Name: _____ Date: _____

The Nine-Inch Pan Problem

Circle group

A cake recipe needs an 8-inch round pan. The only round pan in the cupboard is 9 inches wide. One inch seems like a tiny difference. So a baker might just pour in the batter. The cake comes out flat and a bit dry. Math tells us why.

The width of a circle is called its diameter. But the batter covers the bottom of the pan. That is the area. The area of a circle depends on the radius times itself. The radius is half of the diameter. The formula is pi times the radius times the radius. Pi is about 3.14.

The 8-inch pan has a radius of 4 inches. Its area is about 3.14 times 16. That is around 50 square inches. The 9-inch pan has a radius of 4.5 inches. Its area is about 3.14 times 20.25. That is around 64 square inches. The pan is only 12.5 percent wider. But its bottom is more than 25 percent bigger.

So the same batter spreads over a bigger floor. The cake is thinner. A thin layer heats through fast. It may finish sooner. It can dry out if it stays in the full time. A baker who knows this checks the cake early.

The same idea works for any shape. When every length doubles, the area becomes four times as big.

Questions

1. How wide is the pan the recipe needs?

_____

_____

2. What is the formula for the area of a circle?

_____

_____

3. About how big is the bottom of the 9-inch pan?

_____

_____

4. What is a radius?

_____

_____

5. Why is the cake thinner in the bigger pan?

_____

_____

6. Why might a baker check the cake early in the 9-inch pan?

_____

_____

Words to know

diameter: the distance straight across a circle through its center
radius: the distance from the center of a circle to its edge
batter: a runny mix of flour and other foods used for baking
formula: a rule written with numbers or letters
layer: one flat level of something

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

The Nine-Inch Pan Problem

Triangle group

A cake recipe calls for an 8-inch round pan, but the only round pan in the cupboard is 9 inches wide. One inch seems like a tiny difference, so a baker might just pour the batter in. The cake comes out flat and a little dry, and the math explains why.

The width of a circle, called its diameter, is only part of the story. What the batter covers is the area of the bottom, and the area of a circle depends on the square of its radius, which is half the diameter. The formula is pi times the radius times the radius. Pi is about 3.14.

For the 8-inch pan, the radius is 4 inches, and the area is about 3.14 times 16, or around 50 square inches. For the 9-inch pan, the radius is 4.5 inches, and the area is about 3.14 times 20.25, or around 64 square inches. The pan is only 12.5 percent wider, yet its bottom is more than 25 percent larger.

So the same amount of batter is spread over a bigger floor, making a thinner cake. A thinner layer heats through faster, so it often finishes baking sooner and can dry out if it is left in for the full time. A baker who knows this watches the oven earlier, perhaps testing the cake a few minutes ahead of schedule.

The same idea applies whenever a shape grows. When every length doubles, the area becomes four times as large, which is why pizza sizes are such good deals for bigger eaters.

Questions

1. How wide is the pan the recipe calls for?

_____

_____

2. What is the formula for the area of a circle in the passage?

_____

_____

3. About how large is the bottom of the 9-inch pan?

_____

_____

4. What is a radius?

_____

_____

5. Why does the cake come out thinner in the larger pan?

_____

_____

6. Why might a baker check the cake earlier in the 9-inch pan?

_____

_____

Words to know

diameter: the distance straight across a circle through its center
radius: the distance from the center of a circle to its edge
batter: a runny mix of flour and other foods used for baking
formula: a rule written with numbers or letters
layer: one flat level of something

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

The Nine-Inch Pan Problem

Square group

A cake recipe specifies an 8-inch round pan, but the only round pan available in the cupboard measures 9 inches across. A single inch appears to be a trivial difference, so a baker might simply pour the batter into the larger pan and proceed. The cake emerges flat and slightly dry, and the mathematics of circles explains the reason.

The width of a circle, known as its diameter, tells only part of the story. What the batter actually covers is the bottom of the pan, which is its area, and the area of a circle depends on the square of its radius, meaning half of the diameter. The formula is pi multiplied by the radius multiplied by the radius, where pi is approximately 3.14.

For the 8-inch pan, the radius is 4 inches, so the area is about 3.14 times 16, or roughly 50 square inches. For the 9-inch pan, the radius is 4.5 inches, so the area is about 3.14 times 20.25, or roughly 64 square inches. The larger pan is only 12.5 percent wider, yet its bottom is more than 25 percent larger.

Consequently, the same quantity of batter is spread across a much broader floor, producing a thinner cake. A thinner layer heats through more rapidly, so it frequently finishes baking sooner and can become dry if it is left in the oven for the full recommended time. A baker who understands this will check the oven earlier, perhaps testing the cake a few minutes ahead of schedule.

The identical principle applies whenever a shape grows. When every length doubles, the area becomes four times as large, which is why larger pizzas are such good bargains for hungry eaters.

Questions

1. What size pan does the recipe specify?

_____

_____

2. What is the formula for the area of a circle given in the passage?

_____

_____

3. Roughly how large is the bottom of the 9-inch pan?

_____

_____

4. How does the passage define a radius?

_____

_____

5. Why does the cake turn out thinner in the larger pan?

_____

_____

6. Why might a baker test the cake early when using the 9-inch pan?

_____

_____

Words to know

diameter: the distance straight across a circle through its center
radius: the distance from the center of a circle to its edge
batter: a runny mix of flour and other foods used for baking
formula: a rule written with numbers or letters
layer: one flat level of something

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

For the teacher: The Nine-Inch Pan Problem

Each student sheet carries a shape, not a level. The same topic and facts, written three ways.

Circle: The Nine-Inch Pan Problem

Easier · 211 words · Flesch-Kincaid grade 3

1. 8 inches.
2. Pi times the radius times the radius.
3. About 64 square inches.
4. Half of the diameter, or half the width of a circle.
5. The same batter spreads over a bigger floor.
6. A thin layer heats through fast and can dry out if baked the full time.

Triangle: The Nine-Inch Pan Problem

This passage · 246 words · Flesch-Kincaid grade 7.2

1. 8 inches.
2. Pi times the radius times the radius.
3. About 64 square inches.
4. Half of the diameter, or half the width of a circle.
5. The same amount of batter is spread over a bigger floor.
6. A thinner layer heats through faster and can dry out if baked the full time.

Square: The Nine-Inch Pan Problem

Harder · 270 words · Flesch-Kincaid grade 10.2

1. An 8-inch round pan.
2. Pi multiplied by the radius multiplied by the radius.
3. Roughly 64 square inches.
4. Half of the diameter, which is half the width of a circle.
5. The same quantity of batter is spread across a much broader floor.
6. A thinner layer heats through more rapidly and can become dry if baked for the full time.