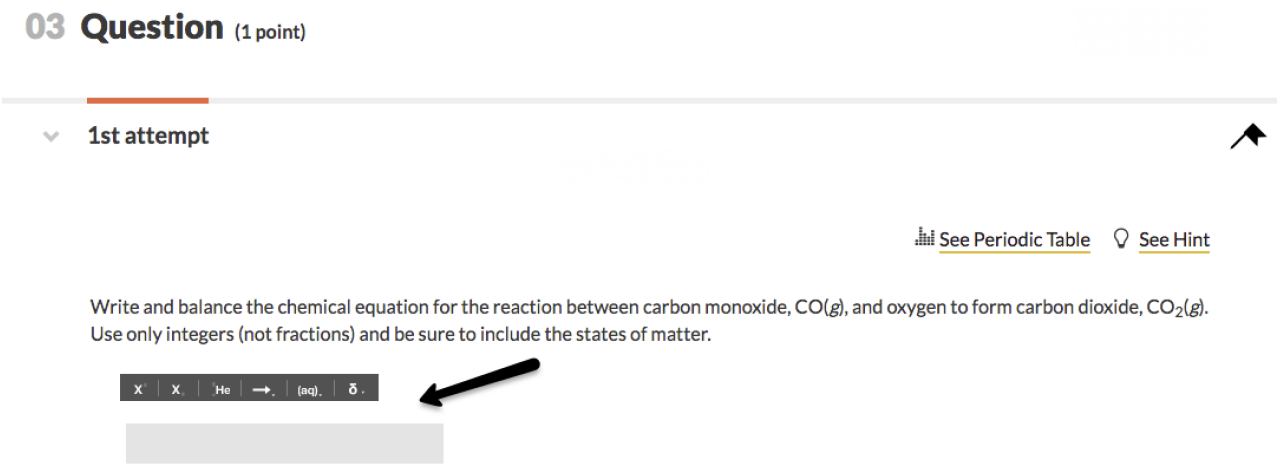
Chemical Equation Question Type

Last Modified on 04/21/2026 12:39 pm EDT

Chemical Equation Module

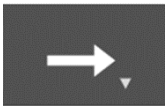
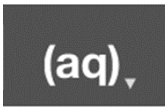
The Chemical Equation Module (CEM) allows students to enter chemical formulas as well as partial or complete chemical equations. The screenshot below shows an example of a CEM question. The CEM is highlighted by the arrow.

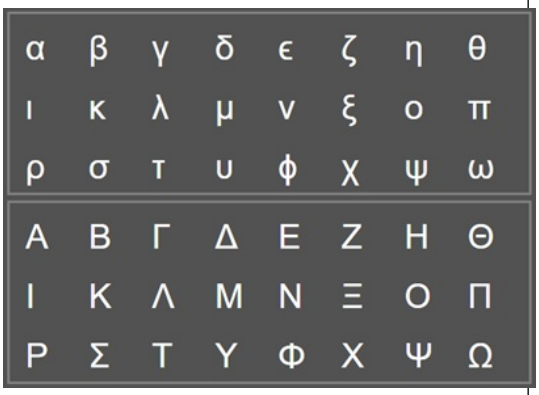


The CEM consists of two main areas: the CEM toolbar (dark gray) and the answer blank (light gray). The toolbar contains tools that are necessary to properly format answers. An enlarged version of the CEM toolbar is shown below.

The table below provides a summary of the available tools and their functions:

CEM Tool Symbols	CEM Tool Names	CEM Tool Functions
	Superscript	The *Superscript* tool is usually used when a charge must be added to an ion's chemical formula. This tool can also be accessed via the hotkey: SHIFT+^
	Subscript	The *Subscript* tool is required to add numbers to a chemical formula. This tool can also be accessed via the hotkey: SHIFT+_

	Isotope	The *Isotope* notation tool is used when a specific isotope of an element must be represented.
	Arrow	The *Arrow* tool is used when entering a chemical equation. Clicking on the icon opens the Arrow dropdown menu, which gives four options to select.
	Arrow dropdown menu 	In the Arrow dropdown menu, the four options from left to right are: The forward reaction arrow, the reverse reaction arrow, the equilibrium arrow, and the double-headed arrow.
	States of matter	The *States of matter* icon allows students to enter the appropriate physical state of a compound or ion into the answer blank. It will only appear on the CEM if the states of matter are graded as a part of the answer for that specific question. Clicking on the icon opens the States of matter dropdown menu, which gives four options from which to choose.
	States of matter dropdown menu 	The States of matter dropdown menu allows students to label chemical substances as: solid, (*s*); liquid, (*l*); gas, (*g*); or aqueous solution, (*aq*).

δ	Greek letters	The *Greek Letters* menu allows students to enter the appropriate upper- or lowercase Greek letter(s) into the answer blank. Clicking the icon opens the Greek letter dropdown menu.
	Greek letter dropdown menu  	The Greek Letter dropdown menu gives access to both lowercase (top) and uppercase (bottom) Greek letters.

Click below for a video introduction to the Chemical Equation Module (CEM).

Your browser does not support HTML5 video.

Using the Chemical Equation Module (CEM)

How to use the Superscript tool: x

An example problem that requires the use of the Superscript tool is shown below.

05 Question (6 points)

A number of chemical reactions have been proposed for the formation of organic compounds from inorganic precursors. Here is one of them:

$$H_2S + FeS + CO_2 \longrightarrow FeS_2 + HCO_2H$$

1st attempt

Part 1 (3 points) See Periodic Table

Identify the ions in FeS, and provide the correct name for the FeS compound.

Provide the symbol and charge of the iron ion present in FeS:

To enter the answer (Fe^{2+}), click in the light-gray answer blank to activate the cursor.

