Do you want to build a snowman?

Teachers Teaching with Technology™
Professional Development from Texas Instruments

Teacher Notes & Answers

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TI-Nspire


Investigation


Teacher


60+ min

Context

Disney and Pixar use a range of mathematical techniques to create their animations.

https://youtu.be/_IZMVMf4NQ0

Aim

Design another version of Olaf using the functions/relations investigated in class. Your design must fit in a standard window and use at least three different equations. Discuss any strengths, limitations and assumptions throughout your investigation.

To complete this task, you must:

- use the problem-solving and mathematical modelling approach to develop your response
- respond with a range of understanding and skills, such as using mathematical language, appropriate calculations, tables of data, graphs and diagrams
- provide a response that highlights the real-life application of mathematics
- respond using a written report format that can be read and interpreted independently of the instrument task sheet
- develop a unique response
- use both analytic procedures and technology

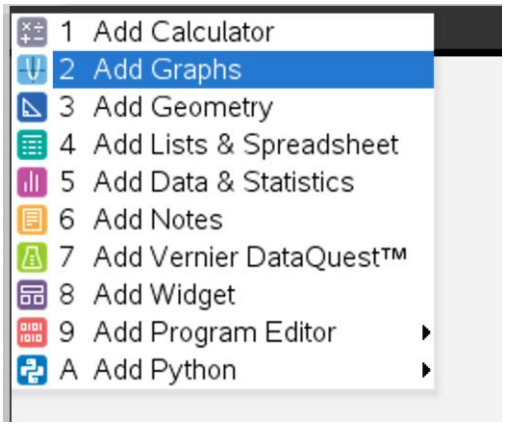
Remember to:

- Open a new graphing page
- Use the TAB button to add a new graph
- Type in the general formula for the function/relation
- Add sliders in for each co-efficient
- Ensure you put a * between the co-efficent and x
- You will find a lot of commands under the menu button, 6: Analyse Graph

Author: K. Nicholls

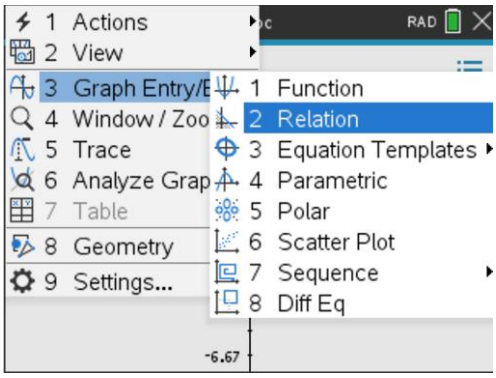
How to create sliders:

1. Start by adding a new Graph application:

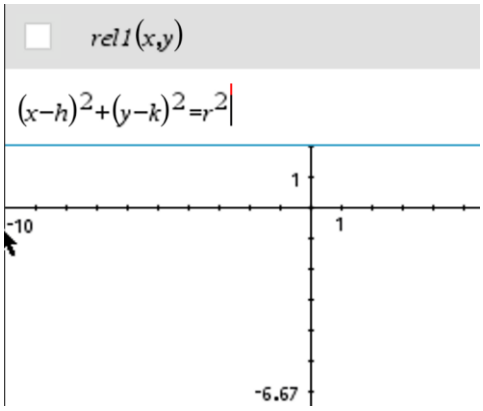


2. Add a relation by going to the Menu button – 3: Graph Entry/Edit – 2: Relation

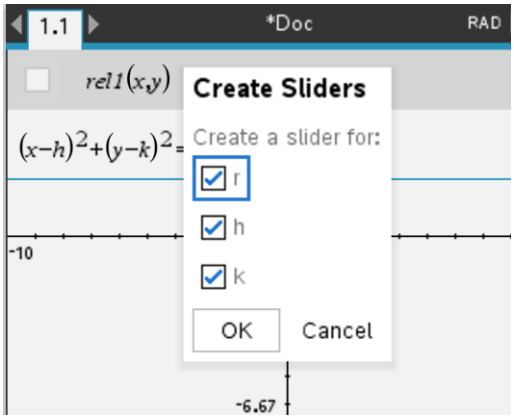
This will allow you to enter any function or relation.



