SCHOLASTIC

THE *Try Your* HARDEST MATH PROBLEM
GRADE 6

At Sunny Middle School, Ms. Addison's class is investigating how greenhouse gases (GHGs) contribute to global climate change. They wrote their research on note cards:

- Greenhouse gases cause climate change by trapping heat on the planet.
- Greenhouse gases contribute to smog and air pollution, which can cause respiratory diseases, like asthma.
- Extreme weather, disruptions to the food supply, and increased wildfires are also caused by greenhouse gases.
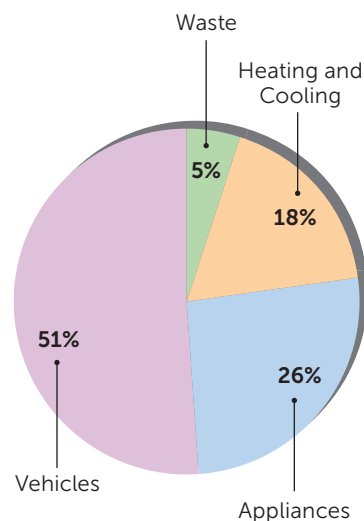
"Where do greenhouse gases come from?" Mia asked.

"One of the most common greenhouse gases is carbon dioxide, also known as CO_2. People release CO_2 into the atmosphere when we burn fossil fuels (like coal and natural gas) for energy and transportation," Ms. Addison answered.

The class examined the graph to the right. The source for the largest percentage of CO_2 emissions for a typical household was vehicles. The students conducted some research and found:

> Highway vehicles release about 1.7 billion tons of GHGs each year.
> Each gallon of gasoline burned creates 20 pounds of GHG.
> A typical vehicle releases 6 to 9 tons of GHG into the atmosphere each year.

Sources of CO_2 Emissions for a Typical Household

Waste 5%
Heating and Cooling 18%
Appliances 26%
Vehicles 51%

Solve the Problem

For their group project, Mia and Ichiro researched hybrid cars that combine gas and an electric motor. "Awesome, so it consumes less fuel and emits less CO_2 into the environment," Ichiro said. Mia found the following information comparing a 2021 gasoline car with the hybrid version.

	Gasoline Car	Hybrid Car
Price	$21,250	$24,125
Gas Mileage in MPG (miles per gallon)	38 MPG on highways 30 MPG in cities	48 MPG on highways 55 MPG in cities

In the first year of driving the hybrid car, a family drives 1,000 miles per month with a ratio of highway to city miles of 2:3. They're looking forward to using less gas this year with their new hybrid car! Assuming it costs $2.454 on average per gallon for gas, how much money should the family plan to spend on gas to drive the hybrid car for a year? Please round all work to the thousandths place when working out solutions with final answers rounded to the nearest hundredth.

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■ S C H O L A S T I C

THE *Try Your* HARDEST MATH PROBLEM
CHALLENGE 1 ANSWER KEY—GRADE 6

Although each problem has one correct numeric solution, there are multiple pathways students can take to arrive at the answer. Teachers, if your students answered Challenge 1 correctly, they are invited to enter Challenge 2! Get the Challenge 2 materials at **scholastic.com/hardestmathcontest**.

Step 1: I know that the family drives 1,000 miles a month. In one year, the total number of miles driven would be 1,000 miles x 12 months, which is 12,000 miles.

Step 2: I need to figure out the total number of miles driven on the highway as well as the city. The ratio of highway to city miles is 2 to 3. The ratio means that for every 2 highway miles driven, a person drives 3 miles in a city. However many miles a person drives, I know there will be a constant proportional relationship between the highway and city miles. In order to keep the relationship constant, I need to use the same multiplier on both numbers in the ratio. I'll call that unknown number x. That means the number of highway miles driven is actually $2x$ and the number of city miles driven is $3x$. Now I can solve for x since I know the total amount of miles driven (12,000), so x's value is the only unknown.

$$2x + 3x = 12,000 \text{ miles}$$
$$5x = 12,000 \text{ miles}$$
$$x = 2,400 \text{ miles}$$

Step 3: I substitute $x = 2,400$ miles into $2x$ and $3x$ to find the actual miles driven for each location.

$$2(2,400) = 4,800 \text{ highway miles}$$
$$3(2,400) = 7,200 \text{ city miles}$$

Step 4: I need to find out how many gallons were used on gas on both the highway and the city. To find this, I can divide the total miles for each by the number of miles the car gets per gallon. On the highway, the car gets 48 miles per gallon. In the city, the car gets 55 miles per gallon.

Highway: 4800/48 = 100 gallons

City: 7200/55 = 130.909 gallons

Step 5: I need to find out how much I spent on gas by multiplying the number of gallons by the price per gallon.

Highway: 100 x $2.454 = $245.40

City: 130.909 x $2.454 = $321.25

Step 6: I then find the total amount of money spent by adding up the amount spent on both highway and city miles.

$245.40 + $321.25 = $566.65

Final Answer: The family should plan to spend **$566.65** on gas to drive the hybrid car for a year.

