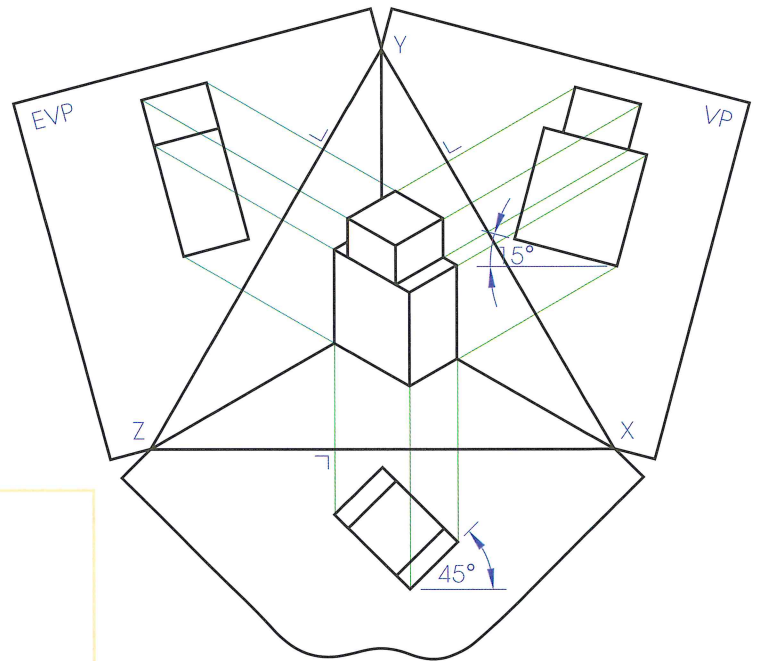
The plan orientated at 45°:

The true shape of $\triangle AOC$ is a right-angled isosceles triangle.

As $\angle A_1O_1C_1$ is 90° then $\angle$s $O_1A_1C_1$ and $O_1C_1A_1$ must be 45°. (180° − 90° = 90° divided by 2 = 45°).
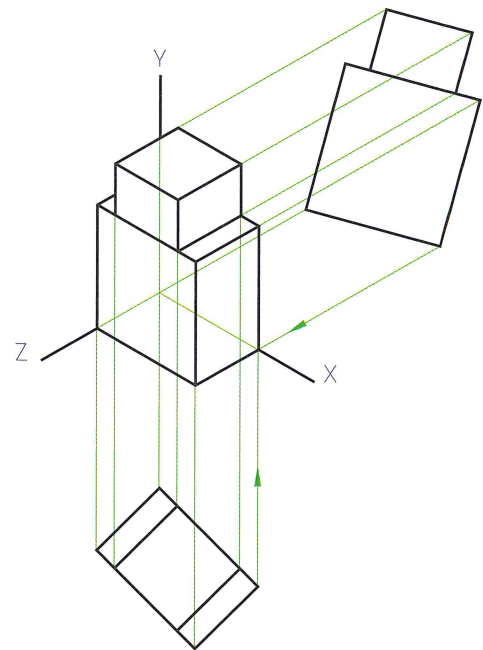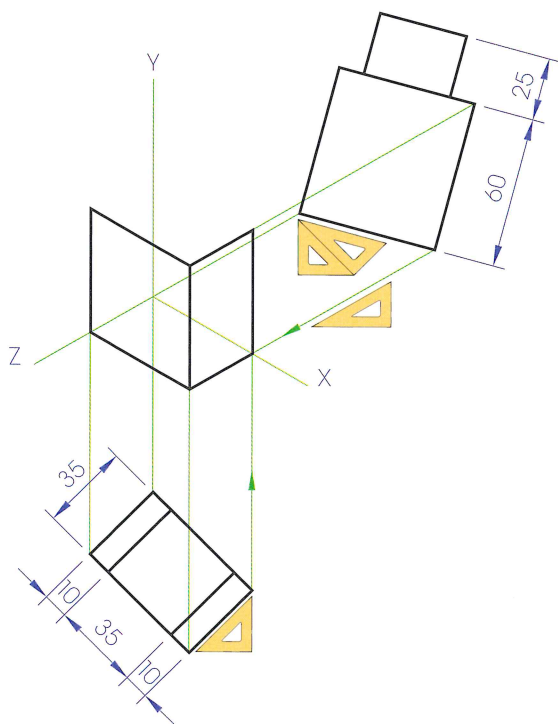
The elevations orientated at 15°:

The true shape of $\triangle OBC$ is a right-angled isosceles triangle.

Therefore $\angle B_2C_2O_2$ is 45° (as above).