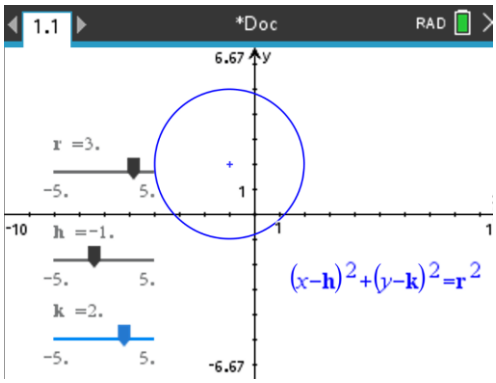
3. Enter your standard form for a circle using the keyboard and push Enter.



4. It will come up as below:



5. Now you can change the value of the sliders to see the changes each variable has on the circle.



6. To add another graph, push the Tab button and repeat the steps above for different functions.

Use the skills in this activity to build your Snowman. You could use any combination of graphs to make your Snowman unique.

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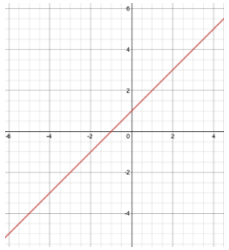
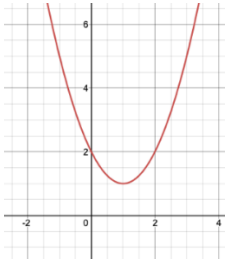
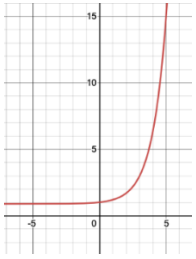
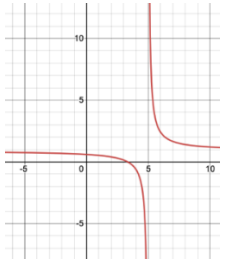
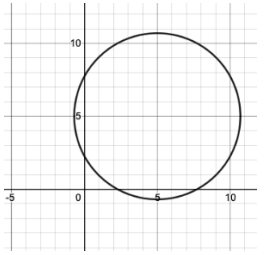
Linear Equations	Parabolic Equations	Exponential Equations	Hyperbolic Equations	Circles (Relations)
$y = mx + c$	$y = ax^2 + bx + c$ $y = a(x-h)^2 + k$	$y = ab^{x-h} + k$	$y = \frac{a}{x-h} + k$	$r^2 = (x-h)^2 + (y-k)^2$
$m =$ changes the gradient of the line If neg: down left to right If pos: up left to right	$a =$ dilates the function (makes it wider or narrower) if neg (looks like a sad face (max curve)), if pos (looks like a happy face (min curve))	$a =$ changes the reflection over the x-axis. Also changes the steepness of the function	$a =$ determines if the graph is reflected by being positive or negative. Also changes the steepness	$r =$ radius of circle
$c =$ determines where the lines intersects with the y-axis	$h =$ x co-ordinate of the turning point – translates the function left or right	$b =$ changes the reflection of the y-axis. Also changes the steepness of the function	$h =$ determines vertical asymptote	$h =$ x co-ordinate of the center of the circle
$Parallel =$ gradients are the same, however; the c value can be different	$k =$ y co-ordinate of the turning point – translates the function up or down	$h =$ moves the graph left or right	$k =$ determines horizontal asymptote	$k =$ y co-ordinate of the center of the circle
$Perpendicular =$ neg * the reciprocal of the gradient of one line	$(h, k) =$ co-ordinate of the turning point	$k =$ moves the graph up or down	$(h, k) =$ where the two asymptotes meet	$(h, k) =$ co-ordinate of the center of the circle
$Sketch$ 	$Sketch$ 	$Sketch$ 	$Sketch$ 	$Sketch$ 
$Reflection\ is\ created\ by?$ Creating a perpendicular line to the original (depends how you reflect)	$Reflection\ is\ created\ by?$ A value being positive or negative	$Reflection\ is\ created\ by?$ Values of a and b. Depends what is being reflected	$Reflection\ is\ created\ by?$ The value of a	

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Instrument-specific marking guide (ISMG)

Criterion: Formulate

Assessment objectives

1. Select, recall and use facts, rules, definitions and procedures from linear and non-linear relationships
2. Comprehend mathematical concepts and techniques drawn from linear and non-linear relationships
3. Justify procedures and decisions by explaining mathematical reasoning

