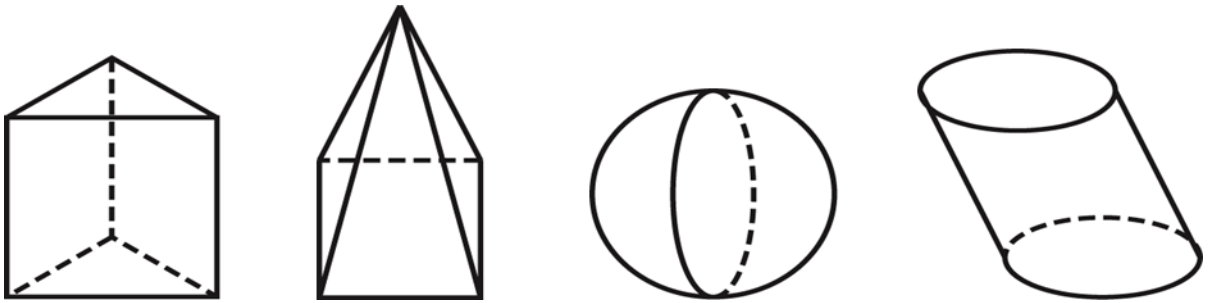
Section 11-4 Geometry in Three Dimensions

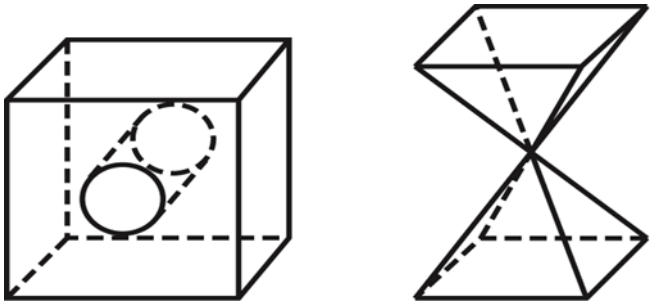
- Simple closed surfaces and polyhedra.
- How to draw three-dimensional shapes.
- Why there are only five regular polyhedra.
- Simple closed surfaces that are not polyhedra.

Simple Closed Surfaces (1 of 2)

A **simple closed surface** has exactly one interior, no holes, and is hollow.



These two figures are not simple, closed surfaces.



Simple Closed Surfaces (2 of 2)

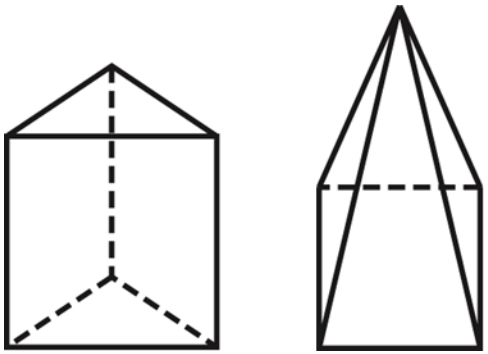
Sphere – the set of all points at a given distance from a given point (the **center**)

Solid – the set of all points on a simple closed surface together with all interior points

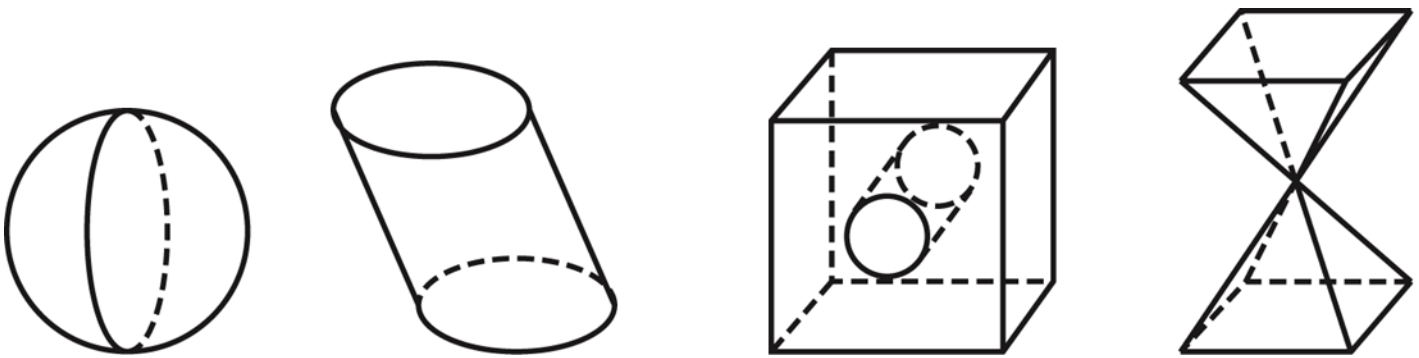
Polyhedron – a simple, closed surface made up of polygonal regions (**faces**). The vertices of the polygonal regions are the **vertices** of the polyhedron. The sides of the polygonal regions are called the **edges** of the polyhedron.