Note: If the step of multiplying by the 12 months of a year was completed at the end of the calculation process instead of the beginning, the final answer becomes **$566.64** due to the results of rounding. Both answers are acceptable.

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THE *Try Your* ✓ HARDEST MATH PROBLEM
GRADE 7

At Sunny Middle School, Ms. Addison's class is investigating how greenhouse gases (GHGs) contribute to global climate change. They wrote their research on note cards:

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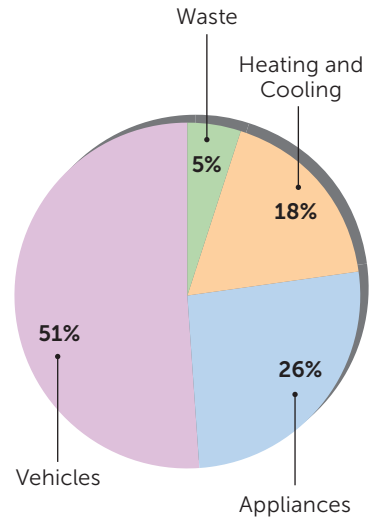
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"One of the most common greenhouse gases is carbon dioxide, also known as CO_2. People release CO_2 into the atmosphere when we burn fossil fuels (like coal and natural gas) for energy and transportation," Ms. Addison answered.

The class examined the graph to the right. The source for the largest percentage of CO_2 emissions for a typical household was vehicles. The students conducted some research and found:

- > Highway vehicles release about 1.7 billion tons of GHGs each year.
- > Each gallon of gasoline burned creates 20 pounds of GHG.
- > A typical vehicle releases 6 to 9 tons of GHG into the atmosphere each year.

Sources of CO_2 Emissions for a Typical Household

Waste
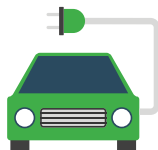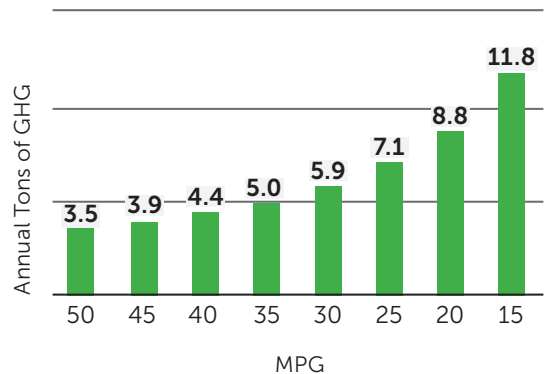Heating and Cooling
5%
18%
51%
26%
Vehicles
Appliances

Solve the Problem

For their group project, Mia and Ichiro researched hybrid cars that combine gas and an electric motor. "Awesome, so it consumes less fuel and emits less CO_2 into the environment," Ichiro said.

"While hybrid cars are better for the environment, I'm seeing that some people are hesitant to buy one because of the higher purchase price," Mia noted.

They found the graph to the right, which shows the miles per gallon (MPG) and the annual tons of GHG produced by 8 different types of cars. If each gallon of gasoline burned created 20 pounds of GHG, and the price of gasoline was $2.454 per gallon, how much money was saved annually on gas by the car that got 40 miles per gallon when compared to the car that got 20 miles per gallon? Provide your answer to the hundredths place. Note: 1 ton = 2,000 pounds.

Reduce your greenhouse gas emissions by choosing a car with better gas mileage.

Annual Tons of GHG

MPG	50	45	40	35	30	25	20	15
Annual Tons of GHG	3.5	3.9	4.4	5.0	5.9	7.1	8.8	11.8

MPG

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THE ˅HARDEST MATH PROBLEM
CHALLENGE 1 ANSWER KEY—GRADE 7

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To compare cost, you need to find the amount spent on gas for each car.

Step 1: Looking at the chart, you can see that the car averaging 40 mpg emitted 4.4 annual tons of GHG.

Step 2: Since 1 ton = 2,000 pounds, convert 4.4 tons into pounds by multiplying by 2,000.

   4.4 x 2,000 = 8,800 pounds GHG

Step 3: Since 1 gallon of gas emitted 20 pounds of GHG, divide the pounds of GHG by 20 to find the number of gallons of gas that emitted that amount of GHG.

   8,800/20 = 440 gallons of gas.

Step 4: Multiply the gallons of gas by $2.454, the price of gas per gallon, to find out how much was spent on gas.

   440 x $2.454 = $1,079.76

Step 5: To find out how much money was saved compared to the car that averaged 20 mpg, we need to repeat the first 4 steps to figure out how much money was spent on gas. Looking at the chart, the car that averaged 20 mpg emitted 8.8 annual tons of gas.

Step 6: Repeat steps 2, 3, and 4 using 8.8 annual tons to figure out how much was spent on gas for the car.

   8.8 x 2,000 = 17,600 pounds GHG
   17,600/20 = 880 gallons of gas
   880 x $2.454 = $2,159.52

Step 7: Find the difference in the two amounts spent on gas.

