Function Fountains Lab

Math Concept(s): Function Creation, Vertical Translation, Parabolas

Source / Text:

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Attach the following documents:

Lab Instructions-

Function Fountains Team Activity

Student Handout(s)-

PolarGraph Paper.pdf (½ inch) Scaffolding support for developing learners

Grid5mm.pdf (½ cm) Core group learners

Rubric and/or Assessment Tool-

Function Fountains Assessment

Short Description (Be sure to include where in your instruction this lab takes place):

Students will create a fountain model with paper on graph paper in the classroom and find the quadratic equation to match each parabola created by the streams of "water."

Lab Plan

Lab Title: Function Fountains

Prerequisite skills: Graphing using a calculator, introduction to parabolic formula, accuracy in measurement

Lab objectives:

- Construct a function using the vertex and parabolic formula
- Translate 3-D information into a 2-D representation
- Understand how extension of endpoints affects the vertex and consequently the coefficient

Standards:

CCSS-M:

- A-CED 1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- A-CED 2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- A-CED 3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

- F-IF 4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- F-BF 1: Write a function that describes a relationship between two quantities.
- F-BF 3: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Standards for Mathematical Practice:

- 1) Make sense of problems and persevere in solving them.
- 2) Reason abstractly and quantitatively.
- 4) Model with mathematics.
- 5) Use appropriate tools strategically
- 6) Attend to precision.
- 7) Look for and make use of structure.

State Standards addressed (2008 Washington State Mathematics Standards):

- **A1.1.A** Select and justify functions and equations to model and solve problems.
- **A1.2.D** Determine whether approximations or exact values of real numbers are appropriate, depending on the context, and justify the selection.
- **A1.3.B** Represent a function with a symbolic expression, as a graph, in a table, and using words, and make connections among these representations.
- **A1.6.A** Use and evaluate the accuracy of summary statistics to describe and compare data sets.
- **A1.6.B** Make valid inferences and draw conclusions based on data.
- **A1.6.D** Find the equation of a linear function that best fits bivariate data that are linearly related, interpret the slope and y-intercept of the line, and use the equation to make

Reading:

- Reading and following specific directions on lab sheet.

Writing:

- Accurate record keeping and written response to key questions.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☒ Think Creatively
☒ Work Creatively with Others
☒ Implement Innovations
Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
☒ Solve Problems
Communication and Collaboration
☒ Communicate Clearly
☒ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐ Access and Evaluate Information
☐ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☒ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☒ Manage Goals and Time
☐ Work Independently
☒ Be Self-Directed Learners
Social and Cross-Cultural
☒ Interact Effectively with Others
☐ Work Effectively in Diverse Teams

Productivity and Accountability
☒Manage rojects
☒Produce Results
Leadership and Responsibility
☐ Guide and Lead Others
☒ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- Centimeter Graph paper or ½ inch polar graph paper, scissors, tape, compass, TI-84 calculator, pencil, additional sheet of paper (for "streams")

Set-Up Required:

- Distribution of materials, projection of photos of fountains or video for discussion

Lab Organization Strategies:

Grouping/Leadership/Presentation Opportunities:

- Groups of three during the lesson
- Individualized for summative assessment

Cooperative Learning:

- Students are given basic materials, expectations and learning objectives and are responsible for assigning roles for each member of the team.

Expectations:

- Students will determine starting intercept and ending intercept
- Students will determine the equation of a parabola
- Students will create a 3-D model of a fountain

Timeline:

- 3 days 50 minute class hours (optional day four presentation)
    - Day one- Watch video or look at photos of fountains, discussion of perspectives, liquid architecture, build paper model

- Day two- Measurement and calculations with teacher check off, begin individual assessment
- Day three- Complete summative assessment
- Optional Day four- Presentation of summative assessments

Post Lab Follow-Up/conclusions:

Discuss real world application of learning from lab

- Fountain mapping for Vegas entertainment.
- Watering landscaping.

Career Applications

- Electronics (i.e microwave transmitters)
- Science (i.e. gravity)
- Artist
- Architect
- Engineering
- Mathematician

Optional or Extension Activities

- Measuring and calculating the equation of a parabola of a sprinkler under low pressure/high pressure
- Determine the area of the coverage of the spray under the parabola
- When standing under the fountain stream, what coefficient (a) would be optimal to stay dry?

Name_____ Period_____ Date_____

Function Fountains Team Activity

You and your group members will be creating a fountain and then finding the quadratic equation to go with your created parabolas.

Remember to use vertex form of equation for a parabola:

$y=A(x-h)^2+k$, with (h,k) being the coordinates of the vertex.

