Working in Document Mode interface

Create new Document Mode file and save it. Then complete all examples and tasks below.

1) What is the square root of -1?
---> Type sqr, press **Ctrl and space** (auto-completion of the command name). From the pop-up menu, select the line "sqrt $\sqrt{x}$", type "-1".
$\sqrt{-1}$
Let's describe four ways to obtain the result (the cursor must be in the expression input area!).
---> a) Press Enter. *You should get:*
$\sqrt{-1}$

I

---> b) **Right-click** (open the context menu). Select Evaluate. *You should see this:*
$\sqrt{-1}$

I

---> c) From the context menu, select Evaluate and Display Inline. *You should get:*
$\sqrt{-1} =$I

---> d) Analog of c). Press **Ctrl and =** (automatic calculation of mathematical expression) *You should get:*
$\sqrt{-1} =$I

Task 1. Calculate the sum of two rational fractions and obtain the result in the following form:
$\frac{2}{9} + \frac{7}{11} = \frac{85}{99}$

2) Derive the approximate value of the number π.
---> a) First method. From the "palettes" on the left, select the Common Symbols palette and expand it. (If the palettes are not visible, select View->Palettes->Expand Docs from the main menu.) Find the π symbol on the palette and click on it or drag it into the input area.
π
---> From the context menu, select Approximate->50
It should look like this:
$\pi \xrightarrow{\text{at 50 digits}} 3.1415926535897932384626433832795028841971693993751$

---> You can also a1) edit the text above the arrow, or a2) replace this block with text. *It should look like this:*
a1)
$\pi \xrightarrow{50\ знаков\ после\ запятой} 3.1415926535897932384626433832795028841971693993751$

a2)

$\pi \approx$ (здесь знак приближенного равенства взят из палитры CommonSymbols) 3.14159265358979323846264338327950288419716\
93993751

Note that when you hover over a symbol in the Common Symbols palette, a tooltip appears with the symbol's name! For example, the symbol for π is called Pi.

---> b) Second method. Type Pi in the input field and press Enter. Hover the cursor over the result and select Approximate->100. *You should get:*

π

$$\pi \xrightarrow{\text{at 50 digits}} 3.14159265358979323846264338327950288419716\93993751$$

Task 2. Output the approximate value of a number e(approximate to 10 decimal places) by typing the e symbol in two ways. Obtain the following strings:

$$e \xrightarrow{\text{at 10 digits}} 2.718281828$$

$$\exp(1) = e \xrightarrow{\text{at 10 digits}} 2.718281828$$

3) Solve the quadratic equation $x^2 + 7x + 10 = 0$

---> x^2 can be typed using the ^ symbol, or using a template a^b on the Expression palette.

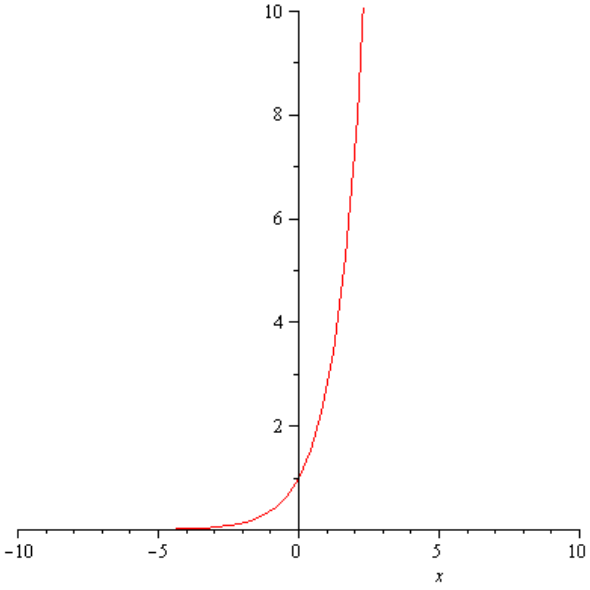
---> dial $x^2 + 7x + 10$ and select Solve->Solve from the context menu. *You should get:*

$$x^2 + 7x + 10 \xrightarrow{\text{solve}} \{x = -2\}, \{x = -5\}$$

Task 3. Solve the quadratic equation $\frac{7x^2}{3} - x = 12$ analytically and numerically (using the Numerically Solve command). Compare the results.

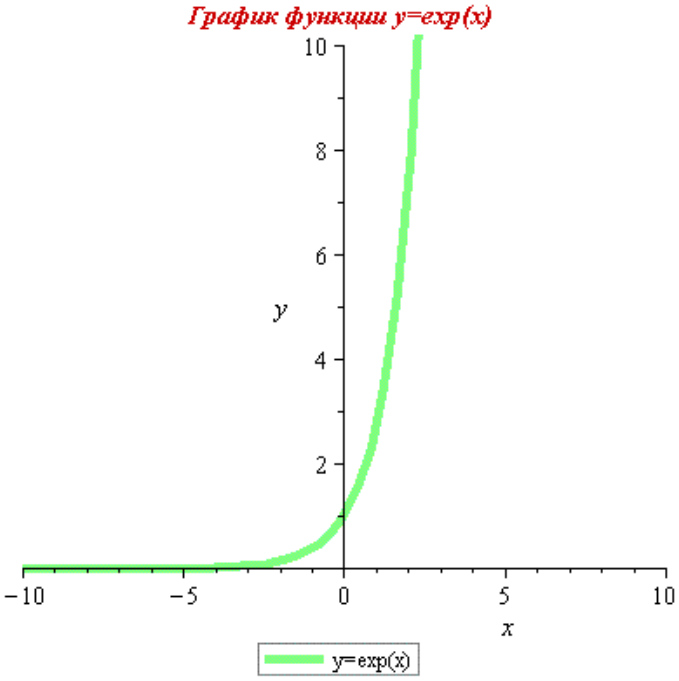
4) What is the range of the exponential function e^x? Determine it by drawing the graph of this function.

