DEQ.8XP

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This program finds the general solution for linear homogeneous differential equations with constant coefficients up to the third order. For example, $a_0y'''+a_1y''+a_2y'+a_3y=0$ where a_0, a_1, a_2, a_3 are constants. First, it will solve the characteristic equation, which is $a_0m^3+a_1m^2+a_2m+a_3=0$. It then uses the output function to output the general solution depending on the roots. If the differential equation was of order one, its root is called *m*. For order two, the roots are called *m* and *n* and for third order, the roots are called *m, n,* and *p*. Because all cubics have at least one real root, the guaranteed real root is *p*. Imaginary answers are in form $m=a+bi$ and if *m* is imaginary, then *n* will be the conjugate such that $n=a-bi.$ The roots affect the answer depending upon whether they are repeating or imaginary. When displaying the solution on the calculator we assume all constants to be 1, however the constants will be included in the following table.

Order	**Roots**	**Output** **General Solution**
1	$m,\ m\in\mathbb{R}$	$y=c_1e^{mx}$
2	$m,\ n;\ m\neq n; m,n\in\mathbb{R}$	$y=c_1e^{mx}+c_2e^{nx}$
2	$m,n;\ m=n;\ m,n\in\mathbb{R}$	$y=c_1e^{mx}+c_2xe^{nx}$
2	$m,n;\ m,n\in\mathbb{C}$	$y=e^{ax}(c_1\cos(bx)+c_2\sin(bx))$
3	$m,n,p;\ m\neq n\neq p; m,n,p\in\mathbb{R}$	$y=c_1e^{mx}+c_2e^{nx}+c_3e^{px}$
3	$m,n,p;\ m=n=p; m,n,p\in\mathbb{R}$	$y=c_1e^{mx}+c_2xe^{nx}+c_3x^2e^{px}$
3	$m,n,;, m=n;\ m,n,p\in\mathbb{R}$	$y=c_1e^{px}+c_2e^{mx}+c_3xe^{nx}$
3	$m,n,p; m=p;\ m,n,p\in\mathbb{R}$	$y=c_1e^{nx}+c_2e^{mx}+c_3xe^{px}$
3	$m,n,p; n=p;\ m,n,p\in\mathbb{R}$	$y=c_1e^{mx}+c_2e^{nx}+c_3xe^{px}$
3	$m,n,p;\ p\in\mathbb{R}; m,n\in\mathbb{C}$	$y=c_1e^{px}+e^{ax}(\cos(bx)+\sin(bx))$

$\mathbb{R}$ = real numbers $\mathbb{C}$ = complex number