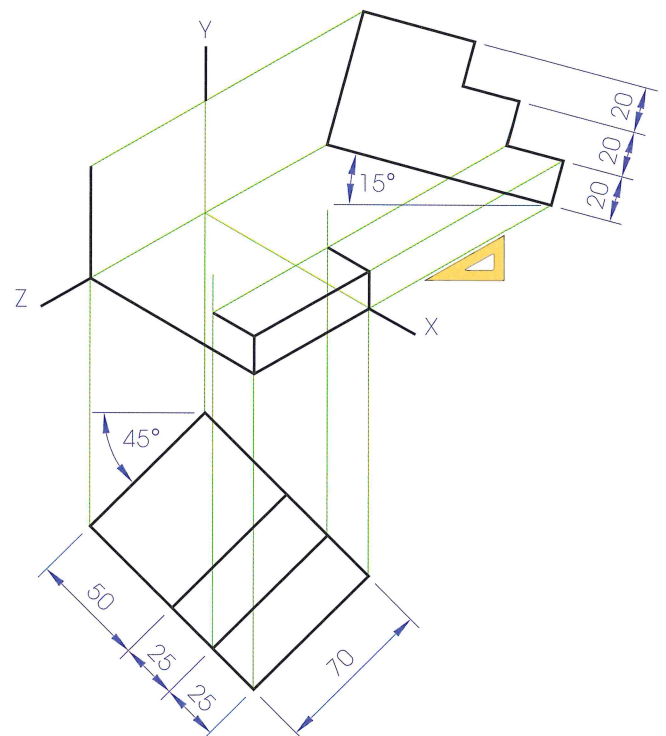B_2C_2 is inclined at 60° (// to side BC of equilateral $\triangle ABC$)

