

Try Your THE HARDEST MATH PROBLEM GRADE 8

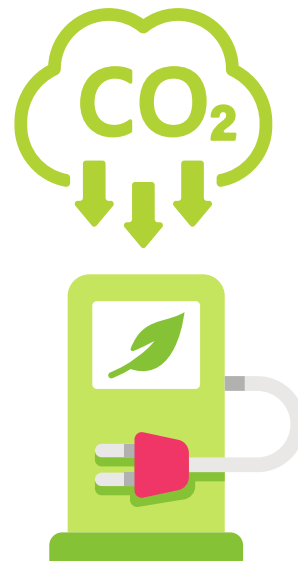
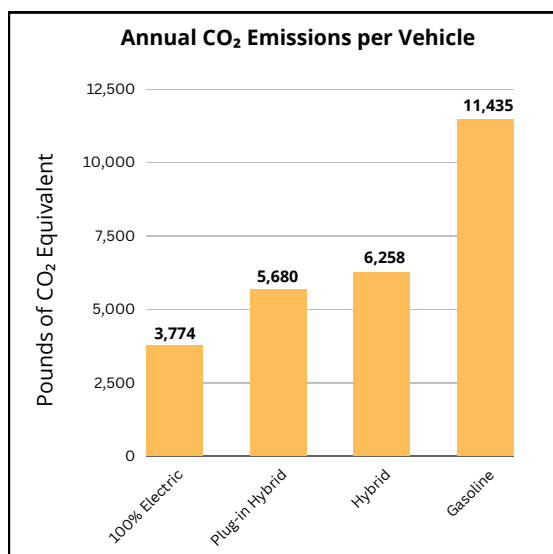
After learning how carbon dioxide (CO₂) emissions cause climate change, Ruben joined up with his friends at Sunny Middle School to form the Climate Crew.

"Burning fossil fuels, like gasoline for cars, is one of the ways humans are releasing a dangerous amount of CO₂ into the environment," Mia said at the first meeting.

"How can we tackle this in our neighborhood?" Ruben wondered.

Solve the Problem

Ruben was intrigued by a graph that Liam found regarding the annual CO₂ emissions of four different types of vehicles. "I wonder if the different annual emissions of these various types of vehicles impacts which cars are sold," he said. "I'll check with a local car dealer."



Ruben discovered that 90% of the local car dealership's sales were gasoline vehicles and the remaining 10% of the sales were equally distributed among the other three types of vehicles. He also found out that the average number of cars sold per month at the car dealership is 240 vehicles. Then, Ruben calculated the annual pounds of CO₂ emissions that would be produced by those 240 cars sold at the current proportions.

Ruben shared the emissions data and his calculations with the owner of the car dealership. "Wow, thanks, Ruben!" the owner said. "You've inspired me to set a goal to move an additional 10% of **total** car sales from the gasoline category to the other types of cars. Then, I'll keep the sales percentages for the other types of cars equally distributed among the three types."

The owner asked Ruben to calculate the percent decrease in annual CO₂ emissions that would result from achieving the goal percentages. **Compared to the current average monthly sales, what will be the percent decrease in annual pounds of CO₂ emissions produced by 240 vehicles sold in one month if the dealership successfully meets its goal? Answer to the nearest whole percent.**

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CHALLENGE 2 ANSWER KEY – GRADE 8

Although each problem has one correct numeric solution, there are multiple pathways students can take to arrive at the answer.

Sample Solution

Step 1: Using the total of 240 new car sales in one month and the current sales percentages, find the number of each type of car sold by the dealership in one month.