Polyhedra

Polyhedra:

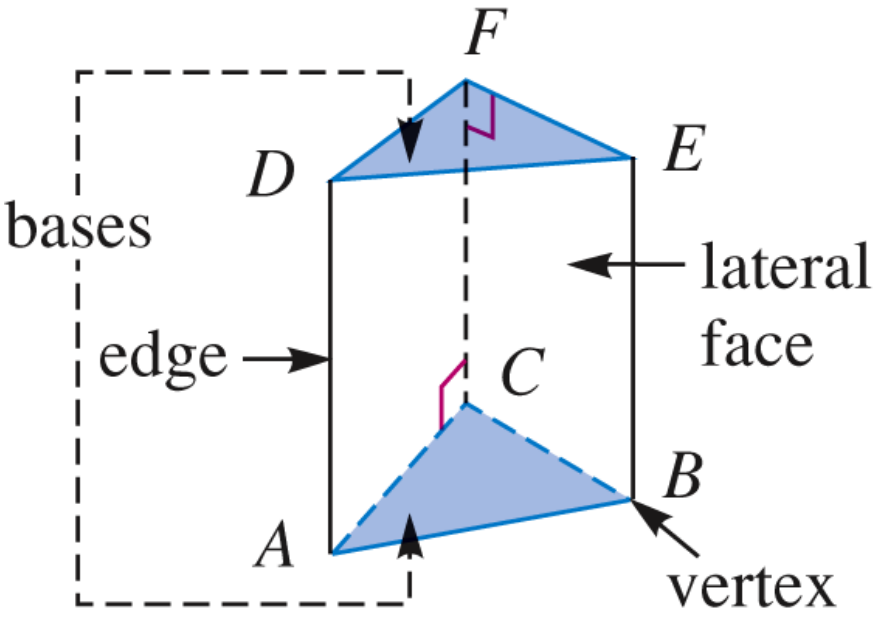


Not polyhedra:



Prisms (1 of 2)

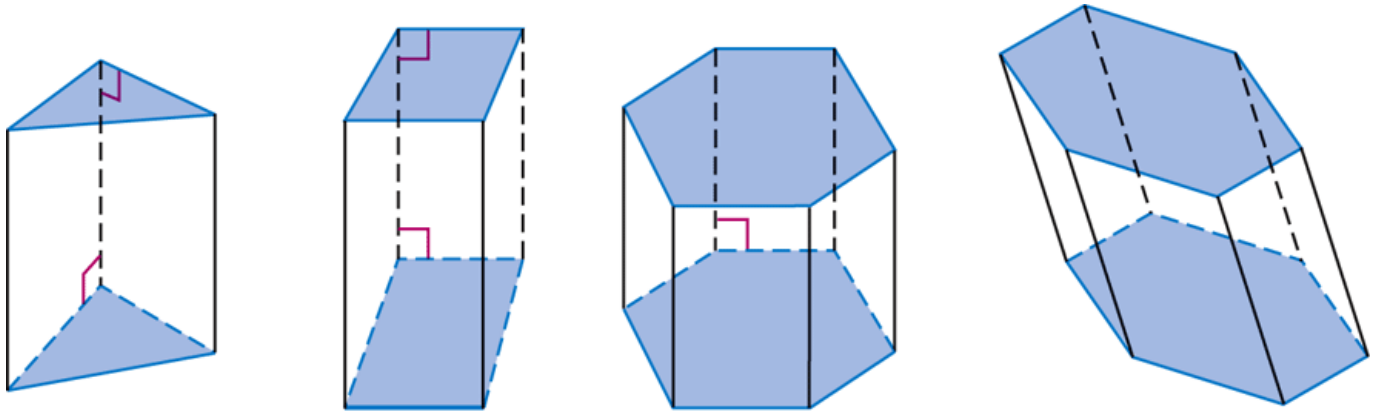
A **prism** is a polyhedron with two parallel, congruent **bases** (upper and lower) and sides (**lateral faces**) that are parallelograms.