Directions:

1. Take a sheet of paper, roll it into a tube. Cut equal width strips from around the tube.

2. Plot the origin of your coordinate grid. Using a compass, draw a circle for the circumference of your fountain spray.

3. Next tape down your tube to the center of your grid, then tape downs each strip along the edge of your circle.

4. Find the intercepts of the start of your spray, and the end of your spray. Then find the vertex of your parabola.

Starting intercept:_____

Ending intercept:_____

Vertex:_____

Equation of the parabola of the spray:_____

Name_____ Period_____ Date_____

Function Fountains Assessment

You will be creating a new fountain and then finding the quadratic equation to go with your created parabolas.

Remember to use vertex form of equation for each parabola: $y=A(x-h)^2+k$

Directions:

1. Take a sheet of paper, roll it into a tube. Cut equal width strips from around the tube.
2. Plot the origin of your coordinate grid. Using a compass, draw 3 circles for the circumference of your fountain sprays.
3. Next tape down your tube to the center of your grid, then tape downs each strip along the edge of your circle.
4. When you are taping down your strips to the outside, at least 1 needs to be on each circle, for a total of three different lengths of sprays.
5. Find the intercepts of the start of your spray, and the end of your spray. Then find the vertex of your parabola.

Spray Distance 1:

Starting intercept:_____

Ending intercept:_____

Vertex:_____

Equation of the parabola of the spray:_____

Spray Distance 2:

Starting intercept:_____

Ending intercept:_____

Vertex:_____

Equation of the parabola of the spray:_____

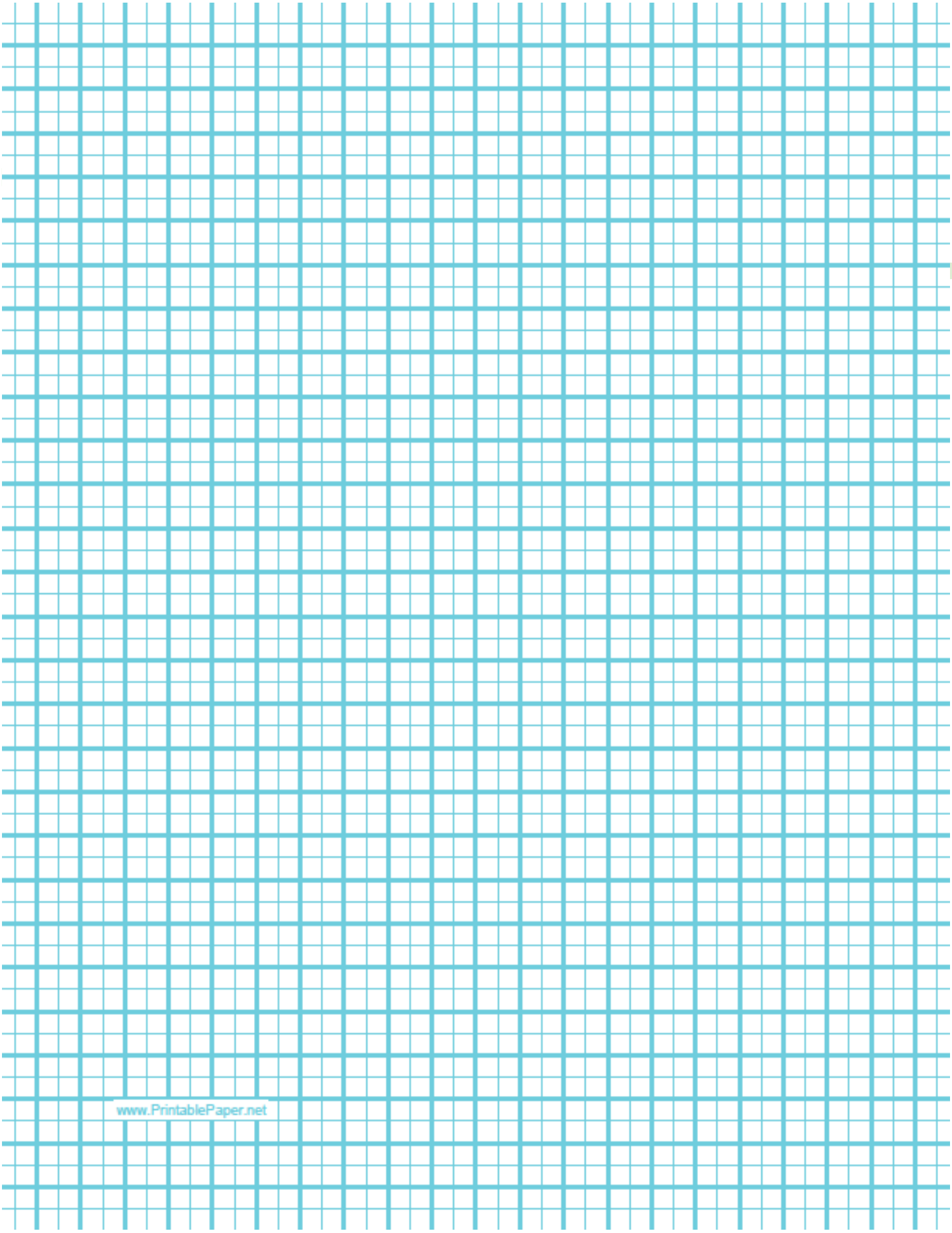
Spray Distance 3:

Starting intercept:_____

Ending intercept:_____

Vertex:_____

Equation of the parabola of the spray:_____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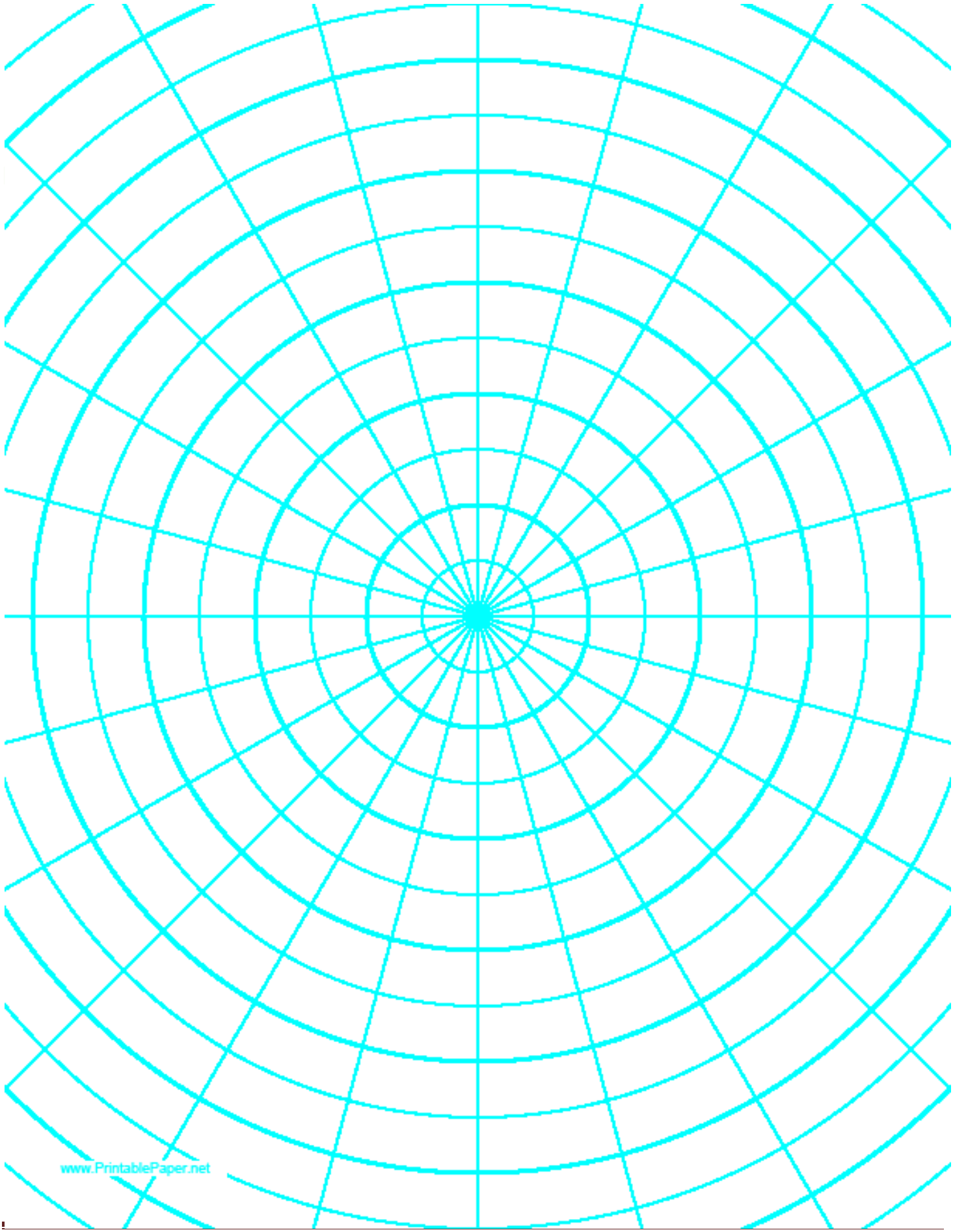
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