Therefore, according to our investigation, a 1.5L coke bottle actually has the volume of 1.5461L

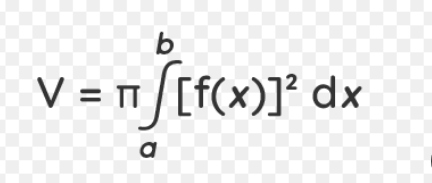
Link to graph:

<https://www.desmos.com/calculator/spgicsyge0>

We used a total of 9 equations to graph the contour of a Coke bottle:

| **Equation** | **Limits** |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  | or |
|  | or |

We used the disk method to compute for the total area:



To compute this accurately with all the complex integrations and so on we used WxMaxima a CAS or Computer Algebra System.

This was the code

kill(all)$

load(draw)$

ratprint: false$

fpprintprec: 5$

/\* First half of Coke Bottle Equations that are in terms of y \*/

eq1(x) := 0.75\*sin(0.87\*x)^2+0.335$

eq2(x) := -0.15\*(x-2.17)^2+1.11$

eq3(x) := 0.01384\*(x-3.87)^2+1.07$

eq4(x) := -0.12\*(x-3.87)^2+1.07$

eq5(x) := 0.102\*(x-5.2)^2+0.95$

eq6(x) := 0.3\*(x-5.2)^2+0.95$

eq7(x) := -0.638\*(x-5.9)^2+1.05$

/\* Second half of Coke Bottle Equations that are in terms of x \*/

eq8(y) := -3.65\*(y-0.5)^2+7$

eq9(y) := -2.564\*(y-0.5)^2 + 7$

/\* Convert the equations into terms of y and choose the variation that lines up with the graph\*/

define(invEq8(x), rhs(solve(eq8(y) = x, y)[2])), numer$

define(invEq9(x), rhs(solve(eq9(y) = x, y)[1])), numer$

/\* Solve for each equation's volume around the x-axis through the Disk Method \*/

v1 : %pi\*integrate(eq1(x),x,0.,1.745)^2, numer;

v2 : %pi\*integrate(eq2(x),x,1.745,2.17)^2, numer;

v3 : %pi\*integrate(eq3(x),x,2.17,3.87)^2, numer;

v4 : %pi\*integrate(eq4(x),x,3.87, 4.8)^2, numer;

v5 : %pi\*integrate(eq5(x),x,4.8, 5.2)^2, numer;

v6 : %pi\*integrate(eq6(x),x,5.2, 5.681)^2, numer;

v7 : %pi\*integrate(eq7(x),x,5.681, 5.9)^2, numer;

v8 : %pi\*integrate(invEq8(x),x,5.899, 7)^2, numer;

v9 : %pi\*integrate(invEq9(x),x,6.359, 7)^2, numer;

/\* Now we compute for the total volume \*/

vTotal : v1 + v2 + v3 + v4 +v5 + v6 + v7 + v8 - v9$ /\* v8 - v9 gets the volume of the bottle's feet stands\*/

inGraphHeight : 7.5$ /\* Note we need to include the bottlecap height too \*/

actualHeight : 0.3048$ /\* 1 foot in meters to keep things metric\*/

/\* By using the ratio we can compute for the actual volume according to the graph \*/

actualVTotal : float(vTotal \* ((actualHeight / inGraphHeight)^3) \* 1000), numer; /\* x1000 to convert m^3 to L \*/

print("Therefore, according to our investigation, a 1.5L coke bottle actually has the volume of", actualVTotal,"L")$

/\* Graphing the generated figure \*/

/\* Create the surfaces of revolution \*/

surface1 : parametric\_surface(eq1(x)\*cos(theta), eq1(x)\*sin(theta), x, x, 0,1.745, theta, 0, 2\*%pi)$

surface2 : parametric\_surface(eq2(x)\*cos(theta), eq2(x)\*sin(theta), x, x, 1.745,2.17, theta, 0, 2\*%pi)$

surface3 : parametric\_surface(eq3(x)\*cos(theta), eq3(x)\*sin(theta), x, x, 2.17,3.87, theta, 0, 2\*%pi)$

surface4 : parametric\_surface(eq4(x)\*cos(theta), eq4(x)\*sin(theta), x, x, 3.87, 4.8, theta, 0, 2\*%pi)$

surface5 : parametric\_surface(eq5(x)\*cos(theta), eq5(x)\*sin(theta), x, x, 4.8, 5.2, theta, 0, 2\*%pi)$

surface6 : parametric\_surface(eq6(x)\*cos(theta), eq6(x)\*sin(theta), x, x, 5.2, 5.681, theta, 0, 2\*%pi)$

surface7 : parametric\_surface(eq7(x)\*cos(theta), eq7(x)\*sin(theta), x, x, 5.681, 5.9, theta, 0, 2\*%pi)$