Prisms (2 of 2)

Right prism – lateral faces are perpendicular to the bases. (lateral faces are rectangles)

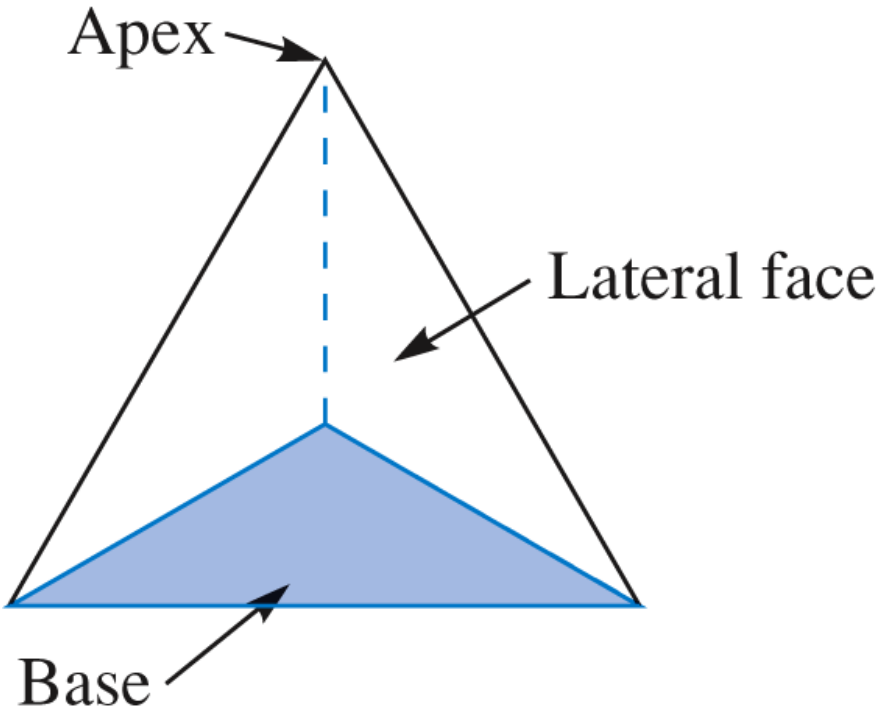
Oblique prism – lateral faces are not perpendicular to the bases. (lateral faces are parallelograms)



Triangular right prism | Quadrilateral right prism | Hexagonal right prism | Hexagonal oblique prism

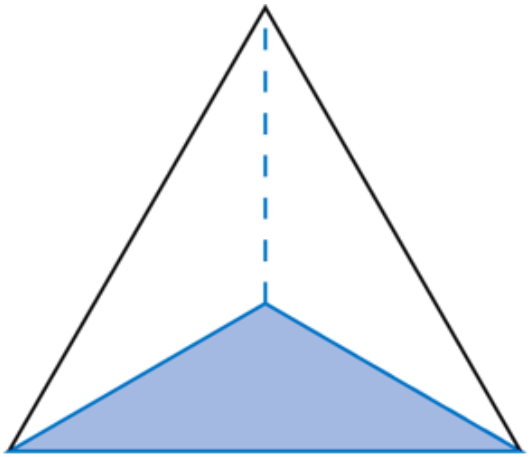
Pyramids (1 of 2)

A **pyramid** is a polyhedron determined by a polygon and a point not in the plane of the polygon.