1st attempt

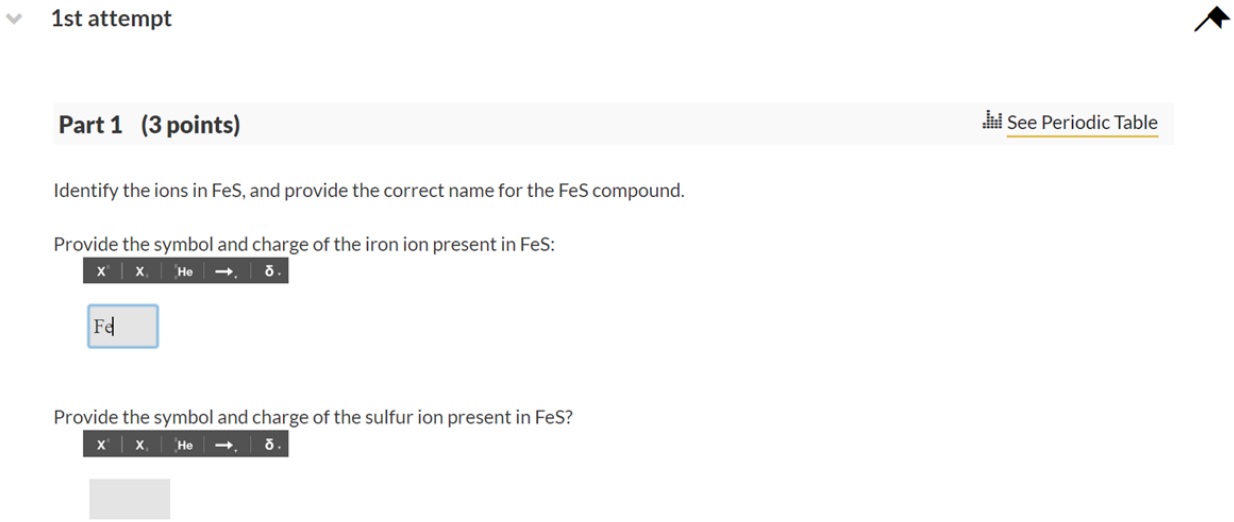
Part 1 (3 points) See Periodic Table

Identify the ions in FeS, and provide the correct name for the FeS compound.

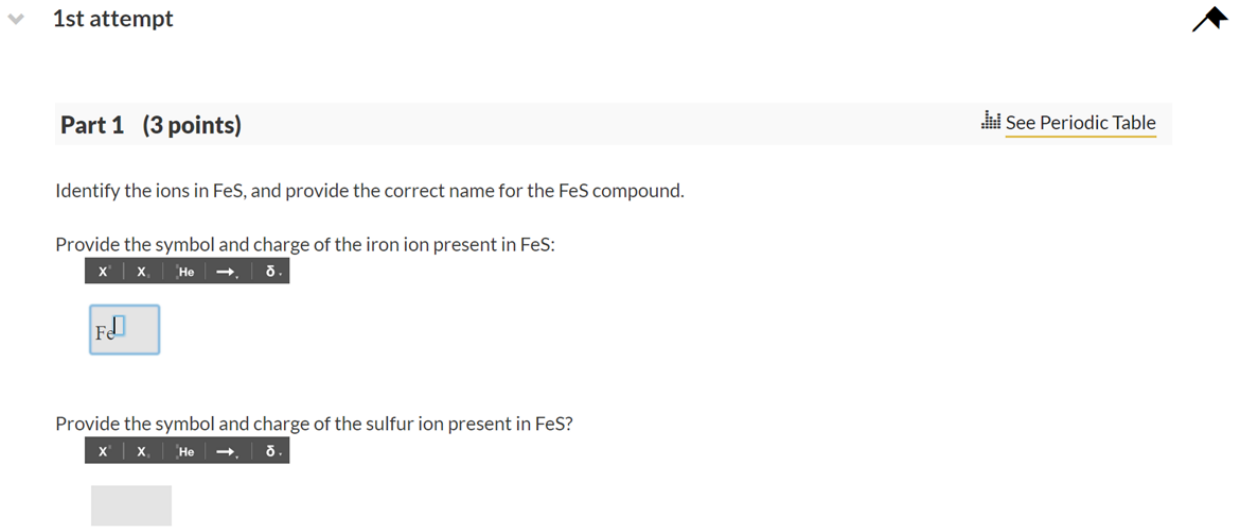
Provide the symbol and charge of the iron ion present in FeS:

Provide the symbol and charge of the sulfur ion present in FeS?

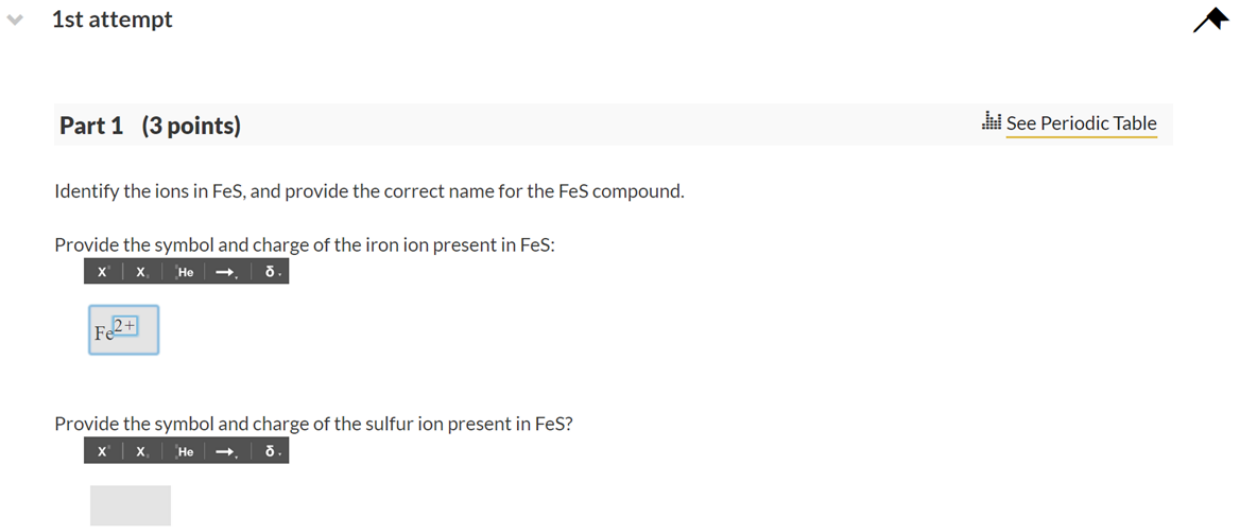
In the answer blank, type the elemental symbol for iron, Fe.



Click on the Superscript icon, X .

