

Let's walk through calculating the number of atoms in 1 gallon of gasoline. Assume the molecular formula for gasoline is  $C_6H_{14}$  and the density of gasoline is 0.85 grams/milliliter.

First, let's convert from gallons of gasoline to milliliters of gasoline.

1 gallon of gasoline = 3785.41 milliliters  
of gasoline

How many milliliters of gasoline do we  
have in one gallon?

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of gasoline

How many milliliters of gasoline do we  
have?

We have one gallon, and so we have  
3785.41 milliliters of gasoline.

We have 3785.41 milliliters of gasoline, and we are told that the density of gasoline is 0.85 grams/milliliter. Let's use this information to calculate the number of grams of gasoline we have.

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$$(0.85 \text{ g/mL}) \times (3785.41 \text{ mL}) \\ = \\ 3217.5985 \text{ grams of gasoline}$$

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The subscript of the C (Carbon) in the gasoline molecule is 6, and this is the number of carbon atoms in a single molecule of gasoline.

Answer: 6

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The subscript of the H (hydrogen) in the gasoline molecule is 14, and this is the number of hydrogen atoms in a single molecule of gasoline.

Answer: 14

Now that we know that there are 6 carbon atoms and 14 hydrogen atoms per molecule of  $C_6H_{14}$  (gasoline), we can use the periodic table to calculate the mass in grams of a mole of gasoline. What is the mass in grams of a mole of gasoline?

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$$\begin{aligned} & ( 6 \text{ Carbon atoms} ) \times ( 12.011 \text{ grams/mole} ) \\ & \quad + \\ & ( 14 \text{ hydrogen atoms} ) \times ( 1.0079 \text{ grams/mole} ) \\ & \quad = \\ & 86.1766 \text{ grams/mole of gasoline} \end{aligned}$$

Previously we found that there are 3217.5985 grams in the 1 gallon of gasoline that we have.

We have also found that there are 86.1766 grams/mole of gasoline molecules.

Use this information to find the number of moles of gasoline molecules we have.

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$$( 3217.5985 \text{ grams} ) / ( 86.1766 \text{ grams/mole} ) =$$

37.3373 moles of gasoline molecules

*Note: This answer is rounded. You should keep all of the digits in your calculator.*

We now know there are 33.3373 moles of gasoline molecules in one gallon of gas.

A mole of molecules is defined as  $6.02 \times 10^{23}$  molecules.

Use this information to determine the number of molecules we have in a gallon of gasoline.

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Use this information to determine the number of molecules we have in a gallon of gasoline.

$$(37.3373 \text{ moles}) \times (6.02 \times 10^{23} \text{ molecules/mole}) \\ = \\ 2.25 \times 10^{25} \text{ molecules}$$

*Note: This answer is rounded. You should keep all of the digits in your calculator.*

We now know there are  $2.25 \times 10^{25}$  gasoline molecules in one gallon of gas. The molecular formula for gasoline is  $C_6H_{14}$ .

Use this information to calculate the number of atoms in one gallon of gasoline.

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Use this information to calculate the number of atoms in one gallon of gasoline.

The molecular formula for gasoline tells us that there are 6 Carbon atoms and 14 hydrogen atoms per gasoline molecule. Thus, there are 20 atoms per gasoline molecule.

$$\begin{aligned} & ( 2.25 \times 10^{25} \text{ molecules} ) \times ( 20 \text{ atoms/molecule} ) \\ & = \\ & 4.50 \times 10^{26} \text{ atoms} \end{aligned}$$