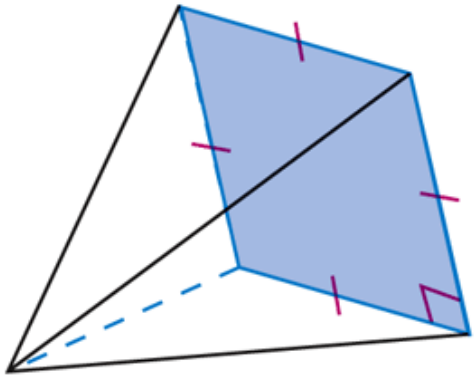


Pyramids (2 of 2)

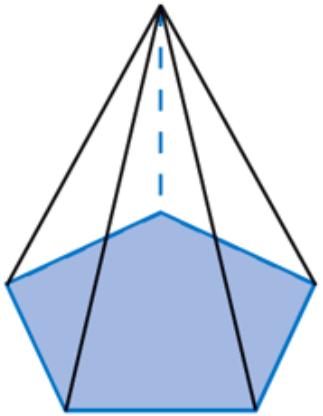
Right pyramid – lateral faces are congruent isosceles triangles.



Triangular pyramid



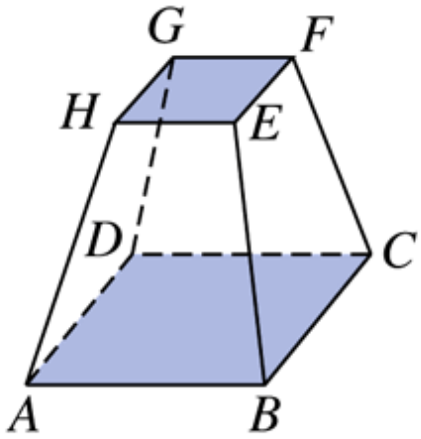
Square pyramid



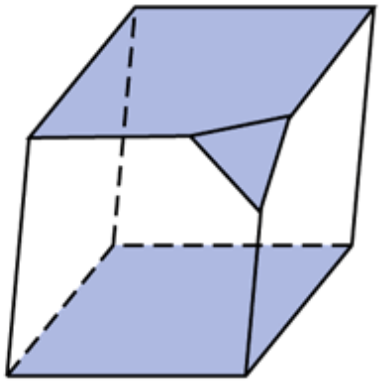
Pentagonal pyramid

Truncated Polyhedron

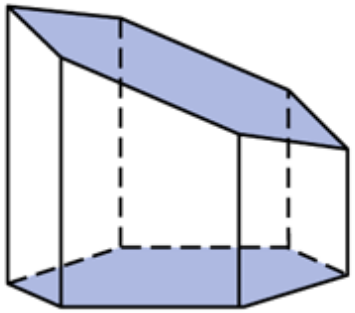
If one or more corners of a polyhedron is removed by an intersecting plane or planes, the polyhedron is a **truncated polyhedron**.



Truncated square pyramid with parallel bases



Truncated cube



Truncated prism

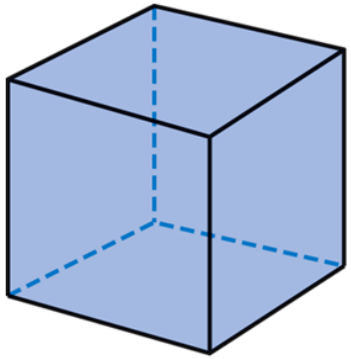
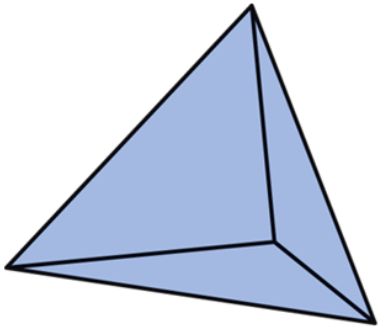
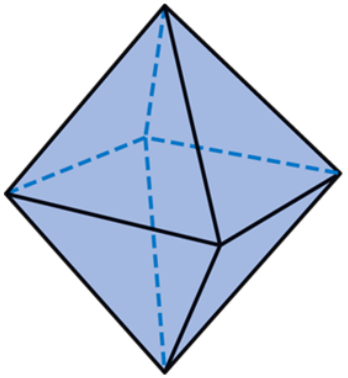
Regular Polyhedra (1 of 5)

