Geogebra – Limiting Sums and Area Under a Graph. An introduction to Integral Calculus using the Squeeze Theorem.

1.		Open a new GeoGebra window, showing Graphics and Algebra windows.
2.		Enter the following in the input box: *f(x) = -0.5x^3+2x^2-x+1* This will create the function $f(x) = -0.5x^3 + 2x^2 - x + 1$
3.		Create two points, *A* and *B* on the x-axis about (1,0) and (3,0) respectively (these two points will determine the interval. You will need to hover above the x-axis until the red xAxis box appears).
4.		Create a slider for the number *n* (interval 1 to 50; increment 1)
5.		Enter in the input box: *us = uppersum[f,x(A),x(B),n]* This will create a variable called 'us' (for upper sum) which will contain the value of the area of all the upper rectangles. NB. *x(A)* gives the x-coordinate of point A.
6.		Enter in the input box: *ls = lowersum[f,x(A),x(B),n]* This will create a variable called 'ls' (for lower sum) which will contain the value of the area of all the lower rectangles.
7.	ABC	Insert the following dynamic text using the Text Tool somewhere in the graphics window: *Upper Sum =* and then select *us* from *objects* or from the Algebra window. You should see the result in the preview window with *us* replaced by its current value. Click OK.
8.	ABC	Insert the following dynamic text using the Text Tool: *Lower Sum =* and then select *ls* from *objects* or from the Algebra window. You should see the result in the preview window with *ls* replaced by its current value. Click OK.
9.		In the input box type: *diff = us – ls*. This will create a new variable, *diff*, which will be the difference between the upper sum and the lower sum values.
10.	ABC	Insert the following dynamic text using the Text Tool: *Difference =* and then select *diff* from *objects* or from the Algebra window. You should see the result in the preview window with *diff* replaced by its current value. Click OK.
11.		Use the slider *n* to change the number of rectangles used to calculate the upper and lower sums. What happens to the difference of the upper and lower sums if *n* is small? What happens to the difference of the upper and lower sums if *n* is large? What happens if you move point B to the right of the x-intercept point of f(x)?
12.		Complete the following sentences in your exercise book: *"The area under the function graph lies between _____"* *"The exact area under the function graph is the limiting value of the sum of all rectangles as the number of rectangles _____"*