Therefore $\angle P_2C_2O_2$ = 60° - 45° = 15°

1. The axonometric plane is equally inclined to the three principal planes of reference. This means that the axonometric axes can be drawn at 30° to the right, vertically and at 30° to the left as shown below, left.
2. Draw the plan orientated at 45° as indicated.
3. Draw the front elevation orientated at 15° as indicated.
4. Project points on the lower part of the bottle vertically from the plan as shown below, left.
5. Project points on the lower part of the bottle at 30° from the front elevation as shown below, left.
6. Join the points, where corresponding lines meet, in order.
7. Complete the axonometric projection by projecting the remaining points from the plan and front elevation as shown below, right.
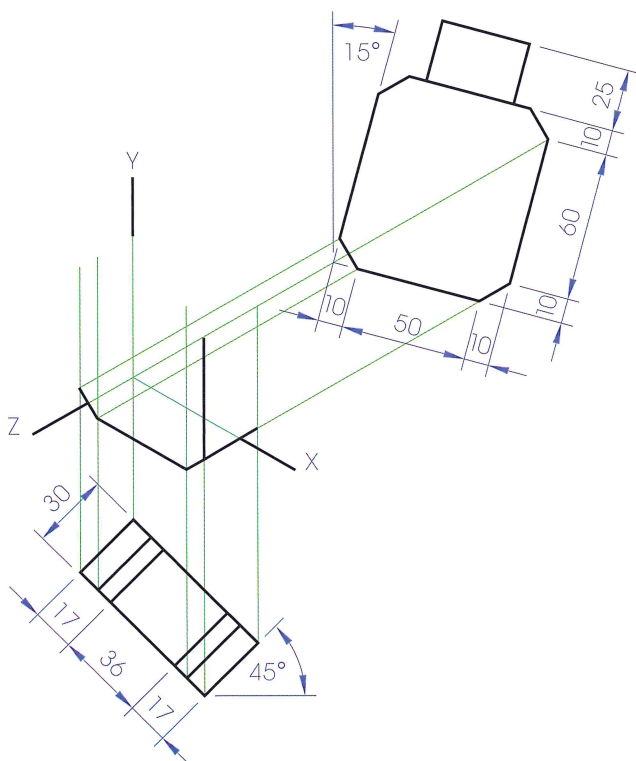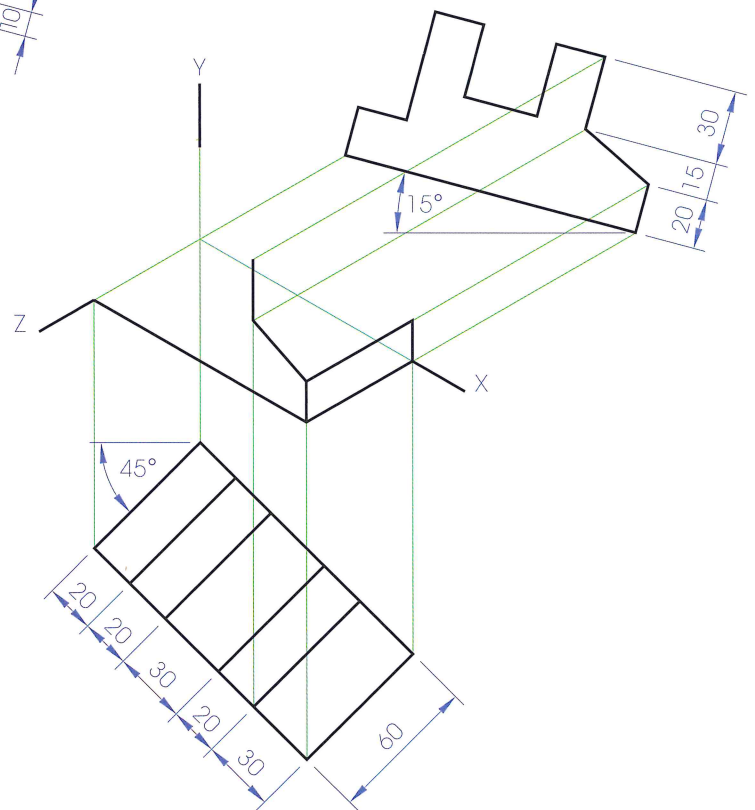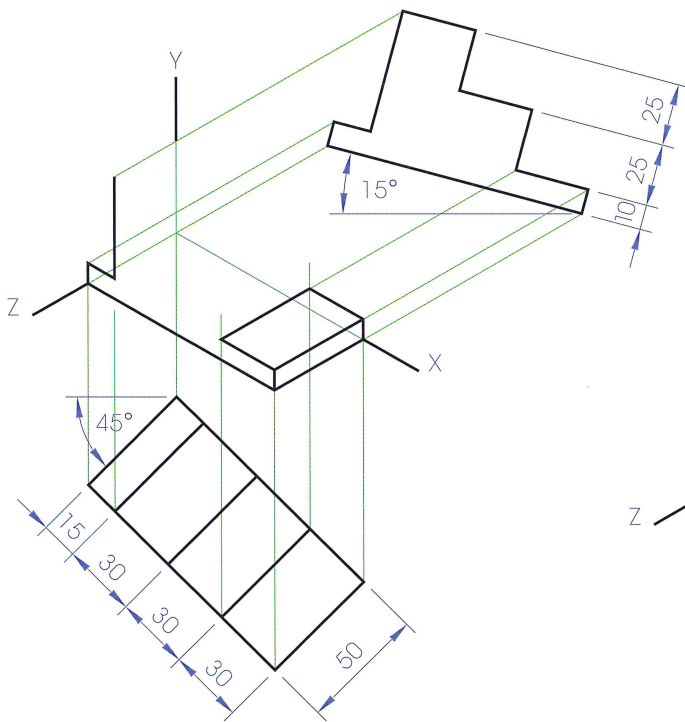
Exercises