Convex polyhedron – a polyhedron in which a segment connecting any two points in the interior of the polyhedron is completely contained within the interior of the polyhedron.

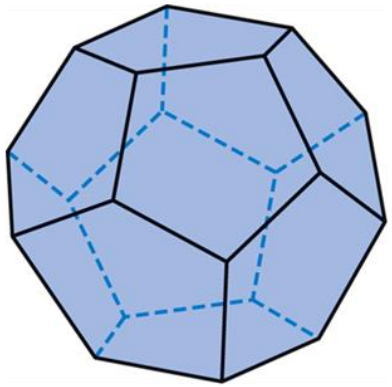
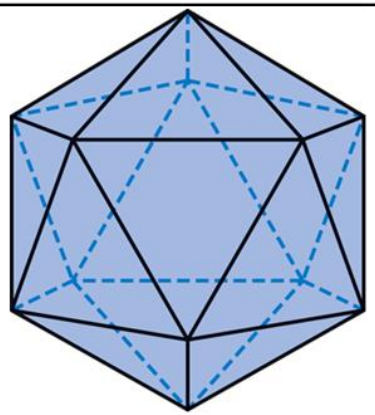
Concave polyhedron - a polyhedron that is not convex

Regular polyhedron – a convex polyhedron whose faces are congruent regular polygonal regions such that the number of edges that meet at each vertex is the same for all the vertices of the polyhedron.

Regular Polyhedra (Platonic Solids)
(2 of 5)

Cube	Tetrahedron	Octahedron
		

Regular Polyhedra (3 of 5)

Dodecahedron	Icosahedron
	

Regular Polyhedra (4 of 5)

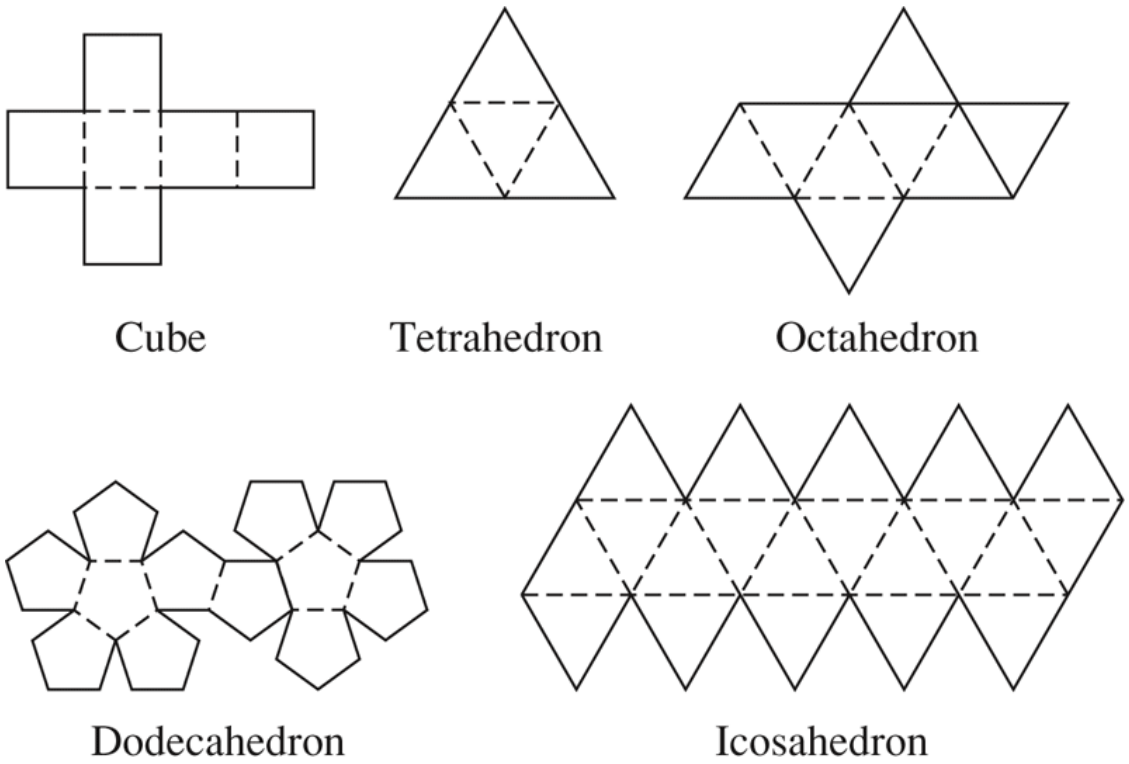
Polygon	Measure of an Interior Angle	Number of Polygons at a Vertex	Sum of the Angles at the Vertex	Polyhedron Formed	Model
Triangle	60°	3	180°	**Tetrahedron**	
Triangle	60°	4	240°	**Octahedron**	
Triangle	60°	5	300°	**Icosahedron**	

