

ZTRANSF

n→z: Z-Transform (5-10s) δ=Kroneckerdelta θ=Heaviside Unitstep	<pre> 4: a^n 3: -z 2: a-z 1: -((a+z)·z·a) 3 (a-z) Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> 5: δ(n-3) 4: 1 3: z 2: a^n·θ(n-1) 1: -a a-z Ztrex n+z z+n Zrule DIEQ DIhom </pre>
n→z: Z-Transform (15s)	<pre> 5: cos(n·b) 4: z·e^{i·b} 3: z·(z·e^{i·b}-1) + -z 2: a^n·sin(n·b) 1: z·i + z·e^{i·b}·i z·(z·e^{i·b}-1) + z·(z·e^{i·b}-a) Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> 4: COSH(n·b) 3: z·e^b + -z 2: 2·(z·e^b-1) + 2·(e^b-z) 1: δ(n-3)+n+θ(n+1) 1 + z + z z^3 + z - 1 (z-1)^2 Ztrex n+z z+n Zrule DIEQ DIhom </pre>
n→z: Z-Transform (5-10s)	<pre> 3: 2 2: n 1: n! 1 (z+1)·e^z z^2 Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> 6: LN(n) 5: Z(LN(n)) 4: IZ(z) 3: 1/z 2: 2^n + n + 1 1: z + z + z z-2 (z-1)^2 + z-1 Ztrex n+z z+n Zrule DIEQ DIhom </pre>
z→n: inverse Z-transform (5-10s)	<pre> 5: 1 4: z 3: δ(n-3) 2: 1 1: (n-1)·θ(n-1) a Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> 6: 1 5: (z+2)^3 4: (n-2)·(n-1)·(n-2)·θ(n-1) 3: z+1+1/2 2: s(n-1)+IZ(z)+δ(n) 1: 1 Ztrex n+z z+n Zrule DIEQ DIhom </pre>
z→n: inverse Z-transform (5-15s)	<pre> 4: 1 3: (z·(-1)^(n-1) - i·i^(n-1))·θ(n-1) 2: z^2+3 1: 3·δ(n-1) - (z·(-1)^(n-1) + (-2)^(n-1)) z Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> 4: (z^2+4·a·z+a^2)·z 3: (z-a)^4 2: n^3·a^n 1: (z-2)·(z-1)^2 (z^n-(n+1)·z) Ztrex n+z z+n Zrule DIEQ DIhom </pre>
z→n: inverse Z-transform (5-15s)	<pre> 5: 1 4: z 3: δ(n-3) 2: 1 1: (n-1)·θ(n-1) a Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> 3: a 2: z 1: (n-1)·n·a^(n-2)·θ(n-2) n! Ztrex n+z z+n Zrule DIEQ DIhom </pre>
Zrules: rules of Z-transform	<pre> RULES OF Z TRANSFORM F(z)=Σ(n=0,∞,f_n/z^n) f_n=1/(2·π·i)∮F(z)z^(n-1)dz a·f_n+b·g_n → a·F(z)+b·G(z) f_n → F(z) (n,k=0,1,2) f_n-k → z^k·F(z) f_n+k → z^{-k}·F(z) a^n·f_n → F(z/a) n·f_n → -z·dF(z)/dz f_n/n → ∫(z,∞,F(z),z) (FD=0) GRAPH OK </pre>	<pre> f_n-k → z^{-k}·F(z) f_n+k → z^k·F(z) a^n·f_n → F(z/a) n·f_n → -z·dF(z)/dz f_n/n → ∫(z,∞,F(z),z) (FD=0) Σ(j=0,n-1,f_j) → F(z)/(z-1) Σ(j=0,n,f_j) → z·F(z)/(z-1) Σ(j=0,n,f_j)·g_{n-j} → F(z)·G(z) df_n=fn+1-fn → (z-1)F(z)-zF0 dkfn → (z-1)^k·F(z)-zΣ(j=0,k-1,(z-1)^{k-j-1}dkfj) GRAPH OK </pre>