1. The figure over shows the incomplete isometric projection of a **flight of steps** using the axonometric axes method.
   (i) Draw the axonometric axes X, Y and Z.
   (ii) Draw the plan orientated at 45° as shown.
   (iii) Draw the front elevation orientated at 15° as shown.
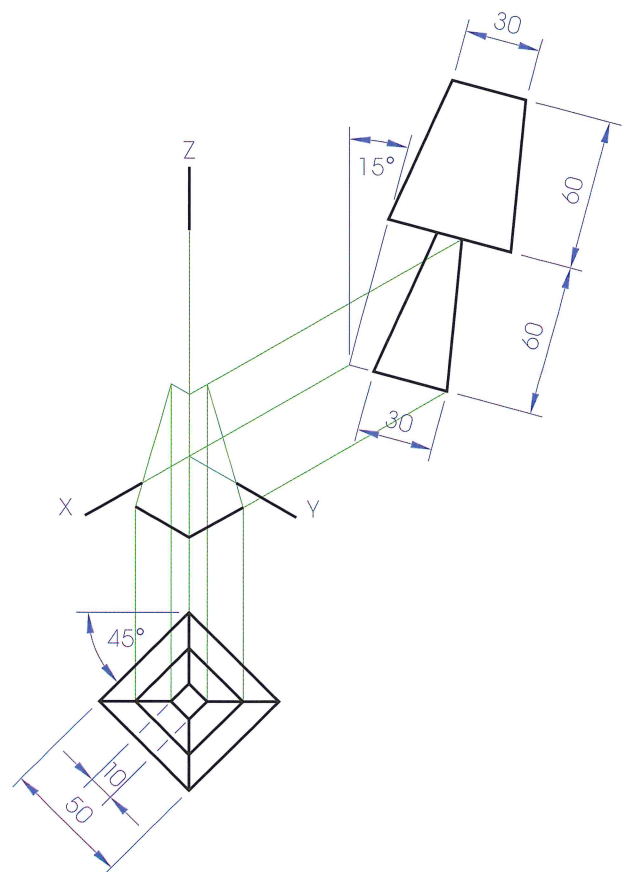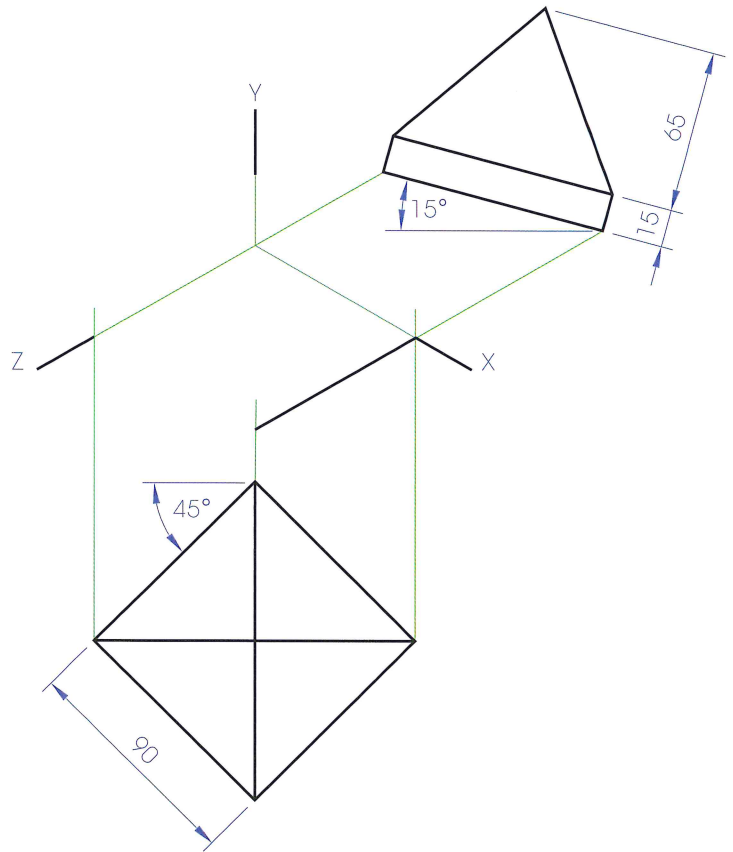   (iv) Draw the completed axonometric projection of the steps.

2. The figure below shows the incomplete isometric projection of three objects using the axonometric axes method. In each case, the elevation and plan are also shown in their required positions.

  (i)   Draw the axonometric axes X, Y and Z.
 (ii)   Draw the plan orientated at 45° as shown.
(iii)   Draw the side elevation orientated at 15° as shown.
(iv)   Draw the completed axonometric projection.