   $2159.52 − $1,079.76 = $1,079.76

Final Answer: $1,079.76 was saved annually on gas for the car that averaged 40 miles per gallon compared to the car that averaged 20 miles per gallon.

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THE *Try Your* HARDEST MATH PROBLEM
GRADE 8

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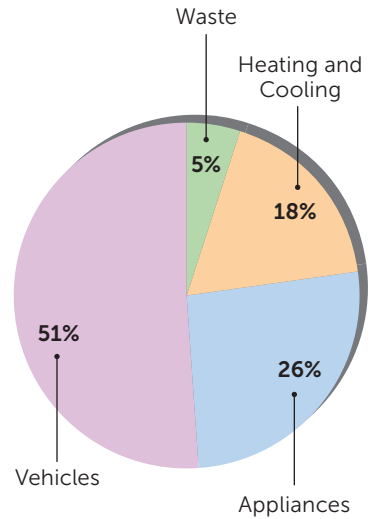
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Sources of CO_2 Emissions for a Typical Household

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Heating and Cooling
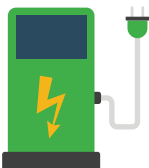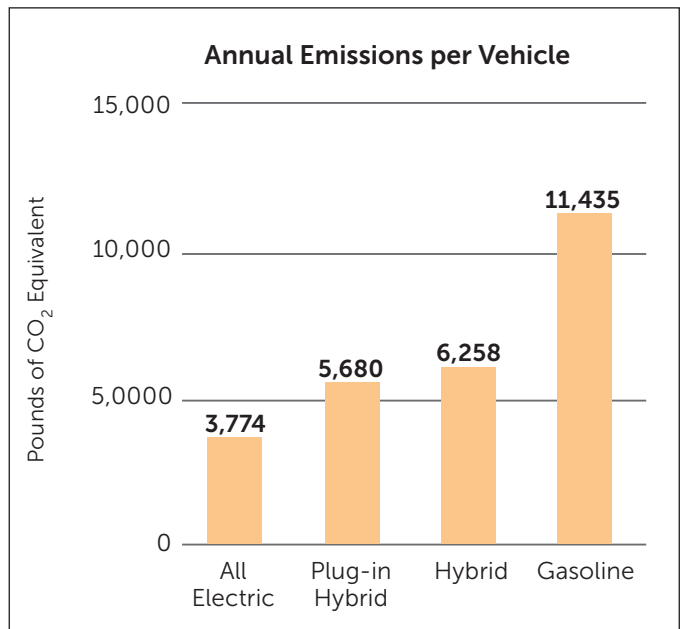5%
18%
51%
26%
Vehicles
Appliances

Solve the Problem

While researching, Ichiro found that a gasoline car can drive 210,000 miles on average over its lifetime (period of time a car can operate). A plug-in hybrid car can drive a lifetime of 300,000 miles.

Consider two families that each drive 15,000 miles a year for the lifetime of the car—one with a gasoline car and the other with a plug-in hybrid.

What is the percent decrease for the pounds of CO_2 that the plug-in hybrid car would emit over its lifetime as opposed to the gasoline car? Round your final percentage to the nearest integer.

Annual Emissions per Vehicle

Pounds of CO_2 Equivalent

15,000

10,000

5,0000

0

3,774	5,680	6,258	11,435
All Electric	Plug-in Hybrid	Hybrid	Gasoline

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Try Your

THE ᵛHARDEST MATH PROBLEM
CHALLENGE 1 ANSWER KEY—GRADE 8

Although each problem has one correct numeric solution, there are multiple pathways students can take to arrive at the answer. Teachers, if your students answered Challenge 1 correctly, they are invited to enter Challenge 2! Get the Challenge 2 materials at **scholastic.com/hardestmathcontest**.

Step 1: The data in the graph is annual data. I need to figure out how many years it will take each car to reach its life span.

Gasoline Car: 210,000/15,000 = 14 years

Plug-In Hybrid Car: 300,000/15,000 = 20 years

Step 2: Once we know the number of years each car will be driven, we can figure out the total pounds of CO_2 emitted.

Gasoline Car: 14 yrs x 11,435 lbs = 160,090 lbs

Plug-In Hybrid Car: 20 yrs x 5,680 lbs = 113,600 lbs

Step 3: Before I can find the percent decrease between the two vehicles, I first need to find the difference between the two cars' pounds of CO_2 emissions. I set up this equation:

160,090 lbs (gasoline car) − 113,600 lbs (hybrid car) = 46,490 lbs of difference in emissions

Step 4: Next, following the formula for percent change, I divide the difference of 46,490 lbs by the amount of emissions from the higher-emitting car, the gasoline car. I need to use the gasoline car's emissions here, as opposed to the hybrid, in order to find how much emissions have decreased from the car that emits more.

46,490 / 160,090 = 0.290399....

Step 5: Since the question asked for the answer to be provided as a percentage to the nearest integer, I multiply the decimal by 100 to convert it to a percentage and round it to 29%.

Final Answer: The percent decrease for the pounds of CO_2 that the plug-in hybrid car would emit in contrast to the gasoline car is **29%** (or -29% change).