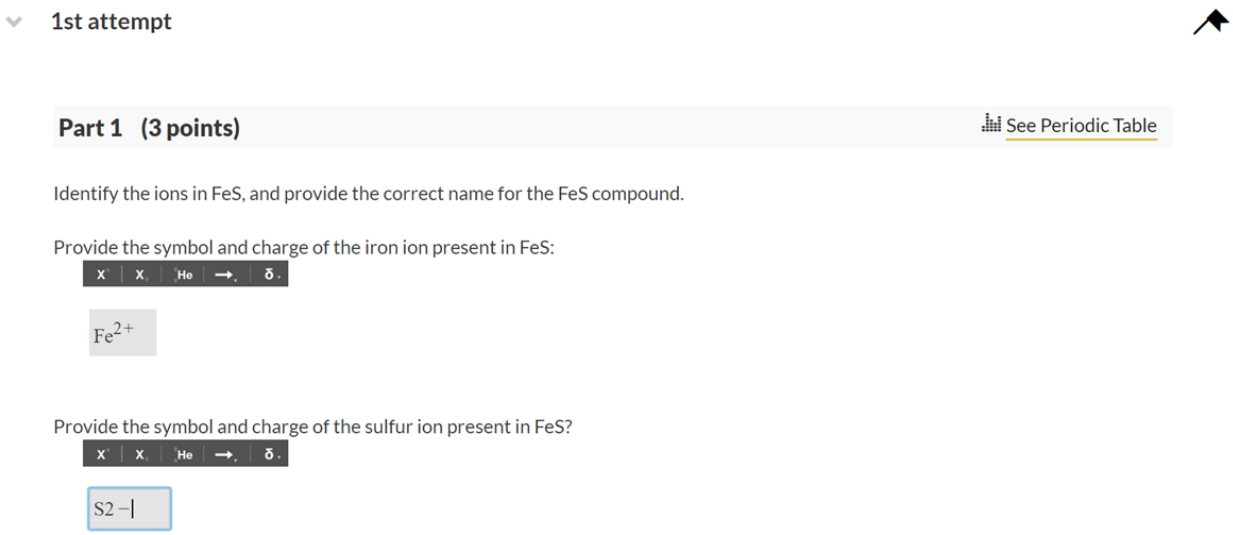


In the Superscript window, enter the charge (2+) of the iron ion. NOTE: You could also enter the charge for iron as +2. Smartwork views both 2+ and +2 as identical when grading.

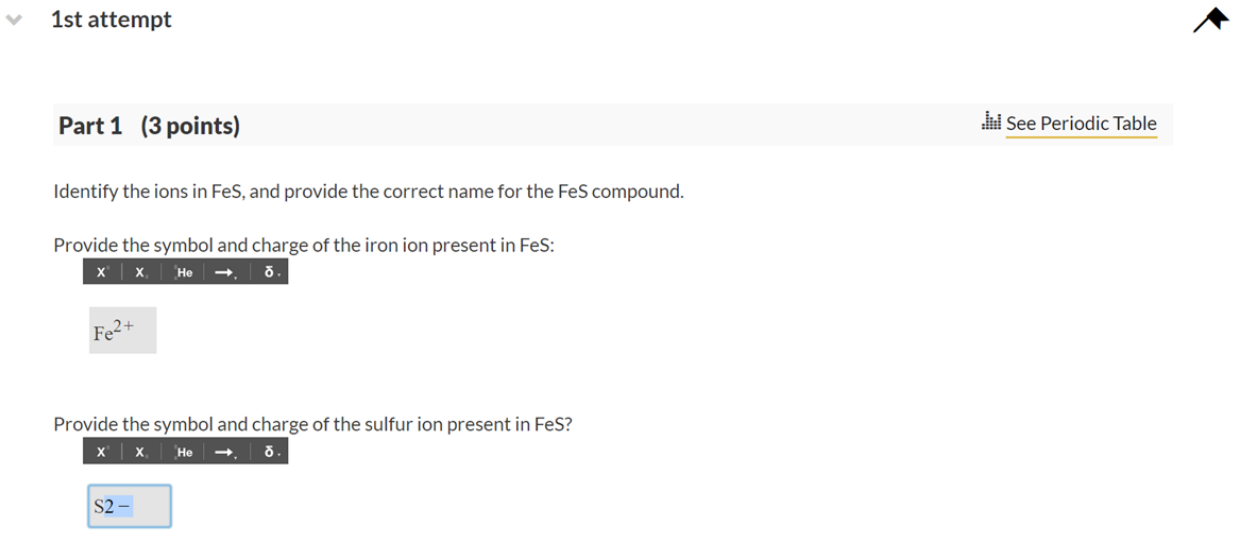


For the second part of the problem, the answer is S^{2-}. To enter this answer, we can follow the same general steps as above. We can also use an alternative method, where we type the characters into the answer blank and then highlight the portion of the text we would like to format as superscript.

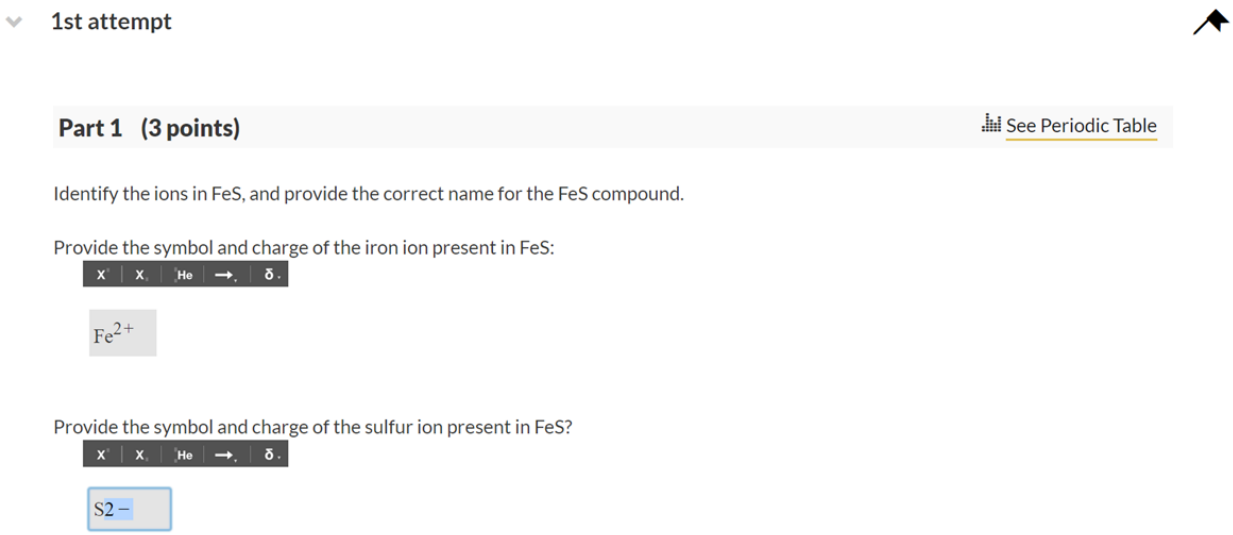
Using the alternative method, type S2- into the second answer blank.



Using your mouse, highlight the '2−' portion of the answer.



Click the Superscript button, X , to format 2– properly.



Since either method will properly format your answer, use the one that best suits you.