3. The incomplete isometric projections of a **Ferrero Rocher** box and a **square-based lampshade**, using the axonometric axes method are shown over and below, right. In each case the elevation and plan are also shown in their required positions. For each object:
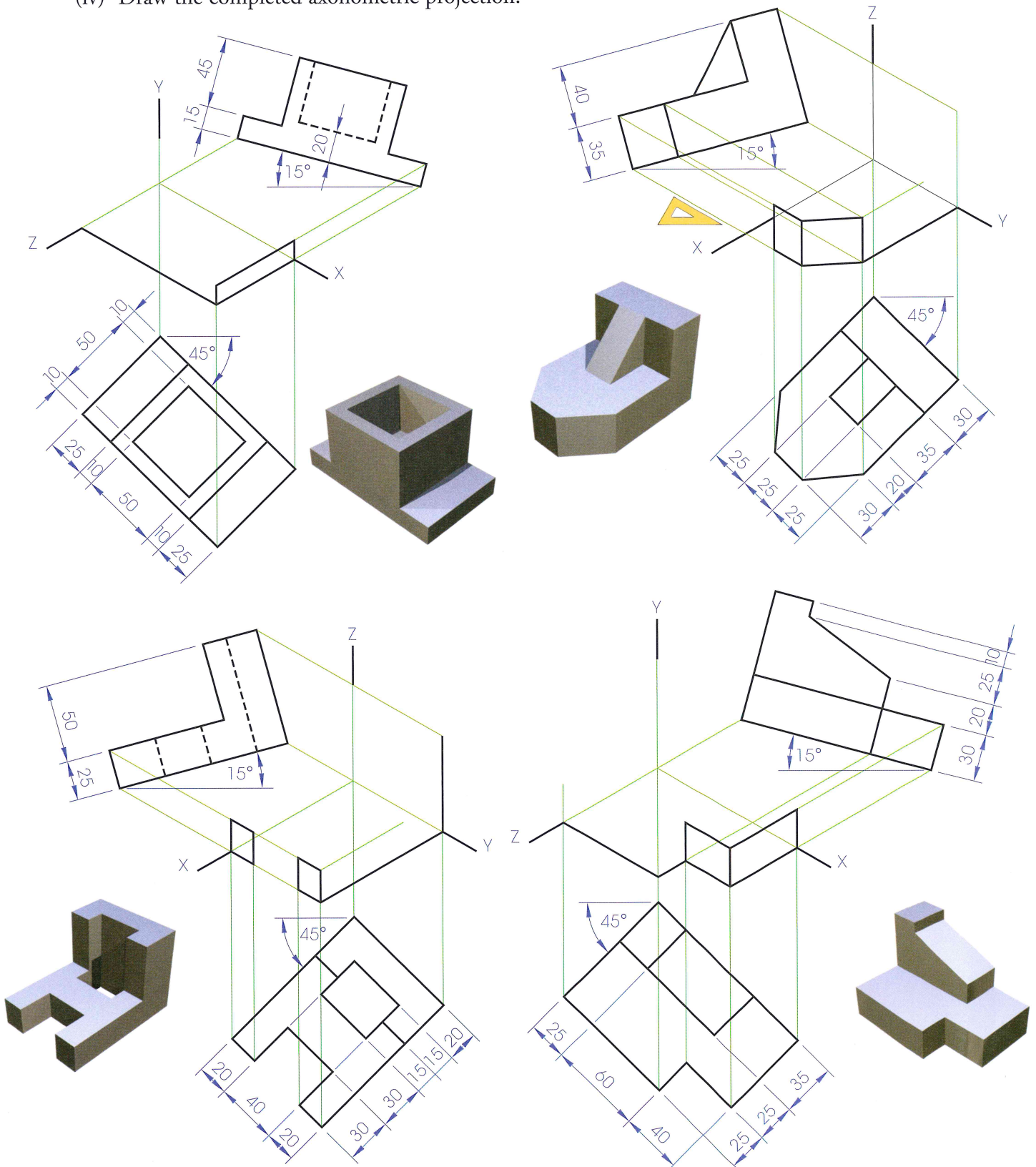
   (i)   Draw the axonometric axes X, Y and Z.

   (ii) Draw the plan orientated at 45° as shown.

   (iii) Draw the side elevation orientated at 15° as shown.

   (iv) Draw the completed axonometric projection.