- Number of gasoline cars sold, g : $g = 240 \text{ cars} \times 0.9 \rightarrow g = 216 \text{ gasoline cars}$
- Number of non-gasoline cars sold, h : $h = 240 \text{ cars} \times 0.1 \rightarrow h = 24 \text{ non-gasoline cars}$
- Number of each type of non-gasoline cars sold, k :
 $k = 24 \text{ non-gasoline cars} \div 3 \text{ types} \rightarrow k = 8 \text{ of each type of non-gasoline car}$

Step 2: Get the total annual emissions of these 240 cars, e .

$$\begin{aligned}
 e &= (11,435 \text{ lbs of CO}_2 \text{ equivalent} \times 216 \text{ gasoline cars}) \\
 &\quad + (6,258 \text{ lbs of CO}_2 \text{ equivalent} \times 8 \text{ hybrid cars}) \\
 &\quad + (5,680 \text{ lbs of CO}_2 \text{ equivalent} \times 8 \text{ plug-in hybrid cars}) \\
 &\quad + (3,774 \text{ lbs of CO}_2 \text{ equivalent} \times 8 \text{ cars that are 100\% electric}) \\
 e &= 2,469,960 \text{ lbs} + 50,064 \text{ lbs} + 45,440 \text{ lbs} + 30,192 \text{ lbs} \\
 e &= 2,595,656 \text{ lbs of CO}_2 \text{ equivalent}
 \end{aligned}$$

Step 3: Find the owner's goal for percentage of sales for each type of car.

- Goal percentage of new car sales for gasoline cars, q :
 $q = 90\% \text{ of new car sales} - 10\% \rightarrow q = 80\% \text{ of new car sales for gasoline cars}$
- Goal percentage of new car sales for non-gasoline cars collectively, r :
 $r = 100\% - 80\% \text{ gasoline cars} \rightarrow r = 20\% \text{ of new car sales for non-gasoline cars}$

Step 4: Using the total of 240 new car sales in one month, calculate the number of each type of car that would be sold at the goal sales percentages.

- Number of gasoline cars, s : $s = 240 \text{ cars} \times 0.8 \rightarrow s = 192 \text{ gasoline cars}$
- Number of non-gasoline cars, t : $t = 240 \text{ cars} \times 0.2 \rightarrow t = 48 \text{ non-gasoline cars}$
- Number of each type of non-gasoline cars, v :
 $v = 48 \text{ non-gasoline cars} \div 3 \text{ types} \rightarrow v = 16 \text{ of each type of non-gasoline car}$

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(...sample solution continued...)

Step 5: Get the total annual emissions of these 240 cars, f .

$$\begin{aligned} f &= (11,435 \text{ lbs of CO}_2 \text{ equivalent} \times 192 \text{ gasoline cars}) \\ &+ (6,258 \text{ lbs of CO}_2 \text{ equivalent} \times 16 \text{ hybrid cars}) \\ &+ (5,680 \text{ lbs of CO}_2 \text{ equivalent} \times 16 \text{ plug-in hybrid cars}) \\ &+ (3,774 \text{ lbs of CO}_2 \text{ equivalent} \times 16 \text{ cars that are 100\% electric}) \end{aligned}$$

$$\begin{aligned} f &= 2,195,520 \text{ lbs} + 100,128 \text{ lbs} + 90,880 \text{ lbs} + 60,384 \text{ lbs} \\ f &= 2,446,912 \text{ lbs of CO}_2 \text{ equivalent} \end{aligned}$$

Step 6: Get the difference, d , in annual emissions for the 240 cars sold in one month at the current percentages and the goal percentages.

$$\begin{aligned} d &= e - f \\ d &= 2,595,656 \text{ lbs of CO}_2 \text{ equivalent} - 2,446,912 \text{ lbs of CO}_2 \text{ equivalent} \\ e &= 148,744 \text{ lbs of CO}_2 \text{ equivalent} \end{aligned}$$

Step 7: Translate the difference in annual emissions into a percentage.

$$\begin{aligned} \frac{148,744 \text{ lbs}}{2,595,656 \text{ lbs}} &= \frac{p}{100} \\ 2,595,656p &= 14,874,400 \\ p &= 14,874,400 \div 2,595,656 \\ p &= 5.73\% \end{aligned}$$

FINAL ANSWER: As compared to the current sales, there would be a **6% decrease (or -6% change)** in annual CO₂ emissions by 240 cars sold in one month if the dealership successfully meets its goal.