Click below for a video demonstration of the Superscript tool.

Your browser does not support HTML5 video.

How to use the Subscript tool: X

The Subscript tool can be used in a very similar manner to the Superscript tool. The problem below asks us to give the chemical formula for the diagram shown. The answer is CH_2O_2.

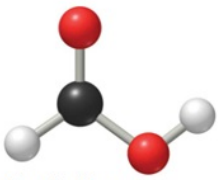
02 Question (1 point)

What is the chemical formula for the following compound?

Note: Typically, chemists write the C first, followed by the H, then other atoms in alphabetical order. Please follow this format when submitting your answer

1st attempt

See Periodic Table See Hint

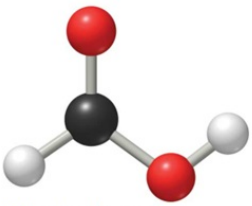


Chemical formula:

To enter the answer, click in the answer blank (light-gray) to activate the cursor.

1st attempt

See Periodic Table See Hint

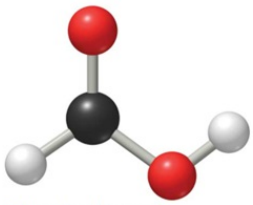


Chemical formula:

In the answer blank, type CH and then click the Subscript button, X₂ .

1st attempt

See Periodic Table See Hint



Chemical formula:

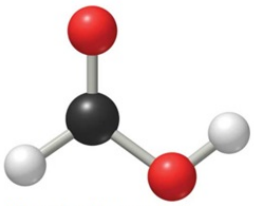
X X He → δ

CH

Enter the number 2 into the Subscript window, and then click the light-gray answer blank. You can now enter the capital letter O, click the Subscript button, and enter the next 2.

1st attempt

See Periodic Table See Hint



Chemical formula:

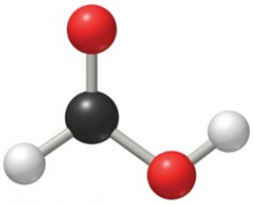
X X He → δ

CH_2O_2

An alternate method is to enter all of the characters first and then highlight the one(s) that should be subscript. For this problem, you would type CH2O2.

1st attempt

See Periodic Table See Hint



Chemical formula:

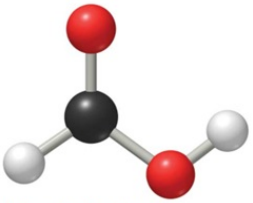
X' | X. | He | →. | δ.

CH2O2

Using the mouse, highlight the first 2.

1st attempt

See Periodic Table See Hint



Chemical formula:

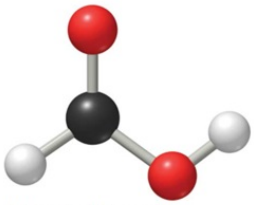
X' | X. | He | →. | δ.

CH2O2

Clicking the Subscript button, **X.** , will format the 2 properly. You can then highlight the next 2 and click the Subscript button again. NOTE: Using this alternate method, you can only highlight/format one region at a time.

1st attempt

See Periodic Table See Hint



Chemical formula:

CH_2O_2

Click below for a video demonstration of the Subscript tool.

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How to use the Isotope tool: $^{A}_{Z}$He

When entering a specific isotope as an answer, the Isotope tool should be used. The general format for an isotope using this tool is $^{A}_{Z}X$, where *X* is an elemental symbol, *A* is the mass number, and *Z* is the atomic number. The Isotope tool can be used in much the same way as the Superscript and Subscript tools. The problem below asks us to complete the given equation. The answer is $^{64}_{28}Ni$.

10 Question (3 points)

Fill in the blanks with the complete nuclide symbols for the particles that are required to balance the following nuclear reactions.

1st attempt

Part 1 (1 point) See Periodic Table See Hint

$^{209}_{83}Bi + \square \longrightarrow {}^{1}_{0}n + {}^{272}_{111}Rg$

Click the light-gray answer blank to activate the cursor.

1st attempt

Part 1 (1 pt) See Periodic Table See Hint

Click the Isotope tool icon, He , to open the Isotope tool.

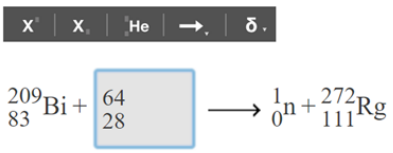
1st attempt

Part 1 (1 pt) See Periodic Table See Hint

Click in the top box and enter 64. Then click in the bottom box and enter 28.

1st attempt

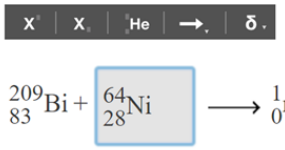
Part 1 (1 pt) See Periodic Table See Hint



Click in the answer blank and enter Ni.

1st attempt

Part 1 (1 pt) See Periodic Table See Hint



Click below for a video demonstration of the Isotope tool.

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How to use the Arrow tool,

The arrow tool is typically used when a chemical equation is the answer to a question. The tool has a dropdown menu that provides four arrow choices. (Note the small triangle in the lower right of the icon.) The dropdown menu is shown below. From left to right, the options are: the forward reaction arrow, the reverse reaction arrow, the equilibrium arrow, and the double-headed arrow. As you progress through your course, you will learn when to use which specific arrow.

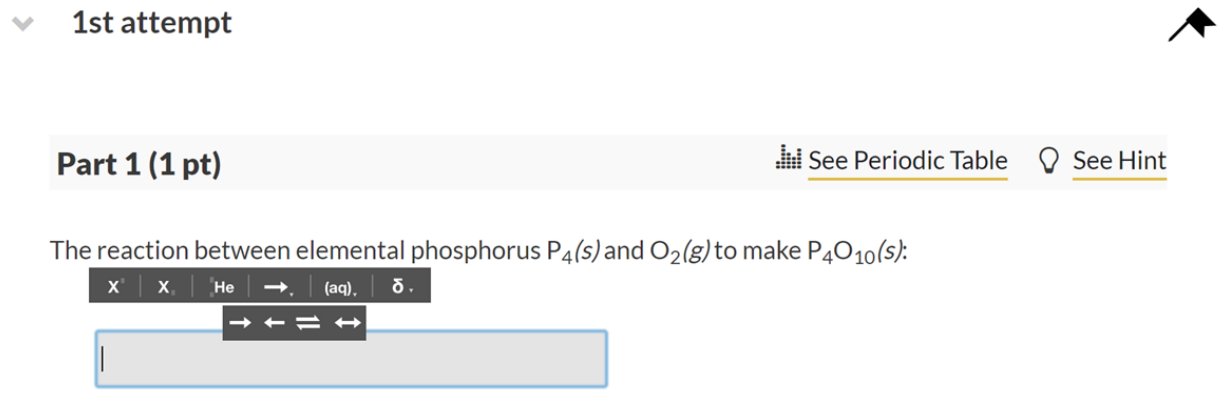
To enter an arrow, click on the light-gray answer blank to activate the cursor.

1st attempt

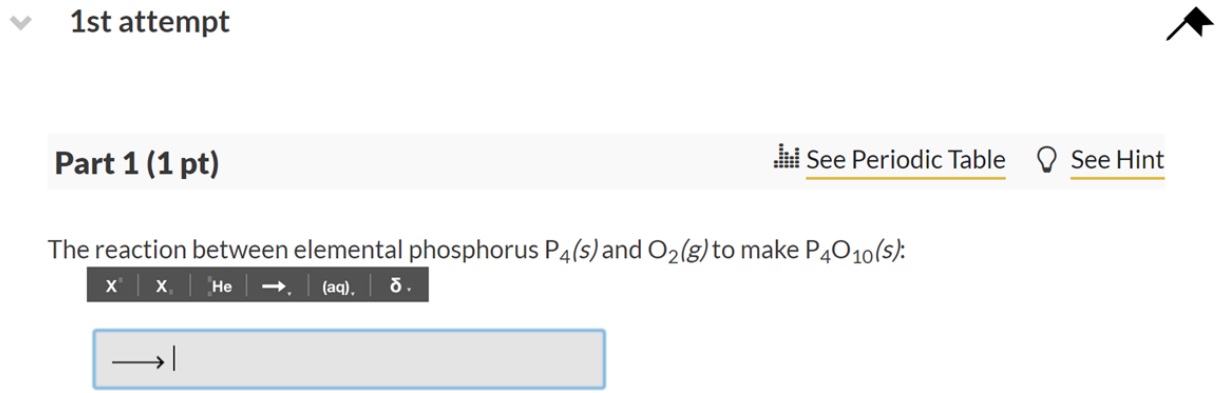
Part 1 (1 pt) See Periodic Table See Hint

The reaction between elemental phosphorus $P_4(s)$ and $O_2(g)$ to make $P_4O_{10}(s)$:

Click on the Arrow icon,  , in the CEM toolbar to open the dropdown menu.



In the dropdown menu, click on your choice of arrow and it will appear in the answer blank. In the picture below, the forward reaction arrow was chosen.



Click below for a video demonstration of the Arrow tool, States of Matter tool, and the Greek Letters tool.

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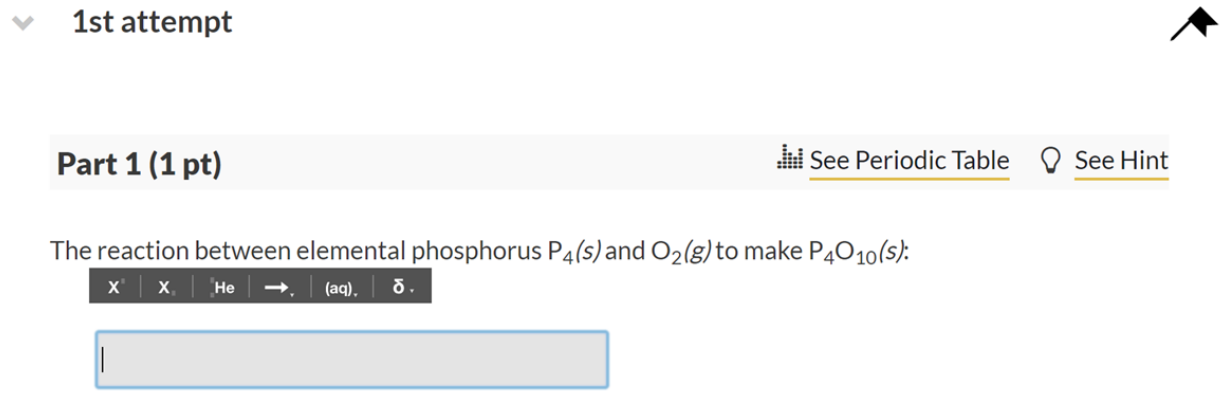
How to use the States of Matter tool, 

The States of Matter tool is generally used when the answer to a chemical equation problem requires that the physical states of each reactant and product be included. Note that this tool will only appear in the CEM toolbar if the states of matter will be graded as a part of your answer.

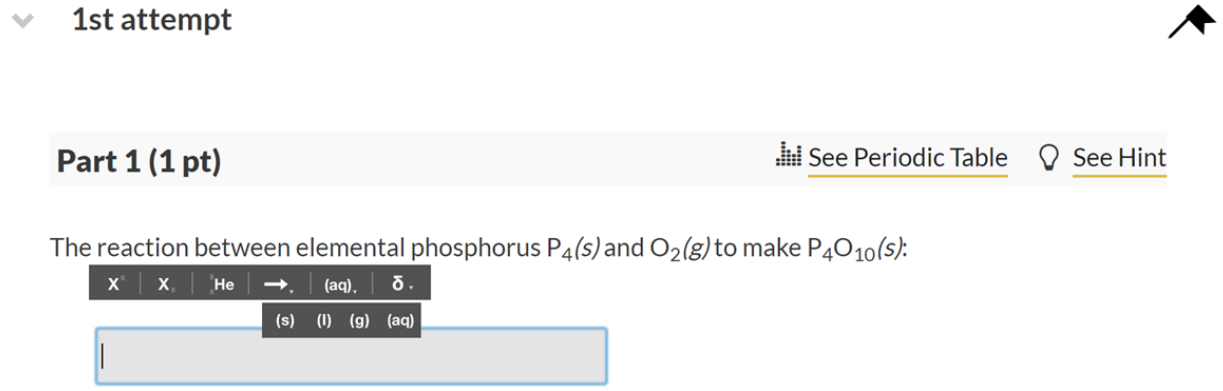
The tool has a dropdown menu that provides four choices. (Note the small triangle in the lower right of the icon.) The dropdown menu is shown below. From left to right, the options are: (*s*) for solids; (*l*) for liquids; (*g*) for gases; and (*aq*) for aqueous solutions. You will learn when to use which specific arrow as you progress through the course.

To enter a state of matter, click on the light-gray answer blank to activate the cursor.

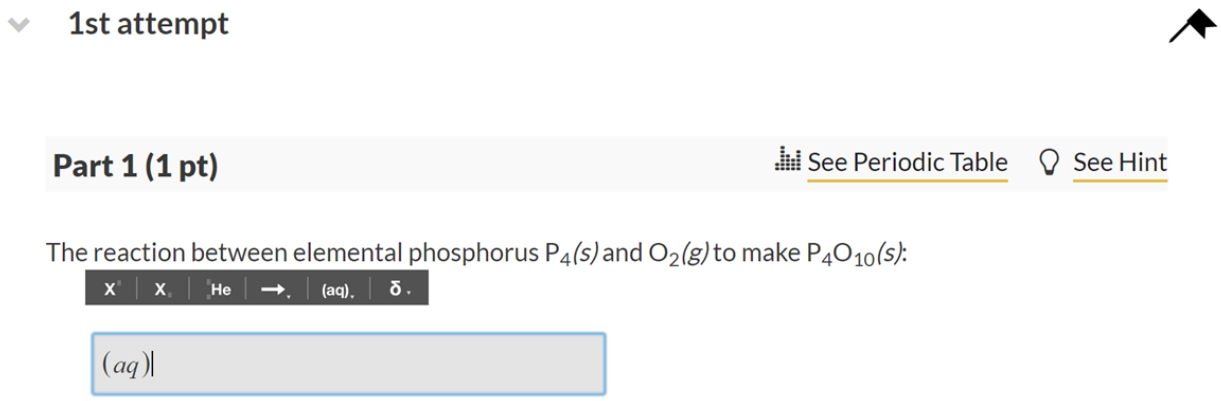


Click on the States of Matter icon, 

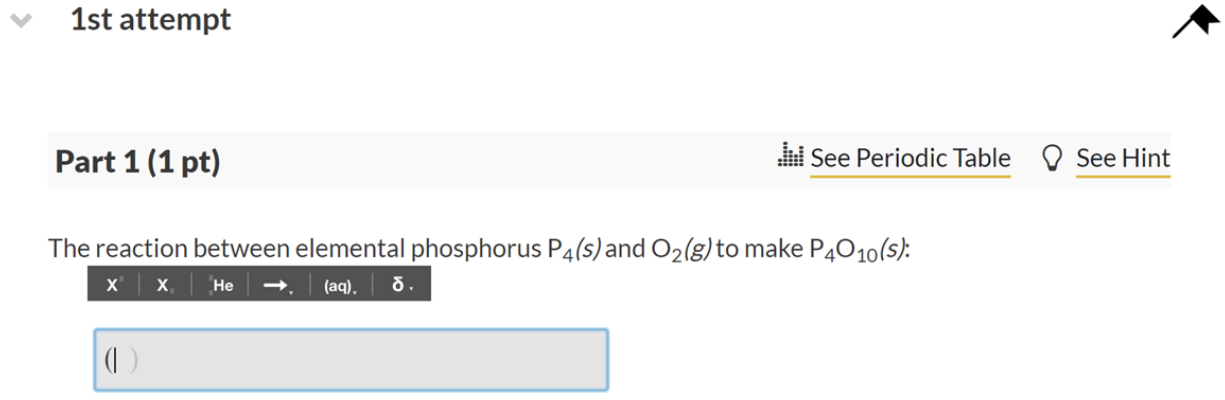
, in the CEM toolbar to open the dropdown menu.



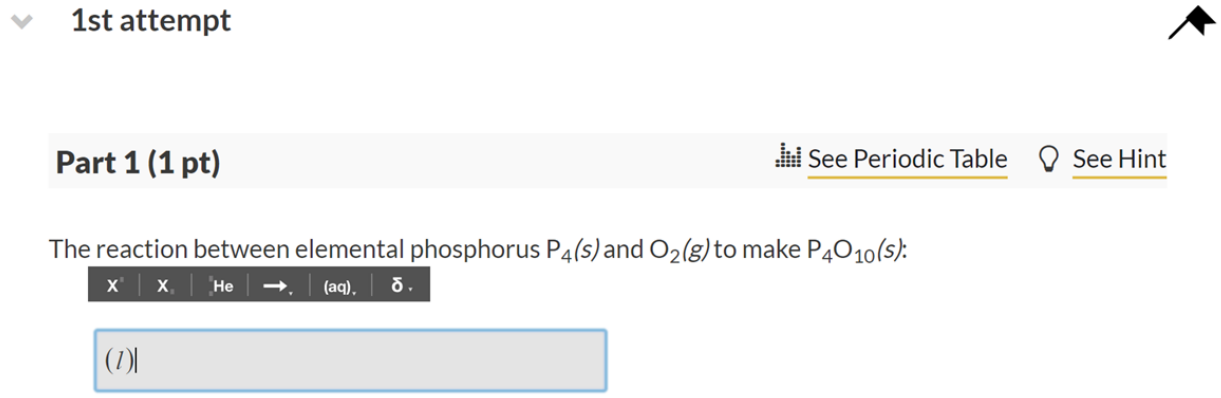
In the dropdown menu, click on your choice of state of matter and it will appear in the answer blank. In the picture below, the label of aqueous solution (*aq*) was chosen.



In addition to this method, you can also manually enter the states of matter. Click in the answer blank to activate the cursor, and enter the left parenthesis character, '('. This will open the states of matter format option.



The cursor is now active in the text box between the parentheses. Type in the letter(s) corresponding to the state of matter of your choice, followed by the right parenthesis character, ')'. The example in the figure below shows an *l* indicating the liquid state. Notice that the answer blank automatically italicized the *l* for us.



Click below for a video demonstration of the Arrow tool, States of Matter tool, and the Greek Letters tool.

