A styrofoam corner protector is shown in the 3D graphic below. An axonometric view is shown on the right. A plan which has been positioned relative to the axes is also shown.

(a) Indicate the dihedral angle between the surfaces A and B.
(b) Draw the elevation of the object in the correct position on the XY plane and indicate the dihedral angle between the surfaces A and C.

The projections of a square pyramid are shown above. Determine the dihedral angle between the surfaces A and B using the point view method.

In the world around us, there are many obvious connections between geometry and architecture; the Great Pyramids of Egypt shown in the 3D graphic above are a classic example of square based pyramids.

Use the point view method to determine the dihedral angle between the surfaces A and B of the square based pyramid whose projections are given.
The 3D graphic across shows the nose section of an airplane. The elevation and plan of an airplane windshield are given below.

(a) Determine the dihedral angle between the surfaces A and B.
(b) Determine the dihedral angle between the surface C and the horizontal plane. This is called the inclination of the surface C to the horizontal plane.

Learning Outcomes
Students should be able to:
- Determine the dihedral angles between adjacent plane surfaces

Given the horizontal and vertical projections of two roof surfaces ABC and ABD. Determine the dihedral angle between the surfaces.
A cooker hood allows for the controlled extraction of moist air from a kitchen and as such has become an integral part of the modern home. A stainless steel cooker hood is shown in the 3D graphic across (left).

The drawing below shows the projections of a cooker hood.

(a) Determine the dihedral angle between the surfaces A and B using:
   (i) the point view method  
   (ii) the rabatment method

(b) Develop the surface C of the cooker hood.

The 3D graphic across shows a lamp and shade. The shade is a square pyramid which has been truncated as shown. The plan and elevation of the lampshade are given above.

(a) Use the rabatment method to determine the dihedral angle between the surfaces A and B.

(b) Draw a one-piece surface development of the shade.

Learning Outcomes

Students should be able to:

- Determine the dihedral angles between adjacent plane surfaces forming solid objects using the rabatment method
- Determine the development of surfaces of pyramidal frustums
The projections of a series of containers, which are based on a magazine file, a bin for used towels, a bread bin and a cigarette bin, respectively are shown below. A 3D graphic of each of the containers is also given.

In 1—3, complete the surface development of the containers; in 4, draw the elevation, plan and end view of the bin.

Learning Outcomes
Students should be able to:
- Prepare surface developments of surface containers and sheet metal fabrications
The 3D graphics below show two litter bins made from wood and stainless steel, respectively. The plan and elevation of the bins are given. Draw a development of the curved surface of each litter bin. The join seam should be on the shortest possible line.

The 3D graphic below shows a scoop made from aluminum. The elevation, end view and incomplete plan of the scoop are also given.

(a) Complete the plan of the scoop and draw a development of the curved surface.
(b) If the scoop is completely full and held so that none of the material can fall out, what angle does the handle make with the H.P.

Learning Outcomes
Students should be able to:
- Prepare surface developments of sheet metal and wood fabrications
The 3D graphic on the right shows a charity collection box with a sloped top. The plan and elevation of the box are also given.

(a) Project an end view looking in the direction of the arrow A.

(b) Draw a one-piece surface development of the collection box.

(c) In the isometric pictorial, obtain the traces of the simply inclined plane that contains the sloped top.

Learning Outcomes

Students should be able to:

- Project an end view of an object from the elevation and plan
- Prepare surface developments of surface containers
- Depict the traces of a simply inclined plane in three dimensional format
The log roll shown in the 3D graphics is a toy which appeals to children and adults alike, because it is challenging and fun to use. It is very useful for children to let off steam and also useful for adults to reduce work stress.

The drawing below shows the elevation of part of the log roll. It consists of three right cylinders intersecting as shown.

(a) A portion of the plan of the right cylinder B has been drawn. Complete the plan of the cylinder B by inscribing an ellipse in the given rectangle.

(b) Complete the development of the curved surface of the cylinder A.

Learning Outcomes
Students should be able to:
- Develop intersections involving right cylindrical surfaces
- Construct an ellipse in a rectangle given the principal vertices
(a) The figure below shows the plan of two lean-to roof surfaces. All the surfaces have a pitch of 30°.
(i) Complete the given freehand pictorial sketch of the roof system and project an elevation of the roof.
(ii) Develop the true shape of the roof surfaces A and B.