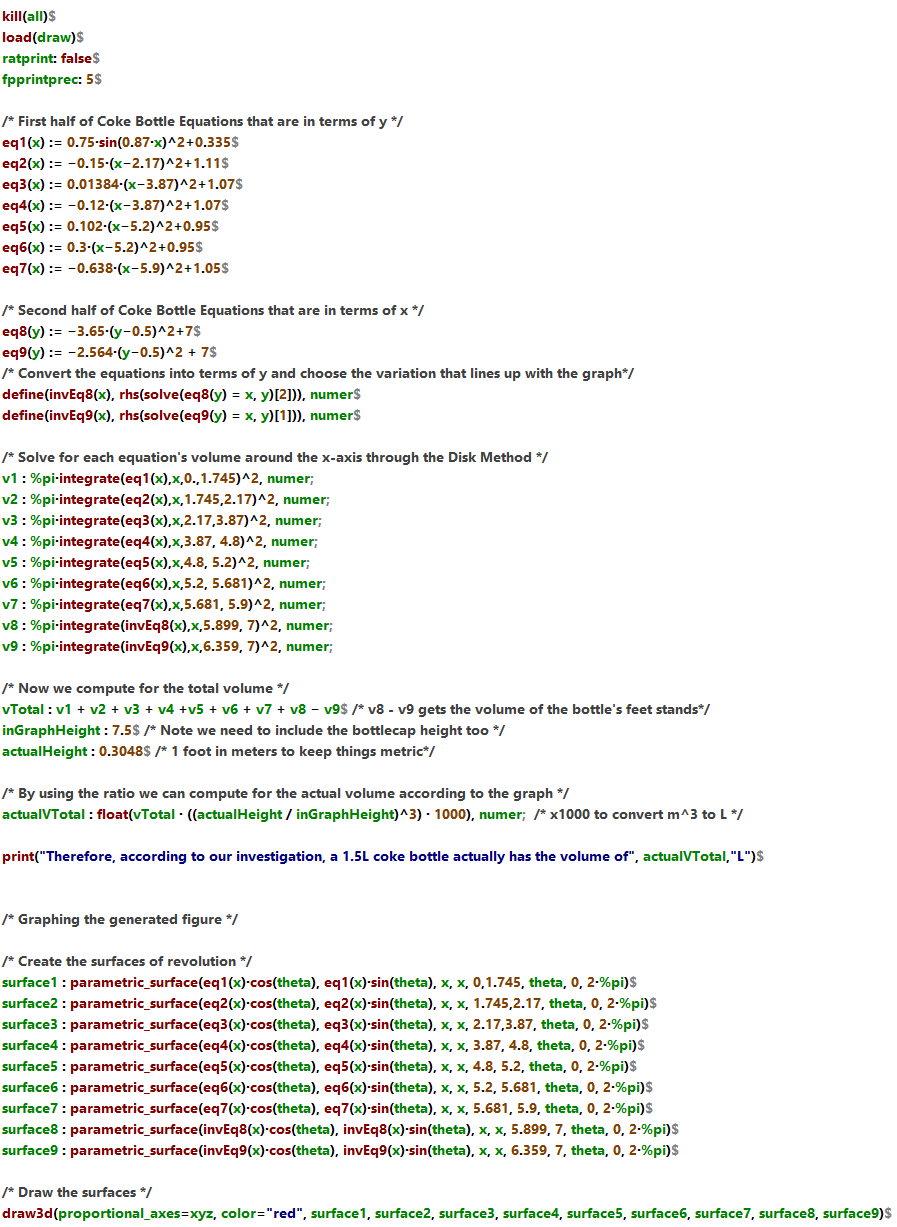
surface8 : parametric\_surface(invEq8(x)\*cos(theta), invEq8(x)\*sin(theta), x, x, 5.899, 7, theta, 0, 2\*%pi)$

surface9 : parametric\_surface(invEq9(x)\*cos(theta), invEq9(x)\*sin(theta), x, x, 6.359, 7, theta, 0, 2\*%pi)$

/\* Draw the surfaces \*/

draw3d(proportional\_axes=xyz, color="red", surface1, surface2, surface3, surface4, surface5, surface6, surface7, surface8, surface9)$

With syntax highlighting:



Output:

