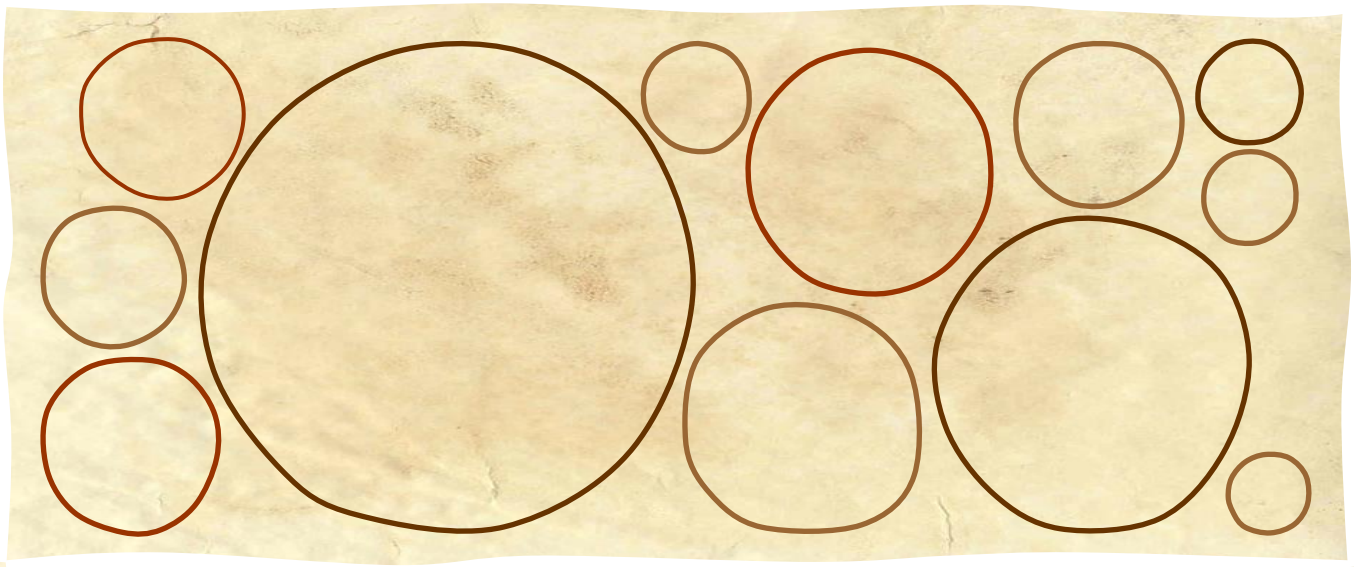
A Circle Drawing Competition

It is said that Pope Boniface VIII (1230-1303) once asked a selection of artists to create something which demonstrated their skills. Giotto di Bondone (1266-1337) met this challenge by drawing a perfect freehand circle.

Giotto di Bondone

This is not an easy thing to do. Try it yourself.

How can we judge if a shape is close to being a perfect circle? In the collection of shapes below which one is the closest to being a perfect circle?



Task 1

In groups administer a circle drawing competition across a whole grade of students different from your own. You will need to determine a way to convert these entries into electronic images.

The definition of a circle is the collection of all points which are all the same distance away from a fixed point, the center. Use this definition in the next task.