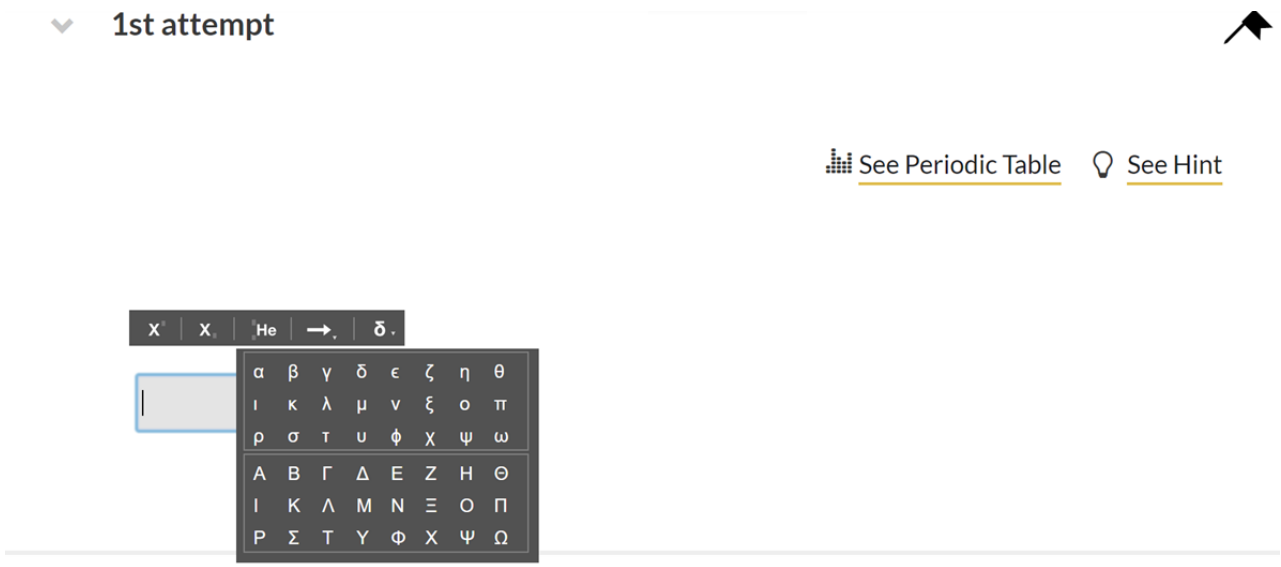
Your browser does not support HTML5 video.

How to use the Greek Letters tool, δ

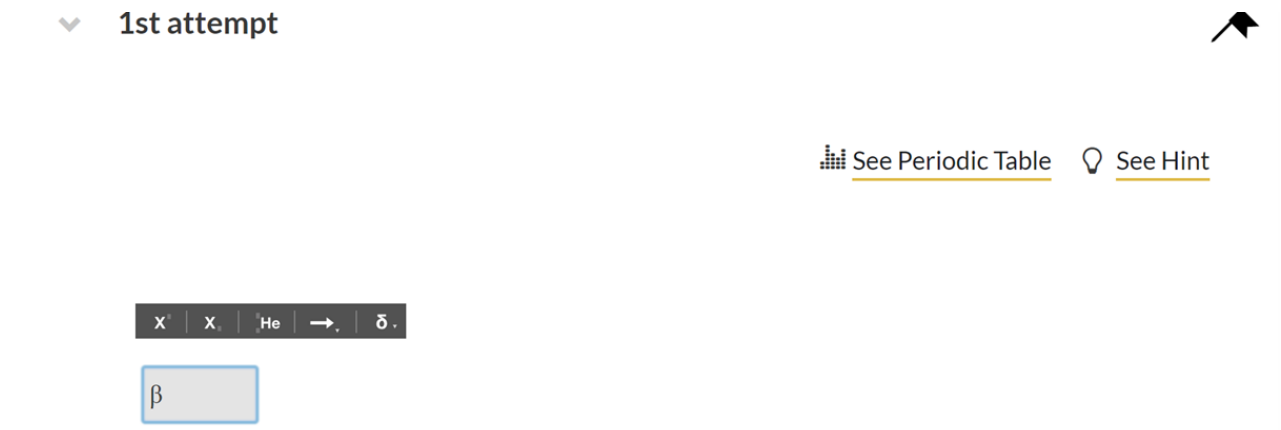
The Greek Letters tool will be needed whenever a specific Greek character is required in an answer. The tool has a dropdown menu that provides access to all 24 letters of the Greek alphabet in both lowercase (top) and uppercase (bottom). Note the small triangle in the lower right of the icon; this dropdown menu is shown below.

To enter a Greek letter, click on the light-gray answer blank to activate the cursor.

Click on the Greek letters icon, δ, in the CEM toolbar to open the dropdown menu.



In the dropdown menu, click on your choice of letter, β, and it will appear in the answer blank. In the picture below, the lowercase letter "beta" was entered.



Click below for a video demonstration of the Arrow tool, States of Matter tool, and the Greek letters tool.

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Entering a chemical equation into the Chemical Equation Module (CEM)

To enter an entire chemical equation as an answer to a problem, we can apply the techniques described above regarding how to use the CEM tools. In most cases, entering a chemical equation will require us to use several of the CEM tools in the same answer blank. In the example problem below, we are asked to enter the complete, balanced chemical reaction between $P_4(s)$ and $O_2(g)$ to produce $P_4O_{10}(s)$.

The correct answer is: $P_4(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$

18 Question (2 points)

Balance the following chemical equations (include the states of matter):

1st attempt

Part 1 (1 point) See Periodic Table See Hint

The reaction between elemental phosphorus $P_4(s)$ and $O_2(g)$ to make $P_4O_{10}(s)$:

X X He → (aq) δ

To enter the answer, we will need to use the Subscript, Arrow, and States of Matter tools. Click in the answer blank to activate the cursor. You can then type P4 in the blank.

Using your mouse, highlight the 4 and click the Subscript icon, X , .

1st attempt

Part 1 (1 pt) See Periodic Table See Hint

The reaction between elemental phosphorus $P_4(s)$ and $O_2(g)$ to make $P_4O_{10}(s)$:

X X He → (aq) δ

P4

Click in the light-gray answer blank, and then click on the States of Matter icon, (aq) , to open its dropdown menu.

1st attempt

Part 1 (1 pt) See Periodic Table See Hint

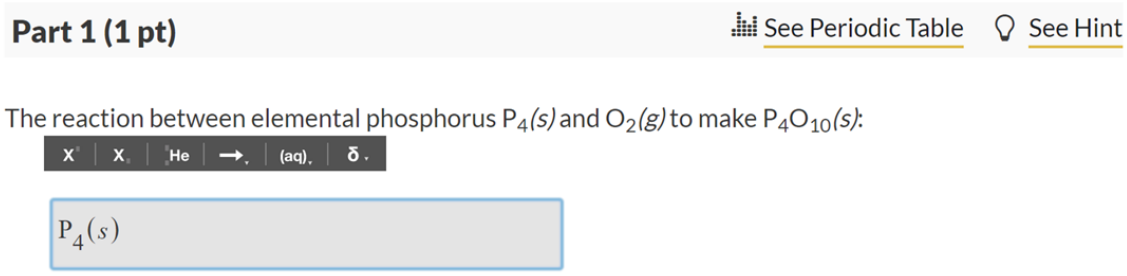
The reaction between elemental phosphorus $P_4(s)$ and $O_2(g)$ to make $P_4O_{10}(s)$:

X X He → (aq) δ

(s) (l) (g) (aq)

P_4

Click on the (*s*) to label P_4 as a solid.