Regular Polyhedra (5 of 5)

Polygon	Measure of an Interior Angle	Number of Polygons at a Vertex	Sum of the Angles at the Vertex	Polyhedron Formed	Model
Square	90°	3	270°	**Cube**	
Pentagon	108°	3	324°	**Dodecahedron**	

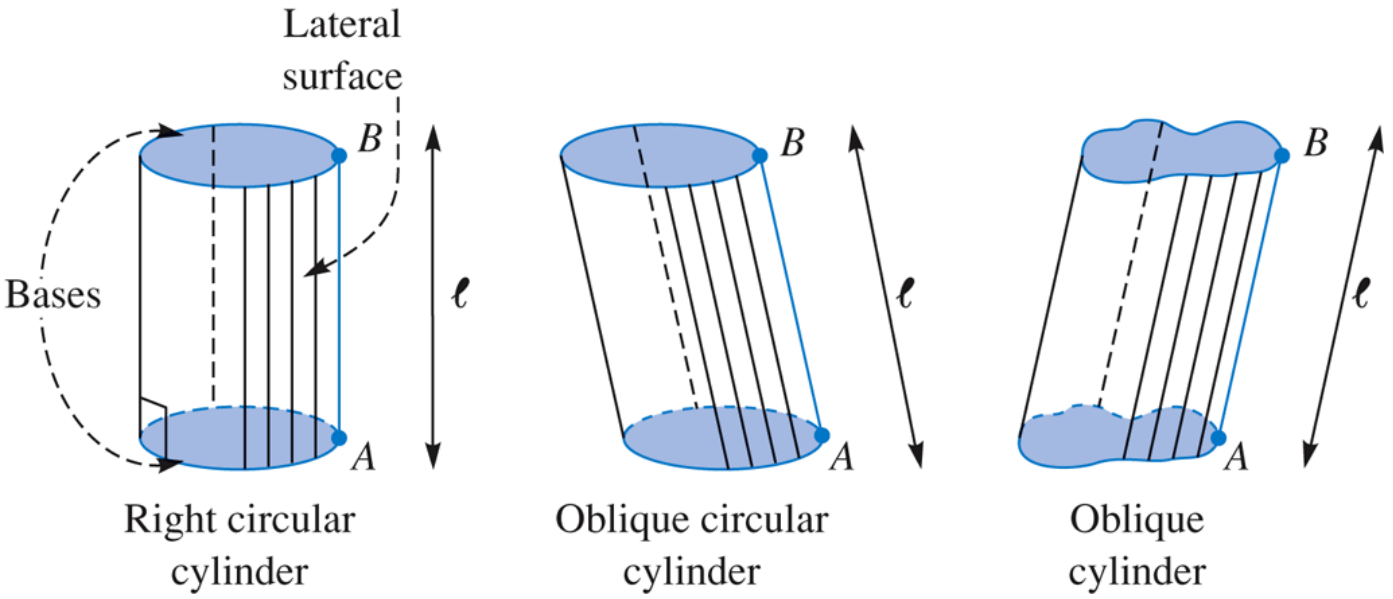
Nets

These patterns can be used to construct the five regular polyhedra.



