1- Main Formula:

$$V = \int_a^b \mathbf{A(x)}\, dx$$

This formula is applied in the following 3 methods:

i- Slicing Method:

Take a cross-sectional slice of the shape.

A(x) is found depending on the shape of the cross-section.

Example: Rectangle: A(x) = length * width

Circle: $A(x) = \pi R^2$

ii- Disk Method:

The cross-section is already known to be a circle.

so $A(x) = \pi R^2$

and $V = \int_a^b \pi R^2\, dx$

iii- Washers Method:

Donut-shaped cross-sections, so the cross-section area is:

Area of Outer Circle - Area of Inner Circle

$A(x) = \pi R_{outer}^2 - \pi R_{inner}^2$

and so, $V = \int_a^b \pi R_{outer}^2 - \pi R_{inner}^2\, dx$

that is, $V = \int_a^b \pi (R_{outer}^2 - R_{inner}^2)\, dx$

2- Cylindrical Shells Formula:

and $V = \int_a^b \text{Circumference} * \text{height}\, dx$

and $V = \int_a^b 2 \pi R * \text{height}\, dx$