4. The figure below shows the incomplete isometric projection of four objects using the axonometric axes method. In each case the elevation and plan are also shown in their required positions. For each solid:
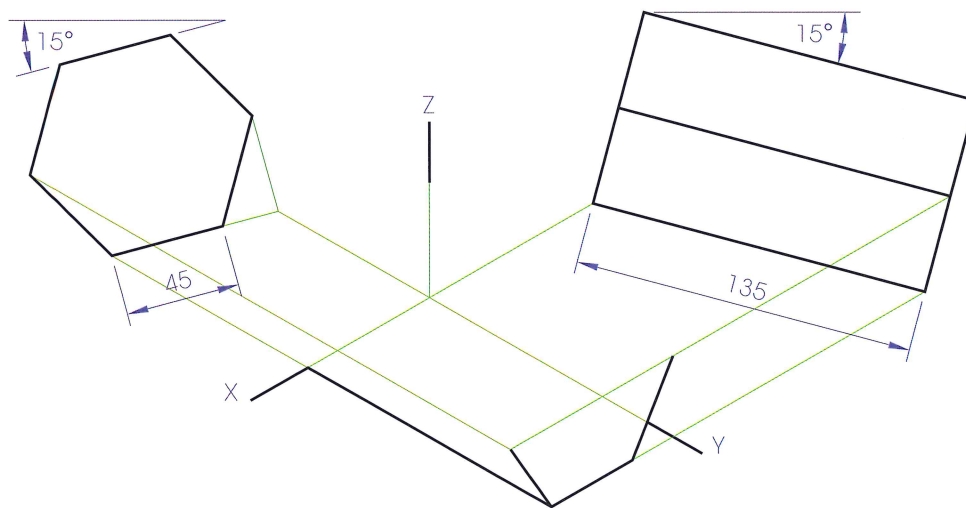
  (i)   Draw the axonometric axes X, Y and Z.
 (ii)   Draw the plan orientated at 45° as shown.
(iii)   Draw the elevation orientated at 15° as shown.
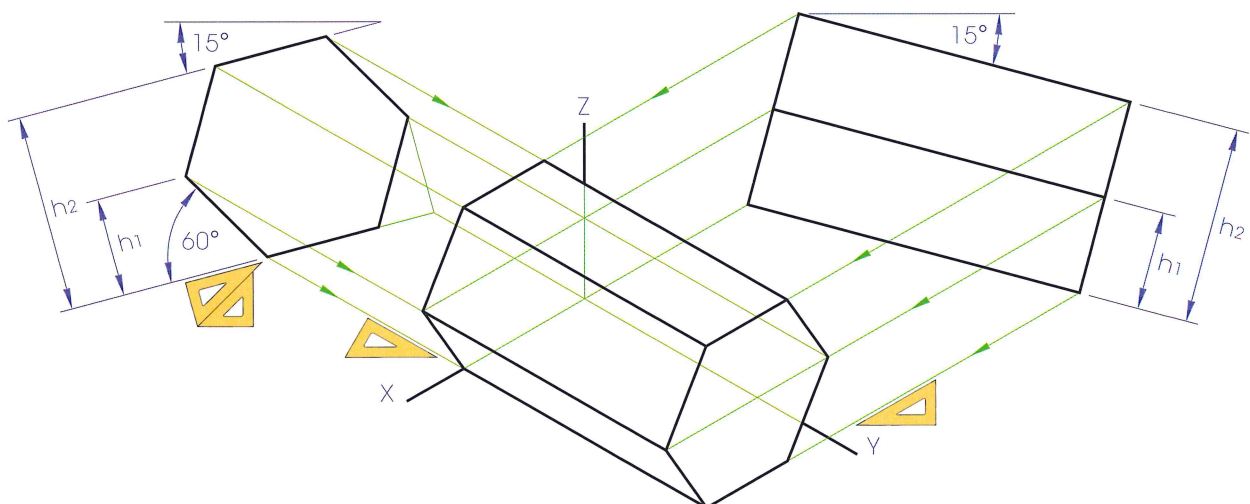(iv)   Draw the completed axonometric projection.

Example

The incomplete isometric projection of the **Amicelli box** using the axonometric axes method is shown below. The box is based on a **regular hexagonal prism**. The front and side elevations are also shown in their required positions.

 (i) Draw the axonometric axes X, Y and Z.

 (ii) Draw the elevations orientated at 15° as shown.

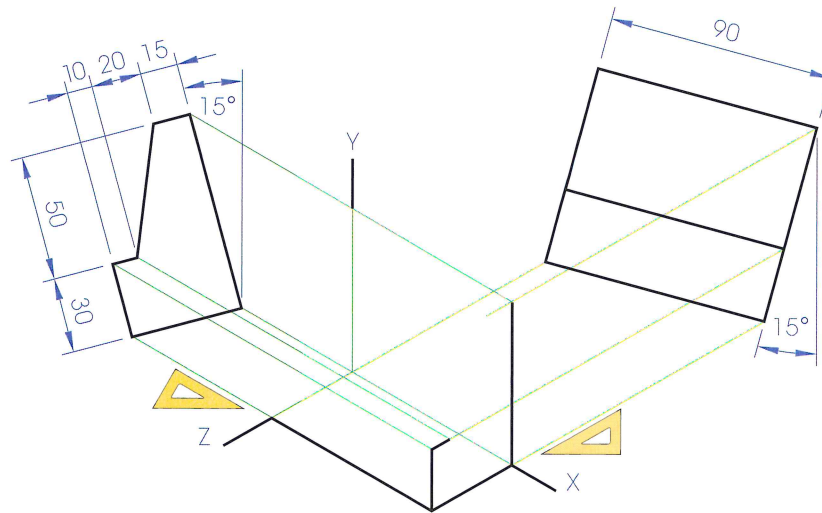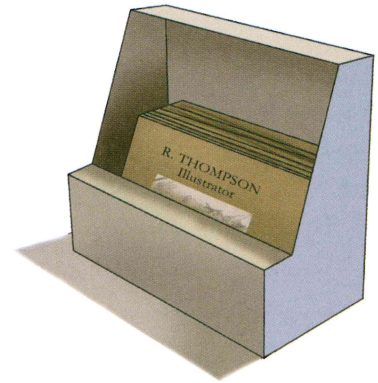(iii) Draw the completed axonometric projection.