Task 2

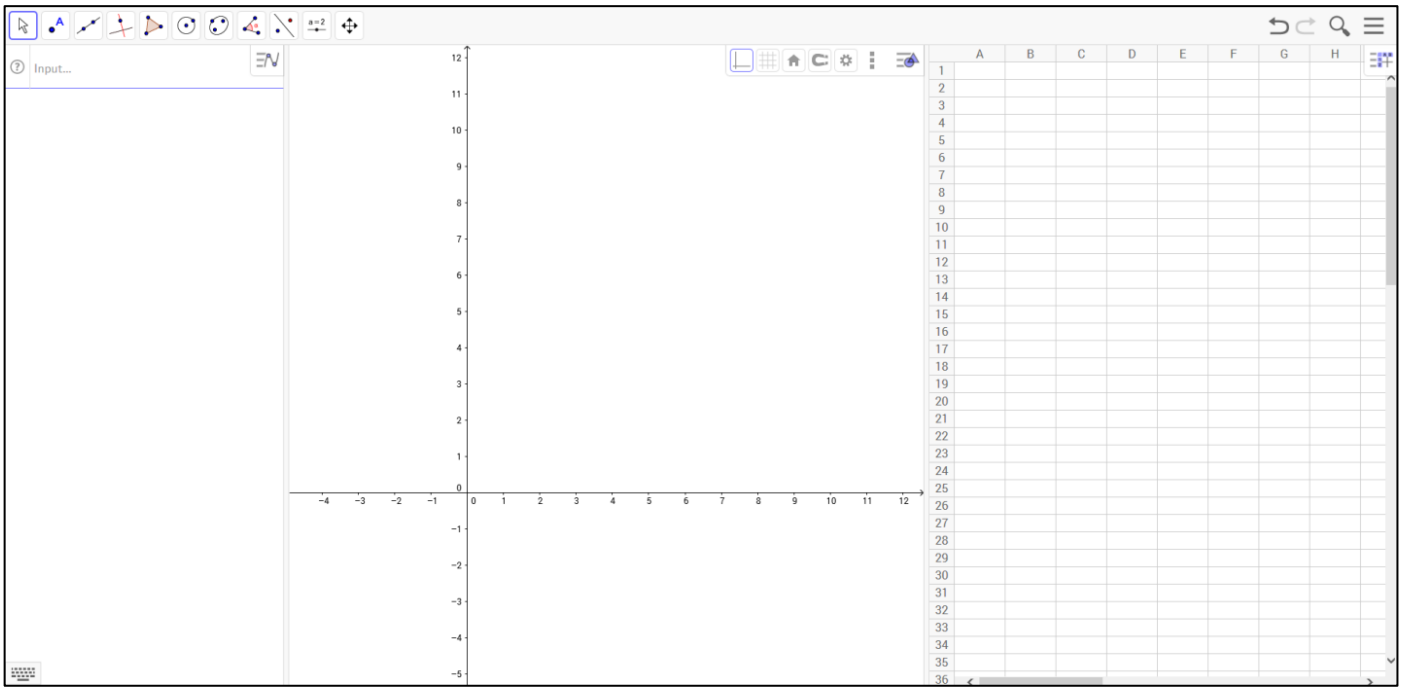
Individually (not in groups) analyze each entry and determine the student in the grade who created a shape which is the closest to being a perfect circle.

Create a report of your work. Be sure to include an introduction, an explanation of what you investigated and how you investigated it, examples of the mathematics you used, and the conclusions of your investigation. Other things you should include are:

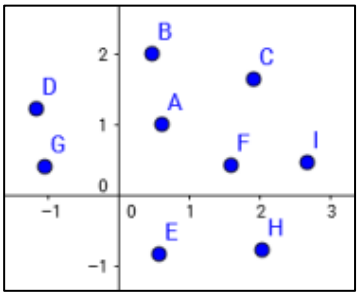
- Different students will draw different sized circles. Explain how and why this will affect results and explain how you dealt with this issue.
- If the methods you used involved doing anything “by eye” explain how you made sure you were as accurate as possible (you should try and minimize the amount of measurements done this way).

Geogebra Tutorial

Make sure that *Spreadsheet*, *Algebra* and *Graphics* are all displayed as in the screenshot below.



Select the *Point* tool and click in the *Graphics* view to create some points as in the screenshot on the right.



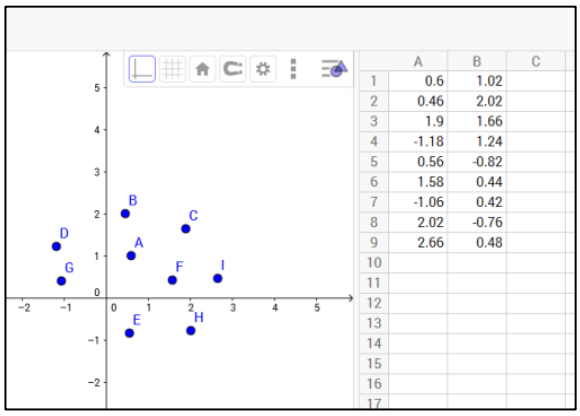
We can record the coordinates of all of this point to the spreadsheet. To do this we first need to create a list containing all of the points.

In the *Algebra* box type: `myList={A,B,C,D,E,F,G,H,I}`

Note that you can name the list anything you want, you do not have to use the name `myList`.

In the *Algebra* box type: `fillColumn[1,x(myList)]`

This will display all the *x*-coordinates of the points in the first column of the spreadsheet. See if you can determine what to type so that all of the *y*-coordinates are displayed in the second column of the spreadsheet, as in the screenshot on the right.



	A	B	C
1	0.6	1.02	
2	0.46	2.02	
3	1.9	1.66	
4	-1.18	1.24	
5	0.56	-0.82	
6	1.58	0.44	
7	-1.06	0.42	
8	2.02	-0.76	
9	2.66	0.48	

Note that your coordinates will almost certainly have different values to the ones in the screenshot.

You can now use the spreadsheet to perform calculations on these coordinates.