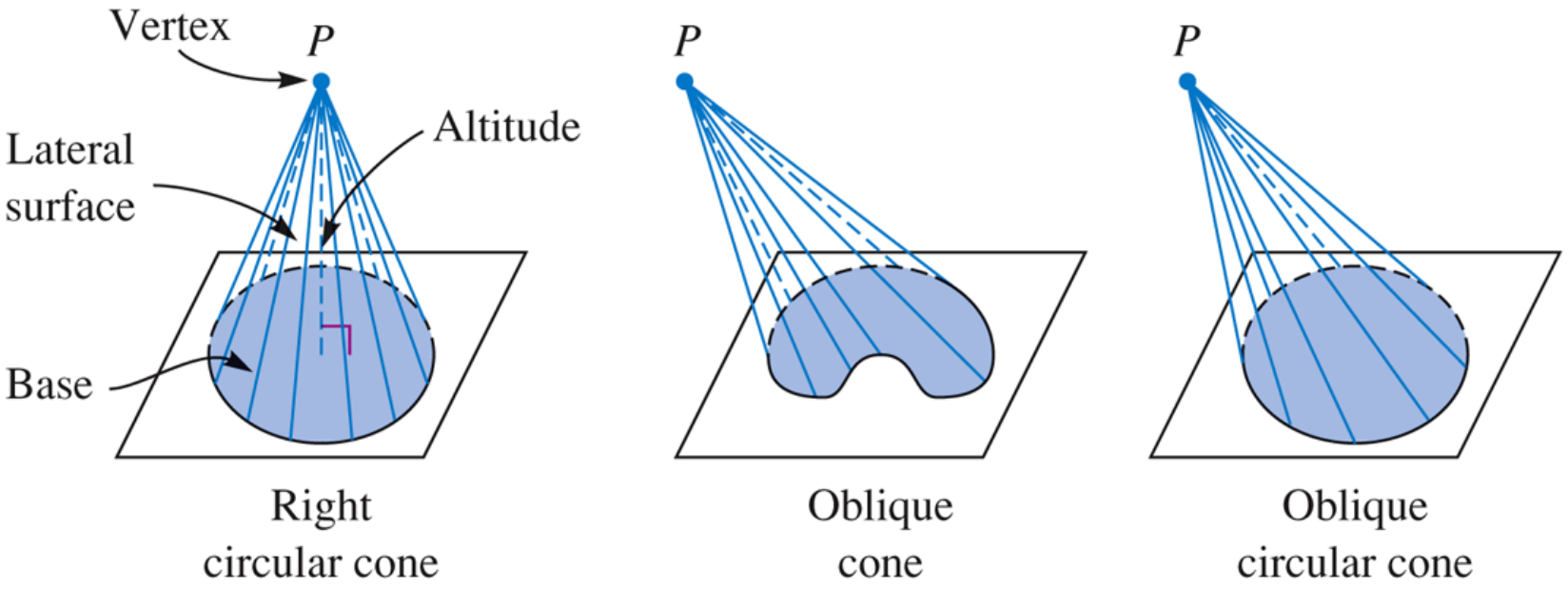
Cylinders and Cones (1 of 2)

Cylinder – a simple, closed surface that is not a polyhedron; formed as a segment *AB* parallel to a given line *l* traces a planar curve other than a polygon.



Cylinders and Cones (2 of 2)

Cone – the union of the line segments connecting a point *P* with each point of a simple, closed curve, the simple, closed curve, and the interior of the curve.



This ends Section 11.4