DEAD MAN'S CURVE

Performance Standard (9B/9C).I

Calculate the force needed to keep a car on a curve using a set of formulas and a geometric property of circles accordingly:

- *Mathematical knowledge*: know the relationships between circles, arcs, chords, tangents and secants,
- *Strategic knowledge*: use appropriate strategies to apply formulas and geometric properties of circles, and
- *Explanation*: explain completely and clearly what was done and why it was done.

Procedures

1. Provide students with sufficient learning opportunities to develop the following skills in order to (9B) identify, describe, classify, and compare relationships using points, lines, planes, and solids and (9C) construct convincing arguments and proofs to solve problems:
   - Identify relationships between circles, arcs, chords, tangents and secants, and
   - Create and critique arguments concerning geometric ideas and relationships such as properties of circles, triangles, and quadrilaterals.
2. Provide each student a copy of the "Dead Man's Curve" task sheet and the rubric. Have students review and discuss the task to be completed and how the rubric will be used to evaluate it.
3. Ask students to complete the following task in class:

   On a dangerous stretch of highway, a young man was driving when he thought he saw something on the road and jammed on the brakes. He locked all four wheels, leaving skid marks 100 feet long, stopping just short of the Dead Man's Curve. If he hadn't thought he had seen something, would he have made it around the curve? To determine if he would have made it around the curve without slowing down, use the following formulas and knowledge of geometry to answer the question:
   a. Force = Mass $*$ Acceleration
   b. Mass = Weight/force of gravity
   c. Acceleration = Velocity^2/Radius
   d. Length of skid marks = Velocity^2/(2 $*$ force of gravity $*$ coefficient of friction)

   Facts needed for this problem: The force of gravity is 32 ft/s^2 and the coefficient of friction is 1.0. The weight of the car is 3000 pounds, and the average weight of each of the four occupants of the car is 150 pounds (driver and three passengers). If conditions are at their best, as we are assuming, the force needed to keep the car in the curve will be less than or equal to the total weight of the car and occupants. At the curve, a chord of 100 feet has a middle ordinate (perpendicular bisector) of 10 feet from the outside of the curve to the chord.

4. Evaluate each student's work using all three dimensions of the rubric and its guide to determine the performance level. A4 in mathematical knowledge will require a correct answer of "no" for making it around the curve, and a calculation of force of 5538 which is less than 3600. A4 in strategic knowledge will require the correct use of the given formulas and the recall of the property of intersecting chords in a circle: $x_1 \cdot x_2 = y_1 \cdot y_2$ where $50 \cdot 50 = 10 \cdot (d-10)$ to find d and therefore find r. m=112.5, v=80, r=130, and F=112.5 (80 squared/130)=5538. A 4 in explanation will require a complete explanation of all work done and the reason for each stop.

Examples of Student Work not available

Resources

- Copies of the "Dead Man's Curve" task sheet
- Calculator
- Mathematics Rubric

Time Requirements

- One class period

NAME _____ DATE _____

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Student Task Sheet

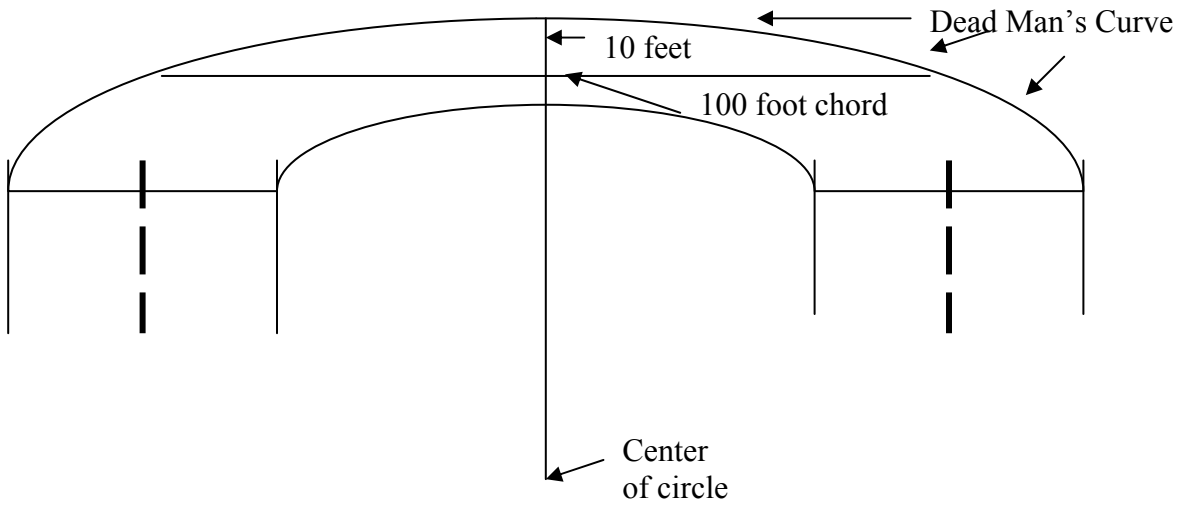
On a dangerous stretch of highway, a young man was driving when he thought he saw something on the road and jammed on the brakes. He locked all four wheels, leaving skid marks 100 feet long, stopping just short of the Dead Man's Curve. If he hadn't thought he had seen something, would he have made it around the curve?

To determine if he would have made it around the curve without slowing down, use the following formulas and knowledge of geometry to answer the question.

e. Force = Mass * Acceleration
f. Mass = Weight/force of gravity
g. Acceleration = Velocity^2/Radius
h. Length of skid marks = Velocity^2/(2 * force of gravity * coefficient of friction)

Facts needed for this problem: The force of gravity is 32 ft/s^2 and the coefficient of friction is 1.0 lbs. The weight of the car is 3000 pounds, and the average weight of each of the four occupants of the car is 150 pounds (driver and three passengers). If conditions are at their best, as we are assuming, the force in pounds, needed to keep the car in the curve will be less than or to the total weight of the car and occupants. At the curve, a chord of 100 feet has a middle ordinate (perpendicular bisector) of 10 feet from the outside of the curve to the chord. See figure.

Show all work needed to answer the question and write in words what you did and why you did each step.



Adapted from "Math for a World that Rocks, St. Ignatius College Prep, Chicago, 1995, pp. 22-23.