

# LAPLACE

Lap: improved Laplace transform (1s)	4: 3:  2:  1: Lap	SINH(2X) $\frac{2}{X^2-4}$ $e^{X^2}$ $LAP(e^{X^2})$	4: 3: 2:  1: Lap	$\frac{2X}{X^4+2X^2+1}$ $X \cdot \sin(X)$ $LAP(e^{X^2})$ $e^{X^2}$
ILap: inverse Laplace transform (4s)	Lap   ILap   t+s   s+t   Lrules   Deq		Lap   ILap   t+s   s+t   Lrules   Deq	
s→t: Laplace transform (1s)	6: 5: 4: 3:	SINH(t) $\frac{1}{s^2-1}$	6: 5: 4:	$\frac{2s}{s^4-2s^2+1}$
t→s: Laplace back transform (3s)	2: 1: Lap   ILap   t+s   s+t   Lrules   Deq	d1d1Delta(t) $\frac{1}{s^2}$	3: 2: 1: Lap   ILap   t+s   s+t   Lrules   Deq	$\frac{1}{t \cdot \sinh(t)}$ $\frac{s^3}{s^4-2s^2+1}$ d1d1d1Delta(t)
Lrules: rules of Laplace transform, page 1	RULES OF LAPLACE TRANSFORMATION $F(s) = \int_0^\infty f(t) e^{-st} dt$ $F(t) = 1/(2\pi i) \int_{c-i\infty}^{c+i\infty} F(s) e^{st} ds$ $F(t) \rightarrow F(s)$ $F(at) \rightarrow F(s/a)$ $F(t-a) \rightarrow e^{-as} F(s)$ $F(t+a) \rightarrow e^{-as} F(s)$ $e^{-at} F(t) \rightarrow F(s+a)$ $F(n) \rightarrow s^n F(s) - s^{n-1} F(0)$ GRAPH			
page 2	$F(s) = \int_0^\infty f(t) e^{-st} dt$ $F(t) = 1/(2\pi i) \int_{c-i\infty}^{c+i\infty} F(s) e^{st} ds$ $F(t) \rightarrow F(s)$ $F(at) \rightarrow F(s/a)$ $F(t-a) \rightarrow e^{-as} F(s)$ $F(t+a) \rightarrow e^{-as} F(s)$ $e^{-at} F(t) \rightarrow F(s+a)$ $F(n) \rightarrow s^n F(s) - s^{n-1} F(0)$ GRAPH			
Ldsolve: solve linear differential equation (4s) Y→DE: insert solution (5s)	7: 6: 5: 4: 3: 2: 1: L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	$\frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) + 4 \frac{\partial}{\partial X} (Y(X)) + 4 Y(X) =$ $\frac{(24X+12) \cdot cC0 + 12X \cdot cC1 + X^4}{12} e^{-(2X)}$ 0=0	6: 5: 4: 3: 2: 1: L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	$\frac{(24X+12) \cdot cC0 + 12X \cdot cC1 + X^4}{12} e^{-(2X)}$ $\frac{X^4 + 48X + 12}{12} e^{2X}$
c→c0: insert cCk (1.3s)	L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex		L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	
Ldsolve: solve linear differential equation (4s) Y→DE: insert solution (5s)	7: 6: 5: 4: 3: 2: 1: Ldsol   Y+DE   Ysol   c+c0   L+DE   Lapde	$\frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) + 4 \frac{\partial}{\partial X} (Y(X)) + 4 Y(X) =$ $\frac{(24X+12) \cdot cC0 + 12X \cdot cC1 + X^4}{12} e^{-(2X)}$ 0=0	6: 5: 4: 3: 2: 1: Ldsol   Y+DE   Ysol   c+c0   L+DE   Lapde	$\frac{(24X+12) \cdot cC0 + 12X \cdot cC1 + X^4}{12} e^{-(2X)}$ $\frac{X^4 + 48X + 12}{12} e^{2X}$
c→c0: insert cCk (1.3s)	Ldsol   Y+DE   Ysol   c+c0   L+DE   Lapde		Ldsol   Y+DE   Ysol   c+c0   L+DE   Lapde	
Ldsolve: solve linear differential equation (4s) Y→DE: insert solution (12s)	7: 6: 5: 4: 3: 2: 1: L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	$\frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) \right) + 4 \frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) + 4 Y(X) =$ $\frac{(5 \cdot cC0 - (cC1 + cC2) \cdot 5^X) + 10 \cdot cC0}{24} e^{5X}$ 0=0	6: 5: 4: 3: 2: 1: L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	$\frac{(5 \cdot cC0 - (cC1 + cC2) \cdot 5^X) + 10 \cdot cC0}{24} e^{5X}$ $\frac{32 \cdot 3^X \cdot 2^X - (5 \cdot 5^X \cdot 3^X - 3)}{30} e^{3X}$
c→c0: insert cCk (3.6s)	L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex		L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	
L→DE: list to differential equation (1s)	7: 6: 5: 4: 3: 2: 1: L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex	$\frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) \right) + 4 \frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) + 4 Y(X) =$ $\frac{(1 \cdot 4 \cdot 4 \cdot X^2 \cdot e^X)}{3000}$	6: 5: 4: 3: 2: 1: Ldec   CV+c0   Dny   CST   Help   LODETV	$\frac{X^2 - 4X^2 - 11X + 30}{3000}$ $\frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) \right) + 4 \frac{\partial}{\partial X} \left( \frac{\partial}{\partial X} (Y(X)) \right) + 4 Y(X) =$ $\frac{(750 \cdot cC0 - (125 \cdot cC1 + 125 \cdot cC2 + 2))}{3000} e^X$
Ldec: solve linear DEQ (5s)	L+DE   Ldsol   Y+DE   c+c0   Lapde   Ldex		Ldec   CV+c0   Dny   CST   Help   LODETV	
HelpLAPLACE: help	LAPLACE: LAPLACE TRANSFORMATIONS LINEAR DIFFERENTIAL EQNS, SYSTEMS CURRENT VARIABLE VX=X Lap Y(X) + LAP(Y(X)) LAPL. TR. ILap Y(X) + ILAP(Y(X)) INV. L.T. t+s F(t) + G(s) LAPL. TR. s+t G(s) + F(t) INV. LAPL. TR. Lrules - + - RULES OF LAPL. TR. Deq - + - ACTUAL DEQ L+DE Zon, a0 'F(X)' + DEQ Ldsolve DEQ + Y(X) SOLVE DEQ GRAPH			