

Name: _____

Date: _____

Lab -TI-Nspire™ Chemistry-methane-percentage composition

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DEG APPRX REAL

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Goal: Analyze the percent composition of elements in methane, CH₄.

Step 1: Background information and data

Just like knowing the correct proportions of ingredients in cooking, it is important to know the ratios of elements in a compound. In forensics, the ratios of elements in a compound give many clues about the identity of an unknown substance which can be investigated by using spectroscopy and other identification techniques.

Additionally, the makeup of a compound can affect its spatial configuration and therefore its polarity or lack thereof.

An abbreviated periodic table:

1					
H					
1					
	6	7	8	9	10
	C	N	O	F	Ne
	12	14	16	18	20

I am using amu (atomic mass units) as a reflection of protons and neutrons per atom as compared with grams per mole in this exercise.

In finding the atomic mass of **methane, CH₄**, we can start this way:

Element	# atoms	amu/atom	amu for this element in the compound
C	= 1	x 12	= 12 amu
H	= 4	x 1	= 4 amu

16 amu per unit of **CH₄**

Next, to find the percentage composition of **methane, CH₄**, we will divide the total mass of each element by the total mass of the compound, **CH₄**.

Element	amu element/amu compound	elemental % of total mass
C	= 12/16 = .75	x 100 = 75% C
H	= 4/16 = .25	x 100 = 25% H

We will analyze this data on the Nspire.

Step 2: Data analysis

Graphical analysis of data from percentage composition tables above:

Home

New Document

(If it says do you want to save 'Unsaved Document'? Tab to No and Click.)

Add Lists and Spreadsheets

Click

Use the navpad to go to the A cell and type **methane**. This defines our data. Use the navpad to go to the first data cell 1 below.

In the data cells below (identified by the numbers to the left) we will enter the elemental data in total amu for each element in **methane**. In this case the total amu for carbon in **methane** is **12** and the total amu for **hydrogen** is **4** amu.

Type **c** in the first **12** numbered cells using navpad down after each entry. Type **h** in cells **13-16** using the same procedure.

Control and Home

Page Layout, navpad right

Select Layout, click

Layout 2

Click

Control and Tab to go to right panel.

Let's tell the right panel what to do.

Menu

Data and Stats

Click

Check out the scatter plot.

Use the navpad to move the arrow to the bottom of the screen and click on the box. Select **methane** and Click.

This is a dot plot of the amu for **carbon** and **hydrogen** in **methane**.

We will now copy the page so that we can modify it.

Control navpad up (takes us to thumbnail sketches of screens).

Control and Menu

Copy, click

Control and Menu

Paste, click

Control navpad down (returns us to a regular view of screen).

Control and Tab takes us to the right Data and Stats panel.

Menu

Plot Type

Navpad right or click

Select **Bar chart** and click.

Using the arrow to click on a bar shows its # of cases and % of total data.

What is the percentage of carbon? _____

What is the percentage of hydrogen? _____

We will now copy the page again so that we can modify it.

Control navpad up (takes us to thumbnail sketches of screens).

Control and Menu

Copy, click

Control Menu

Paste, click

Control navpad down (returns us to a regular view of screen).

Control and Tab takes us to the right Data and Stats panel.

Menu

Plot Type

Navpad right or click

Select **Pie chart** and click.

Using the arrow to click on a **pie piece** again shows its # of cases and % of total data.

What is the percentage of carbon? _____

What is the percentage of hydrogen? _____

Now, use Control and navpad left to go back and review the previous graphs and data. When finished, go back to the screen with the pie chart by using Control and navpad right.

Spreadsheet-mathematical analysis of data from our percentage composition calculation:

Home

Lists and Spreadsheets

Click

As seen in the formula **table below**, use the navpad to go to the A cell and type **carbon**. Use the tab button to go to the B cell and type **hydrogen**. Use the tab button to go to the c cell and type **unitamu**. Use the tab button to go to the D cell and type **percentn** and then to the E cell and type **percenth**.

The diamond cells are for equations to tell the spreadsheet what to do with the data from the columns.

Next, go to the diamond cell below C and type **a + b**. Navpad down.

What is **a + b**? _____

Next, navpad to the diamond cell below D and type **open parentheses a divided by c closed parentheses multiplied by 100**. Navpad down. Navpad up and notice that the formula appears at the bottom of the screen.

What is **open parentheses a divided by c closed parentheses multiplied by 100**? _____

Navpad to the diamond cell below E and type **open parentheses b divided by c closed parentheses multiplied by 100**. Navpad down.

What is **open parentheses b divided by c closed parentheses multiplied by 100**? _____

The diamond cells are for equations to tell the spreadsheet what to do with the data from the columns.

Lastly, go to the first numbered data cell under column A and enter **12**, which represents the amu of **carbon**. Navpad down. **If it says Dimension mismatch, click OK and navpad to the first data cell under column B.** Enter the number **4**, which represents the amu of **hydrogen** in **methane**. Check out Cell 1 below columns C, D and E.

Navpad down and then enter the data in the spreadsheet below:

Formula Table

A carbon	B hydrogen	C unitamu	D percentn	E percenth
.		a + b	(a/c) *100	(b/c)*100
1 12	4			

Look at the numbers in Cells 1 of C, D and E columns. What do the numbers represent?

C1 _____ What is this? _____

D1 _____ What is this? _____

E1 _____ What is this? _____

Calculator analysis:

Next, we will add a Calculator page and analyze **all** of the percent composition calculations.

Home

Calculator

Click

If you haven't changed system settings to DEG APPRX REAL, do it now (see Hints page).

Instructor: On a calculator page, fractions can be converted to decimals by the following action (without changing the system settings). After pressing enter on the calculator menu, press Menu, navpad to Number, Click, Convert to Decimal and click. The screen will show Ans > Decimal. Now press enter. The fraction will now appear as a decimal number.

We will calculate the data in the following tables:

Table

Element		# atoms		amu/atom		amu for this element in the compound
C	=	1	x	12	=	12 amu
H	=	4	X	1	=	4 amu
						16 amu per unit of CH ₄

1 multiplied by **12** enter

4 multiplied by **1** enter

12 plus **4** enter

Table

Element		amu element/amu compound					elemental % of total mass
C	=	12/16	=	.75	x	100	= 75% C
H	=	4/16	=	.25	x	100	= 25% N

12 divided by **16** enter multiplied by 100 enter

4 divided by **16** enter multiplied by 100 enter

Did you get the values in the chart?

Step 3: Conclusions

You analyzed the methane molecule graphically, on a spreadsheet and with a calculator.

What is the percent composition of **carbon** in methane **CH₄**?

What is the percent composition of **hydrogen** in methane **CH₄**?

For a moment, **let's think about VESPR**. VESPR is the valence electron shell pair repulsion theory. Basically, it states that electrons, being like in charge (-), will distance themselves as far as possible from each other, thus affecting the spatial shape of the compound.

Methane, CH₄, has a tetrahedral shape with hydrogen atoms occupying all of the corners of a trigonal pyramid with four corners (three base corners and one apex). The hydrogen atoms occupy the four corners and the carbon atom is the central atom.

Let's draw this:

The elemental composition also effects the shape of the molecule since the elemental composition effects the electron distribution in the compound. Due to the equal distribution of hydrogen atoms in

the methane molecule, the **methane molecule** is therefore nonpolar, which means it does not mix well in **water**, a **polar** molecule.

What is a common use for **methane**? Where do we get it?

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