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> restart : with(LinearAlgebra) : with(VectorCalculus) :
> # Step 1: Define parameters and parametric equations
  a := 'a':  # Keep 'a' as symbolic
  x_theta := a * cos(theta) * (1 + cos(theta));
  y_theta := a * sin(theta) * (1 + cos(theta));

  # Step 2: Calculate the tangent vector components
  dx_dtheta := diff(x_theta, theta);
  dy_dtheta := diff(y_theta, theta);

  # Step 3: Calculate the magnitude of the tangent vector
  ds := sqrt(dx_dtheta^2 + dy_dtheta^2) :

  # Step 4: Define integrals for M, x_integral, and y_integral
  M := int(ds, theta = 0 .. Pi) :
  x_integral := int(x_theta * ds, theta = 0 .. Pi) :
  y_integral := int(y_theta * ds, theta = 0 .. Pi) :

  # Step 5: Calculate the center of mass coordinates
  x_cm := simplify(x_integral / M) :
  y_cm := simplify(y_integral / M) :

  # Step 6: Display the result for the center of mass
  Center_of_Mass := [x_cm, y_cm];
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$$x\_theta := a\cos(\theta)\,(1+\cos(\theta))$$

$$y\_theta := a\sin(\theta)\,(1+\cos(\theta))$$

$$dx\_dtheta := -a\sin(\theta)\,(1+\cos(\theta)) - a\cos(\theta)\sin(\theta)$$

$$dy\_dtheta := a\cos(\theta)\,(1+\cos(\theta)) - a\sin(\theta)^2$$

$$Center\_of\_Mass := \left[\frac{4a}{5}, \frac{4a}{5}\right] \qquad (1)$$

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