The student work has the following characteristics:	Marks
• *documentation of appropriate assumptions* - *2 assumptions documented about the task (being able to model snowman with known functions/relations, complexity of task using known functions)* - *Make assumptions about the type of graph you will use for each section of your snowman* • *accurate documentation of relevant observations* - *State an observation for each equation used general form, domains and ranges observed from intersection points* • *accurate translation of all aspects of the problem by identifying mathematical concepts and techniques.* - *Method to develop each equation must be identified*	*3–4*
• *Statement of some functions.* • *Statement of some observations.* • *Translations of simple aspects of the problem by identifying mathematical concepts and techniques.*	1–2
• *Does not satisfy any of the descriptors above.*	0

Criterion: Solve

Assessment objectives

4. Select, recall and use facts, rules, definitions and procedures from linear and non-linear relationships
5. Solve problems by applying mathematical concepts and techniques drawn from linear and non-linear relationships

The student work has the following characteristics:	Marks
• *accurate use of complex procedures to reach a valid solution* - *Use of substitution to find equations* - *Use of transformations to find equations* - *Use of algebra to show intercepts for at least 3 points* • *discerning application of mathematical concepts and techniques relevant to the task* - *Suitable selection of equations used from the list: linear; quadratic, exponential, hyperbolic, circle or semi-circle.* • *accurate and appropriate use of technology.* - *Create screenshots of the development of the bag tag using the TI Nspire NON CAS calculator.*	*6–7*
• *use of complex procedures to reach a reasonable solution* • *application of mathematical concepts and techniques relevant to the task* • *use of technology.*	*4–5*
• *use of simple procedures to make some progress towards a solution* • *simplistic application of mathematical concepts and techniques relevant to the task* • *superficial use of technology.*	*2–3*
• *inappropriate use of technology or procedures.*	1
• *does not satisfy any of the descriptors above.*	0

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Criterion: Evaluate and verify

Assessment objectives

6. Evaluate the reasonableness of solutions
7. Justify procedures and decisions by explaining mathematical reasoning

The student work has the following characteristics:	Marks
• *evaluation of the reasonableness of solutions by considering the results, assumptions and observations.* - *Check whether the equations you have calculated are reasonable for the points chosen by using regression analysis, or substitution. The result is reasonable if the regression equation matches the one you calculated. If not, refine your equation by re-doing it with different points.* - *Check whether the assumption you made was the best one for those points, by testing whether another assumption may have given a better result.* • *documentation of relevant strengths and limitations of the solution and/or model.* - *A strength of the solution is if your snowman satisfies the initial brief and why + one more.* - *A limitation of the snowman is that there was a restriction about the types of relations to be used and why + one more.* • *justification of decisions made using mathematical reasoning.* - *General equations of each type of graph are shown to justify the mathematics which follows* - *Consideration of the R^2 value to support suitability of equations used after regression analysis* - *Screenshots justify graphs pass through the expected points* - *Sequential mathematical reasoning.*	*4–5*
• *statements about the reasonableness of solutions by considering the context of the task* • *statements about relevant strengths and limitations of the solution and/or model* • *statements about decisions made relevant to the context of the task.*	2–3
• *statement about a decision and/or the reasonableness of a solution.*	1
• *does not satisfy any of the descriptors above.*	0

Criterion: Communicate

Assessment objective

8. Communicate using mathematical, statistical and everyday language and conventions

The student work has the following characteristics:	Marks
• *correct use of appropriate technical vocabulary, procedural vocabulary, and conventions to develop the response* - *substitution shown* - *concise explanation linking procedures to steps in calculations* - *indices and fractions expressed correctly using equation editor* - *axes of graphs and graphs labelled* - *points used identified by coordinates or labelled (A, B etc)* - *restrictions expressed mathematically correctly* - Labelled *hand drawn sketch on grid paper* - *Screen shots showing points used for each equation.* - *Restrictions stated for each equation.* • *coherent and concise organisation of the response, appropriate to the genre, including a suitable introduction, body and conclusion, which can be read independently of the task sheet.* - *Introduction outlines the task* - *Body* - *Conclusion briefly summarises the task and draws the question together* - *Diagrams/screenshots/tables labelled appropriately* - *Diagrams drawn accurately with technology*	*3–4*
• *use of some appropriate language and conventions to develop the response* • *adequate organisation of the response.*	1–2
• *does not satisfy any of the descriptors above.*	0

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