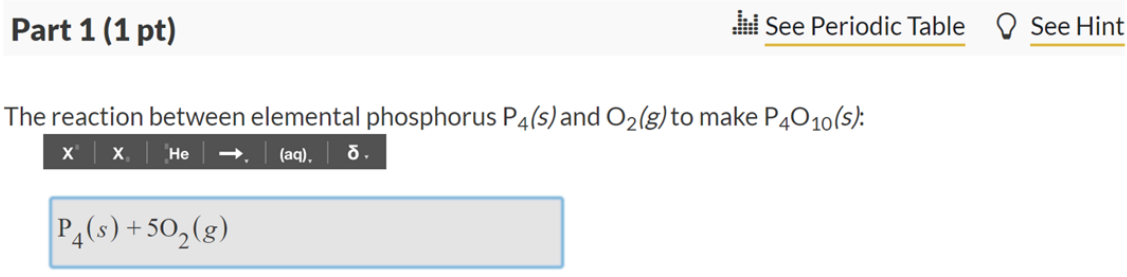


With the cursor active in the answer blank, enter the plus symbol (+). You do not need to add a space before or after the plus symbol. The SmartWork system automatically formats the spacing in the CEM.

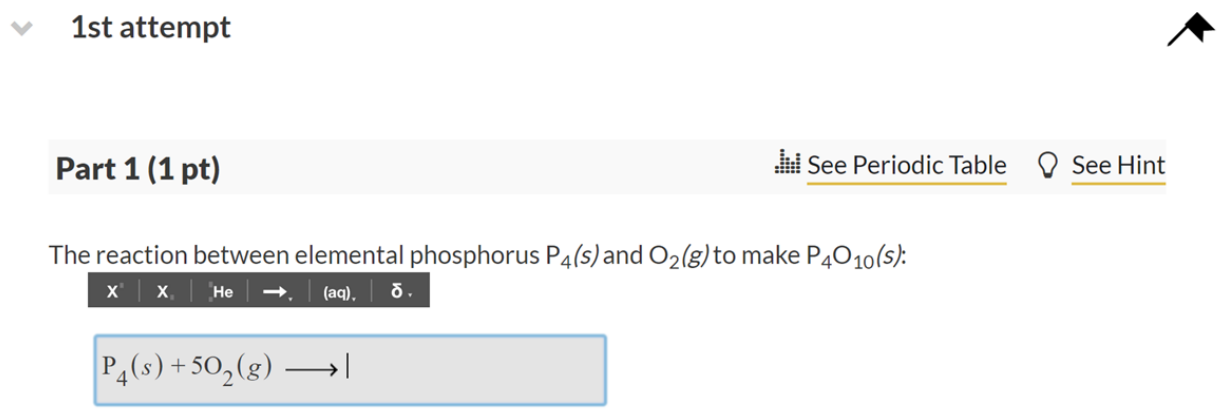
You can now enter the next reactant, $5O_2(g)$, using the same method as for $P_4(s)$. Type 5O2, highlight the 2, and click the Subscript icon, 

. Add the state of matter by clicking on the States of Matter icon, 

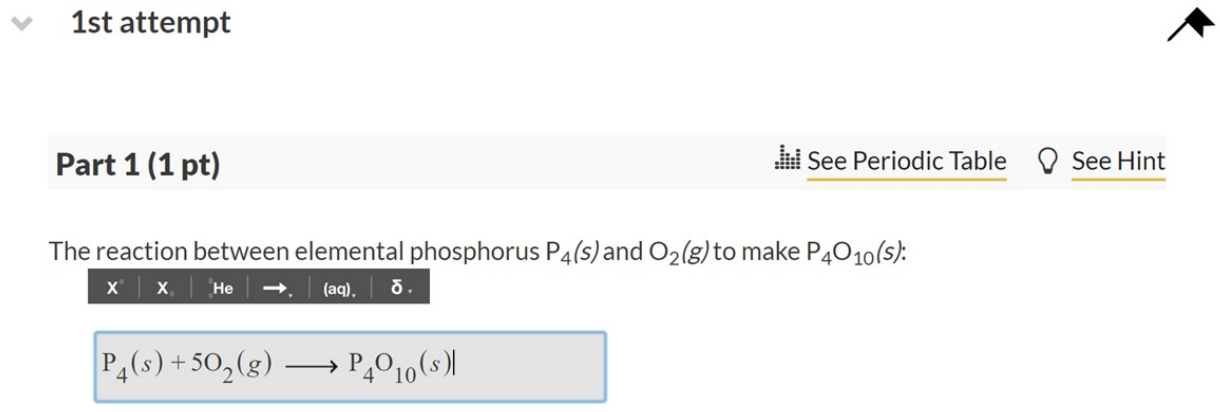
, to open the dropdown and select (*g*).



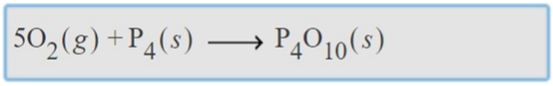
To add the arrow, click on the Arrow icon, 
, and select the forward arrow.



You can now complete the equation by entering the product $P_4O_{10}(s)$ in the same way. Your final answer should look like the picture below.



Note that the CEM accounts for reactants and products being entered in a different order. For example, in the problem above, if the answer had been entered with the reactants reversed,



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the answer would still have been marked as correct.

Click below for a video demonstration applying multiple CEM tools.

Your browser does not support HTML5 video.

Tips and Suggestions for using the Chemical Equation Module (CEM):

1) Be sure to read each problem carefully. Some questions will ask for only a specific chemical formula, such as a reactant or a product, while others may ask for a complete equation, including states of matter, to be entered.

2) Before switching tools within the same answer blank, you will need to click in the answer blank (away from your

entered answer) to exit the current tool and then click the icon for the next tool you need. If you do not do this, you may encounter some formatting issues that will affect how the system grades your answer.

3) States of matter should never be contained within a superscript or a subscript. The system will mark your answers incorrect if this occurs.

4) If you are having difficulty with formatting an answer properly, it may be simpler to delete your answer completely and reenter it, rather than trying to fix it.

5) When the system grades a chemical equation, the order of chemical compounds on either side of a plus sign is not important. For example, if the correct answer was A + B → C + D, then the system would also mark B + A → C + D as correct, along with other variations. So long as A and B are to the left of the arrow while C and D are to the right, the answer will be marked correct.

6) Similarly, when entering the charge for an ion, the Smartwork system will accept the sign of the charge in front of (e.g. +2) or behind (e.g. 2+) the magnitude of the charge. For example, if you are asked to write the ion with charge for iron(II), either Fe^{2+} or Fe^{+2} would be marked as correct.