Criterion C: Communication in Mathematics		
Achievement Level	Level Descriptor	Task Specific Clarification
0	The student does not reach a standard described by any of the descriptors below.	
1 – 2	The student is able to: I. use **limited** mathematical language II. use **limited** forms of mathematical representation to present information III. communicate through lines of reasoning that are **difficult to interpret**	The student is able to: o attempt to explain what is being investigated and how it is being investigated o create a report that is partly able to be understood without referring to the task sheet
3 – 4	The student is able to: I. use **some appropriate** mathematical language II. use **different forms** of mathematical representation to present information **adequately** III. **communicate** through lines of reasoning that are complete IV. **adequately organize** information using a logical structure.	The student is able to: o explain what is being investigated and how it is being investigated without the reader having to refer to the task sheet o use diagrams/screenshots to complement explanations and calculations o create a report that is partly able to be understood without referring to the task sheet
5 – 6	The student is able to: I. usually **use** appropriate mathematical language II. **usually** use **appropriate** forms of mathematical representation to present information **correctly** III. **usually** move between different forms of mathematical representation IV. communicate through lines of reasoning that are **complete and coherent** V. **present** work that is **usually organized** using a logical structure.	The student is able to: o explain what is being investigated and how it is being investigated (including explanations of how any spreadsheets work) o display formulae using the equation editor o use diagrams/screenshots to complement explanations and calculations o create a report that is mostly able to be understood without referring to the task sheet o use mostly appropriate mathematical notation
7 – 8	The student is able to: I. **consistently** use **appropriate** mathematical language II. use **appropriate forms** of mathematical representation to **consistently** present information **correctly** III. move **effectively** between different forms of mathematical representation IV. communicate through lines of reasoning that are **complete**, **coherent** and **concise** V. **present** work that is **consistently organized** using a logical structure.	The student is able to: o clearly explain in his/her own words what is being investigated and how it is being investigated (including explanations of how any spreadsheets work) o display formulae clearly and accurately using the equation editor o use clear and accurate diagrams/screenshots to complement explanations and calculations o move effectively between explanations, calculations, tables and diagrams with appropriate linking sentences (the following table shows, figure 3 demonstrates, etc.) o make good use of space on the page (no unnecessary white space, items positioned thoughtfully etc.) o create a report that is able to be understood without referring to the task sheet o use appropriate mathematical notation

Criterion D: Applying Mathematics in Real Life Contexts		
Achievement Level	Level Descriptor	Task Specific Clarification
0	The student does not reach a standard described by any of the descriptors below.	
1 – 2	The student is able to: I. identify **some** of the elements of the authentic real-life situation II. apply mathematical strategies to **find a solution** to the authentic real-life situation, with **limited success**.	The student is able to: o attempt to develop a method to analyze each diagram and determine which is the closest to being a perfect circle o select some appropriate technology and methods to efficiently perform repetitive tasks
3 – 4	The student is able to: I. identify the **relevant** elements of the authentic real-life situation II. select, **with some success**, **adequate** mathematical strategies to model the authentic real-life situation III. apply mathematical strategies **to reach a solution** to the authentic real life situation IV. **discuss** whether the solution makes sense in the context of the authentic real-life situation.	The student is able to: o develop a method to analyze each diagram and determine which is the closest to being a perfect circle o attempt to explain how and why different sized circles will affect results o select some appropriate technology and methods to efficiently perform repetitive tasks
5 – 6	The student is able to: I. identify the **relevant** elements of the authentic real-life situation II. select **adequate** mathematical strategies to model the authentic real-life situation III. apply the selected mathematical strategies to **reach a valid solution** to the authentic real-life situation IV. **explain** the degree of accuracy of the solution V. **explain** whether the solution makes sense in the context of the authentic real-life situation.	The student is able to: o ensure that any measurements done "by eye" are as accurate as possible o use the definition of a circle to develop a method to analyze each diagram and determine which is the closest to being a perfect circle o explain how and why different sized circles will affect results and how the student's method of analysis deals with this o select appropriate technology and methods to efficiently perform repetitive tasks
7 – 8	The student is able to: I. identify the **relevant** elements of the authentic real-life situation II. select **appropriate** mathematical strategies to model the authentic real life situation III. apply the selected mathematical strategies **to reach a correct solution** to the authentic real life situation IV. **justify** the degree of accuracy of the solution V. **justify** whether the solution makes sense in the context of the authentic real-life situation.	The student is able to: o minimize the amount of measurements done "by eye" o ensure that any measurements done by eye are as accurate as possible o use the definition of a circle to develop a method to analyze each diagram and determine which is the closest to being a perfect circle o clearly and thoroughly explain how and why different sized circles will affect results and how the student's method of analysis deals with this o select appropriate technology and methods to efficiently perform all repetitive tasks