DIhom: solution of homogeneous difference equation DIEQ (1s) DIinhomo: solution of inhomogeneous DIEQ with ansatz (7s)	<pre> 8: 7: 6: 5: 4: 3: 2: y(n+2)-3·y(n+1)+2·y(n)=→ 1: 2^n·c1+1^n·c2 Ztrex n+z z+n Zrule DIEQ DIhom </pre>	<pre> RAD XYZ DEC IC= 'X' CHOME ZTRANSF3 USR 3: y(n+1)+-2·y(n)=n·2^n 2: n·(a+b·n)·2^n 1: 2^n·c1+(n-1)·n·2^n 2^2 DIinh DIaso DIatr y+0I L+0I y+0D </pre>

L→DI: list to difference equation (0.6s)	RAD XY2 DEC C= 'X' (HOME ZTRANSF) USR 5: 4: {1 -3 2 2^n} 3: y(n+2)+-3.y(n+1)+2.y(n)=2^n 2: y(n+2)+-3.y(n+1)+2.y(n)=2^n 1: -((2.2^n-4).y(0))-((2.2^n-2).y(1))+r, 2 DIanhDIzssDIztrf y+0I L+0I y+00	RAD XY2 DEC C= 'X' (HOME ZTRANSF) USR 5: 4: 3: y(n+2)+-3.y(n+1)+2.y(n)=2^n 2: 0 0 1: (n-2).2^n+2 2 DIanhDIzssDIztrf y+0I L+0I y+00
DIzsolve: solution by Z-Transform (38s), with start values (21s)	6: 5: 4: 3: y(n+2)-3.y(n+1)+2.y(n)=2^n 2: (z^2-3.z).Y(z)+2.Y(z)-((z^2-3.z).y(0)+ 1: Y(z)= (z^3-5.z^2+6.z).y(0)+(z^2-2.z).y(1) z^3-5.z^2+8.z-4 SOLVE SUBSTITUTEDFA	5: 4: 3: y(n+2)-3.y(n+1)+2.y(n)=2^n 2: (n-2).2^n+2 1: 2^n=2^n DIanhDIzssDIztrf y+0I L+0I y+00
DIztrf: Z-Transform difference eqn. (12s), 'Y(z)' solve, back transform -> solution y->DI: insert solution in DIEQ (4)	5: 4: 3: (2.2^n-4).y(0)-((2.2^n-2).y(1)+ 2: 0 0 1: (n-2).2^n+2 2 DIanhDIzssDIztrf y+0I L+0I y+00	5: 4: 3: 'n' X (X-1)^2 2: X a.X-1 1: (n-1).0(n-1) a +Gfun/Gfun+Ftabl Fx0 Fxi Fousd
y→y0: insert start values in solution (0.6s)	5: 4: 3: (2.2^n-4).y(0)-((2.2^n-2).y(1)+ 2: 0 0 1: (n-2).2^n+2 2 DIanhDIzssDIztrf y+0I L+0I y+00	5: 4: 3: 'n' X (X-1)^2 2: X a.X-1 1: (n-1).0(n-1) a +Gfun/Gfun+Ftabl Fx0 Fxi Fousd
generating function →Gfun: fn -> f(X) (5-10s) Gfun →: f(X) -> fn	5: 4: 3: (2.2^n-4).y(0)-((2.2^n-2).y(1)+ 2: 0 0 1: (n-2).2^n+2 2 DIanhDIzssDIztrf y+0I L+0I y+00	5: 4: 3: 'n' X (X-1)^2 2: X a.X-1 1: (n-1).0(n-1) a +Gfun/Gfun+Ftabl Fx0 Fxi Fousd
Ftable: table with function values (1s)	5: 4: 3: 2: 1: (n-1).e^i.n.n.0(n-1)+0(n-1) +Gfun/Gfun+Ftabl Fx0 Fxi Fousd	5: 4: 3: 2: 1: 0. +Gfun/Gfun+Ftabl Fx0 Fxi Fousd