1. Draw the axonometric axes X, Y and Z.

2. Draw the side elevation which is a regular hexagon of side 45 mm as shown below.

3. Draw the front elevation by transferring the heights from the side elevation as indicated below.

4. Project points from the elevations at 30° as shown.

5. Join the points where corresponding lines meet to complete the axonometric projection.

Exercises

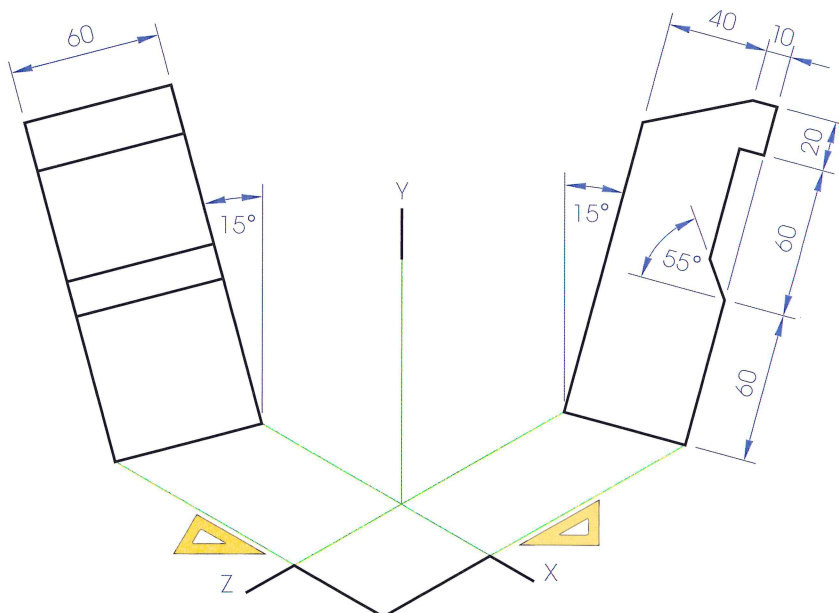**1.** The figure below shows the incomplete isometric projection of a **container** using the axonometric axes method. The front and side elevations are also shown in their required positions.

  (i)   Draw the axonometric axes X, Y and Z.

 (ii)   Draw the elevations orientated at 15° as shown.
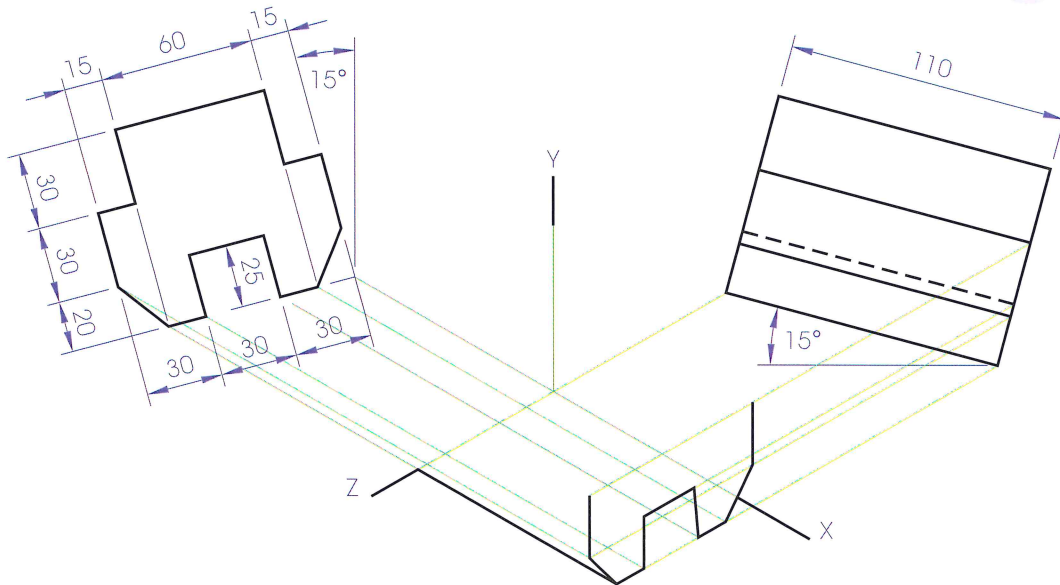
(iii) Draw the completed axonometric projection.

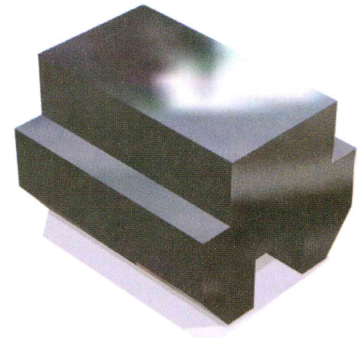**2.** The incomplete isometric projection of an **arcade game** using the axonometric axes method is shown below. The front and side elevations are also shown in their required positions.