(b) The 3D graphic on the right shows a display stand. The projections of the display stand are also given.
(i) Determine the traces of the simply inclined plane that contains the surface A.
(ii) Determine the true shape of the surface A.
A tent is shown in the 3D graphic across. The figure below shows the plan of the tent. The surfaces A and B have a pitch of 55°.

(a) Project an elevation of the tent.

(b) Determine the traces of the oblique plane that contains surface C.

(c) Determine the true shape of surface C.

(d) Shown on the right is a set of isometric axes and the position of the elevation and plan of the tent.

   Draw the completed axonometric projection of the tent and obtain the traces of the oblique plane that contains surface C.

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**Learning Outcomes**

Students should be able to:

* Prepare surface developments of intersecting roof surfaces

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### Parallel Lines

Parallel lines remain parallel in every view.
A 3D graphic of a photo frame is shown across. It consists of a rectangular frame supported by a pentagonal-shaped rear support.

(a) The incomplete outline plan and elevation of two intersecting planes is shown below (left).

(i) Determine the line of intersection between the planes.
(ii) Determine the dihedral angle between the planes.

(b) The figure below (right) shows the projections of a frame and its rear support.

(i) Determine the inclination of the rear support abde to the H.P.
(ii) Establish the true shape of the rear support.

Learning Outcomes
Students should be able to:
- Determine the lines of intersection between two intersecting surfaces
- Determine the dihedral angle between adjacent plane surfaces
- Prepare surface developments of intersecting surfaces
The 3D graphics shows a rocket playhouse and a “triangle-modeled paper pod”, both of which have been made from recycled cardboard.

(a) The plan and elevation of part of the rocket is shown below (left). It is based on a hexagonal pyramid which has been cut as shown. Draw the development of the sides of the pyramid.

(b) The figure below (right) shows the plan and incomplete elevation of two of the surfaces ABC and ABD of the paper pod. The dihedral angle between the surfaces is 150°.

(i) Complete the elevation of the pod by determining the elevation of the point D.
(ii) The triangular door shown in the graphic is offset 8mm from the outer triangle ABC. Draw the plan and elevation of the triangular door.

Learning Outcomes

Students should be able to:

- Determine the dihedral angle between adjacent plane surfaces
- Prepare surface developments of intersecting surfaces
(a) A 3D graphic of a timber post and rail fence is shown below (bottom left). The figure below (left) shows the plan and incomplete elevation of two square based prisms which intersect each other.

Project an end elevation and complete the elevation showing all lines of interpenetration.

(b) The figure below (right) shows the plan of a square vertical post and a supporting strut whose cross-section is a square as shown. The strut makes an angle of 45° with the horizontal plane.

Project an elevation on the given XY line and develop the surfaces of the strut.

Learning Outcomes

Students should be able to:
- Establish the lines of intersection of between intersecting right prisms
- Draw surface developments involving intersecting square based prisms
The 3D graphics show two different types of playground slides. The drawings below show the projections of the two slides. The one on the left is based on an oblique rectangular prism and the one on the right consists of an oblique cylinder.

In each case, complete the plan and draw a surface development of the slides.

Learning Outcomes

Students should be able to:

- Develop the surfaces of an oblique prism and an oblique cylinder
The 3D graphic shows a masonry fireplace installed with a steel fireplace unit whose pictorial projection is shown below. The projections of the transition piece of the unit are given. Complete the development of this transition piece using triangulation.

Learning Outcomes
Students should be able to:
- Determine the developments of transition pieces between ducts of rectilinear/rectilinear cross-section.
- Develop the transition piece between the sheet-metal hopper and the downpipe.

The true shape of cdhg is shown in the elevation. Lines ad, eh, fg, bc, ef, and ab all appear as true lengths in plan.
Fume hoods are common to all chemistry laboratories in schools. There are a wide range of shapes and sizes of fume hoods available.

The 3D graphic on the right shows the transition piece that connects a rectangular shaped hood to a circular ducting unit.

The drawing below shows the plan and elevation of the transition piece.

Draw the complete surface development of the transition piece along the given centre line.

**Learning Outcomes**

Students should be able to:

- Determine the developments of transition pieces between ducts of circular/rectilinear cross-section.
The 3D graphics show a water slide that simulates a ride in a tornado. It is consists of a transition piece between two ducts of circular cross-section. The projections of the trumpet-shaped portion of the slide are given below. It contains a transition piece attached to a right cylinder.

(a) Complete the layout of one-half of the development of the transition unit.

(b) A child winds down the cylindrical part of the slide in the path of a single helix which moves from P to Q in half of an anti-clockwise revolution. Draw the elevation of the helix showing all construction lines.