

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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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 6.02×10^{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 2.25×10^{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.

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