---> From the Expression palette, select a template e^a. Replace *a* with *x* . From the context menu, select Plots->2D Plot. Change the vertical axis values to "0 to 10." To do this, select Axes->Properties->Vertical from the context menu, enter the Range min and Range max values, and click Apply. You can also do the same using the menu that appears at the top by right-clicking on the plot area. *The result should look like this:*



$e^x \rightarrow$

Task 4. Copy the previous graph. Edit it using the context menu and the Plot and Drawing buttons (located next to the Text and Math buttons to switch between text and math modes). The result should look like this:



5) Define a function of two variables $f = \sin x + \cos y$. Calculate its value at the point $x = \pi/2$, $y = \pi/4$

---> Select a template from the Expression palette . $f := (a, b) \rightarrow z$Use tabs to navigate through the *a, b, f, and z* argument fields . **Note: Trigonometric function arguments are entered in parentheses.** Press Enter. On the next line, call the function with the specified argument values. *The result should look like this:*

$f := (x, y) \rightarrow \sin(x) + \cos(y)$

$$(x, y) \rightarrow \sin(x) + \cos(y)$$

$f\left(\frac{\pi}{2}, \frac{\pi}{4}\right) = 1 + \frac{1}{2}\sqrt{2}$

Task 5. Calculate the definite integral $\int_0^{\pi} \sin(x)\, dx$. *It should look like this:*

$\int_0^{\pi} \sin(x)\, dx = 2$

Note that when you hover over an expression in the Expression palette, a tooltip appears with the name and syntax of the corresponding command! For example, the definite integral of a function *f* over a segment [*a,b*] is calculated using the command *int(f,x=a..b)*

6) Find the derivatives of the functions $\ln(x^2 + 1)$ and $\ln(x^3 + 1)$ at the point x=4

---> Type $\ln(x^2 + 1)$. From the context menu, select Differentiate->x, then on the result, select Evaluate at a Point, and enter 4. *You should get:*

$\ln(x^2 + 1) \xrightarrow{\text{differentiate w.r.t. x}} \frac{2x}{x^2 + 1} \xrightarrow{\text{evaluate at point}} \frac{8}{17}$

---> Copy the entire previous line of calculations. Correct $\ln(x^2 + 1)$ on $\ln(x^3 + 1)$, select the entire calculation line and click the exclamation point button on the toolbar at the top. *You should get:*

$\ln(x^3 + 1) \xrightarrow{\text{differentiate w.r.t. x}} \frac{3x^2}{x^3 + 1} \xrightarrow{\text{evaluate at point}} \frac{48}{65}$

Working in Worksheet Mode interface

Create new Worksheet Mode file and save it. Then complete all tasks below.

1. Calculate: $(-1+i)^5$.
2. Calculate an approximate value $\pi^{\frac{1}{3}}$ to 15 decimal places using the **evalf** command **.**
3. Calculate: $e^{i\pi/2}$.
4. Calculate the exact and approximate value of an expression $\sqrt[3]{3+2\sqrt{3}}$ (without using the **evalf** command).
5. Write the formulas: $\omega(k) = \alpha k^2 + \beta k^4$; $\xi = ae^{-\gamma r}\cos(\omega t + \varphi)$.
6. Calculate the exact value of an expression $\text{arctg}3 - \arcsin\frac{\sqrt{5}}{5}$ and its approximate value using the **evalf** command and the symbol to call the previous command.
7. Calculate the approximate value of the number **e** with an accuracy of 50 digits after the decimal point.
8. Transform expression: $\sin(a)\cos(b) + \sin(b)\cos(a)$.
9. Set up the expression: $(a+b)(a-b) = c^2$. Extract the left side and expand the parentheses on the left side of the expression.
10. Factorize the polynomial $p = x^3 - 4x^2 + 5x - 2$.
11. Open the brackets in the numerator of the fraction $\frac{(x-1)(x+2)}{y-3}$.

12. Convert the fraction $\frac{a-b}{a^3-b^3}$ to normal form.
13. Bring similar terms in the expression $a^3x-ax+a^2+a$ relative to x and relative to a.
14. Simplify an expression $\sin^2 3x-\sin^2 2x-\sin 5x\sin x$. What commands can be used?
15. Simplify an expression $4\cos^3 a-3\cos a$. What commands can be used?
16. Given a complex number $z=\left(2e^{i\pi/6}\right)^5$, find its algebraic form, real, and imaginary parts. Find the absolute value and argument of the complex number with and without the **polar** command.