Fx0: function value (1s)	5: 4: 3: 2: 1: 1 (z+2)^3 -2 0 +Gfun/Gfun+Ftabl Fx0 Fxi Fousd	5: 4: 3: 2: 1: 1 2 1 0 2 -3 5 -9 17 -33 65 +Gfun/Gfun+Ftabl Fx0 Fxi Fousd
Fxi: values from a to b step s (4s)	5: 4: 3: 2: 1: 1 (z+2)^3 -2 0 +Gfun/Gfun+Ftabl Fx0 Fxi Fousd	5: 4: 3: 2: 1: 1 2 1 0 2 -3 5 -9 17 -33 65 +Gfun/Gfun+Ftabl Fx0 Fxi Fousd
ZtransfHELP: help	2-TRANSFORM FN ↔ F(z) FOR n≥0 LINEAR DIFFERENCE EQUATIONS DIEQ: akxy(n+k)+...+a0xy(n)=fn %KRONECKERDELTA %HEAVISIDE UNIT-STEP Ztrrex FN + F(z) EXAMPLES n+2 FN + F(z) 2-TRANSFORM z+n F(z) + FN INV. 2-TRANSF. Zrules - + - RULES OF 2-TRANSF. DIEQ - + ACTUAL DIFF. EQ DIhom DIEQ + DIEQ SOLUTION GRAPH	OF HOMOGENEOUS DIEQ DIanh DIEQ y0 + DIEQ SOLUTION OF INHOMOGENEOUS DIEQ ANSATZ y0=n^r.xpl(n).d^n FOR FN=n^r.xd^n p(n)=qd+...+alxn^l r=MULTIPLICITY OF d, IF d = ROOT OF CHAR. POLY. DIzsolve DIEQ + DIEQ YSOL OR DIEQ y0 y1..3 + DIEQ YSOL SOLUTION BY 2-TRANSFORM DIztrf DIEQ + 2-TRANSFORMED GRAPH
ZtransfHELP: help	y+0I DIEQ y0 + 0=0 INSERT SOL. L+0I %ok..00 FN3 + DIEQ y+00 DIEQ y0 y1..3 + DIEQ INSERT STARTVALUES ysol FN + SOLUTION +Gfun FN + F(X) = GENERATING FUNCTION F(X)=EFnX^n WHOSE COEFFICIENTS ARE GIVEN BY THE SEQUENCE FN (FN + F(z), z=1/X) Gfun+ F(X) + FN GENERATING FUNCTION + SEQUENCE GRAPH	(X=1/z, F(z) + FN) Ftable FN,F2 + TABLE OF VALUES Fx0 FN,F2 x0 + F(x0) VALUE Fxi FN,F2 a b s + CF(a)..3 VALUES FOR a TO b STEP s HINT: THE FUNCTIONS %,0 ARE IMPLEMENTED IN THE PROGRAMS Ftable Fx0 Fxi % KRONECKERDELTA %(n)=1 FOR n=0 ELSE 0 % HEAVISIDE UNIT-STEP %(n)=1 FOR n≥0 ELSE 0 GRAPH
ZtransfHELP: help	y+0I DIEQ y0 + 0=0 INSERT SOL. L+0I %ok..00 FN3 + DIEQ y+00 DIEQ y0 y1..3 + DIEQ INSERT STARTVALUES ysol FN + SOLUTION +Gfun FN + F(X) = GENERATING FUNCTION F(X)=EFnX^n WHOSE COEFFICIENTS ARE GIVEN BY THE SEQUENCE FN (FN + F(z), z=1/X) Gfun+ F(X) + FN GENERATING FUNCTION + SEQUENCE GRAPH	POW2IMP (a+b)^n + a^n(b^n) EXP(a)^b + EXP(a.b) EXP(x^n.x^n) + (-1)^n POWER SIMPLIFICATION PO2n SUBPROGRAM OF n+2 z+n CST POW2IMP LID TRIG EXP2HYP EXP2FOM COLLECT EXPAND PARTFRAC FDISTRIB TEXFAND TSIMP HINT: AFTER n+2 z+n YOU CAN USE THESE AND ALG COMMANDS TO SIMPLIFY EXPRESSIONS LFn LIST WITH MATCHES FOR n+2 GRAPH