  (i)   Draw the axonometric axes X, Y and Z.

 (ii)   Draw the elevations orientated at 15° as shown.
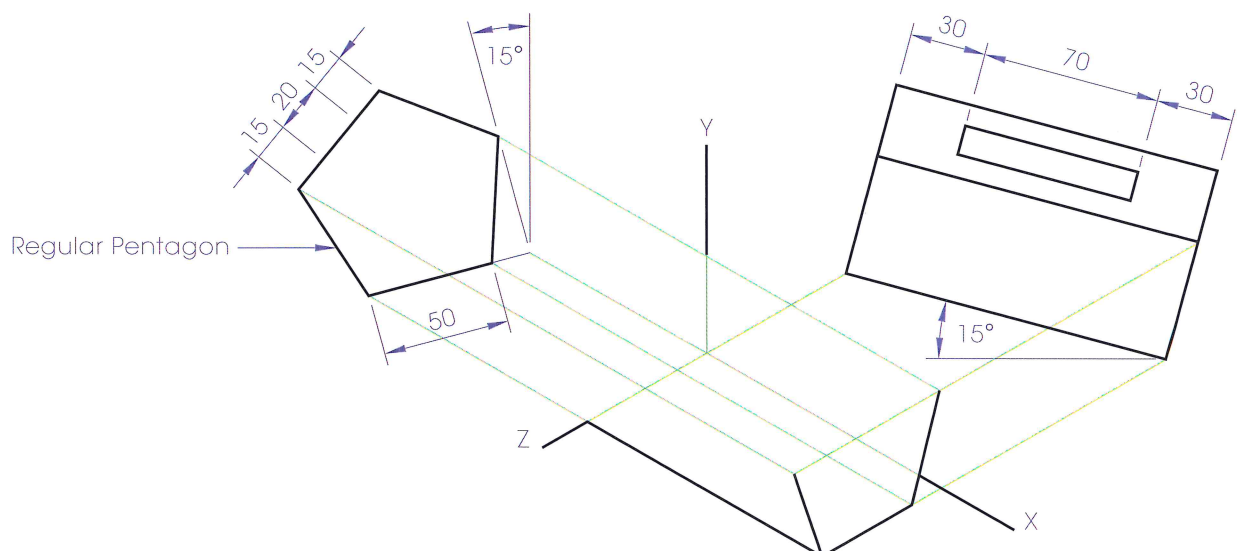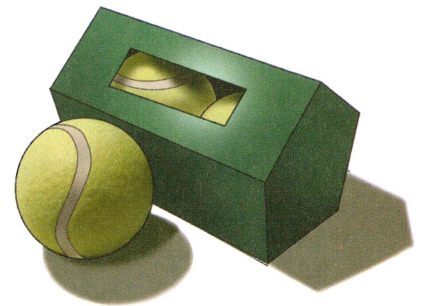
(iii) Draw the completed axonometric projection.

3. The figure below shows the incomplete isometric projection of a
component using the axonometric axes method. The front and side
elevations are also shown in their required positions.

  (i)   Draw the axonometric axes X, Y and Z.

  (ii) Draw the elevations orientated at 15° as shown.

  (iii) Draw the completed axonometric projection.

4. The incomplete isometric projection of a **box for tennis**
balls using the axonometric axes method is shown below.
The front and side elevations are also shown in their required
positions.

  (i)   Draw the axonometric axes X, Y and Z.

  (ii) Draw the elevations orientated at 15° as shown.

  (iii) Draw the completed axonometric projection.

Example

The incomplete isometric projection of a **table lamp** using the axonometric axes method is shown over. The base of the table lamp is a **regular hexagonal prism** and the shade is a frustum of a **regular hexagonal pyramid**.

  (i) Draw the plan orientated at 45° as shown.

 (ii) Draw the axonometric axes X, Y and Z.

(iii) Draw the front elevation orientated at 15° as shown.

(iv) Draw the completed axonometric projection of the lamp.

1. Draw the plan as indicated below, left, and insert the axonometric axes. Note that all the sides of the outer hexagon will be 35 mm long because it is a regular hexagon.

2. Transfer the lengths L1, 35 and L1 from the plan to draw the elevation of the base and the base hexagon of the shade.

3. Repeat this process as appropriate for the smaller hexagon and complete the elevation as shown.

4. Complete the axonometric projection in the normal manner.