

#1: Square, triangle and ramp waves constructed from sine waves, 4/11/19
(4/15/19)

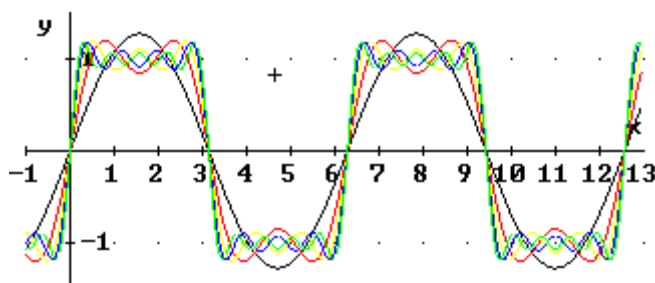
#2: The resulting target waveforms have amplitude = 1 and start with
fundamental $c \cdot \text{SIN}(t)$.

$$\#3: \text{square}(t, n) := \frac{4}{\pi} \cdot \sum_{k=1}^n \frac{\text{SIN}((2 \cdot k - 1) \cdot t)}{2 \cdot k - 1}$$

#4: $\text{square}(t, 5)$

$$\#5: \frac{4 \cdot \text{SIN}(9 \cdot t)}{9 \cdot \pi} + \frac{4 \cdot \text{SIN}(7 \cdot t)}{7 \cdot \pi} + \frac{4 \cdot \text{SIN}(5 \cdot t)}{5 \cdot \pi} + \frac{4 \cdot \text{SIN}(3 \cdot t)}{3 \cdot \pi} + \frac{4 \cdot \text{SIN}(t)}{\pi}$$

#6: $\text{VECTOR}(\text{square}(t, n), n, 1, 5)$



#7: square wave component amplitudes in Vpk and dBVpk

$$\#8: \text{VECTOR} \left(\left[\frac{4}{\pi \cdot (2 \cdot k - 1)}, 20 \cdot \text{LOG} \left(\frac{4}{\pi \cdot (2 \cdot k - 1)}, 10 \right) \right], k, 1, 8 \right)$$

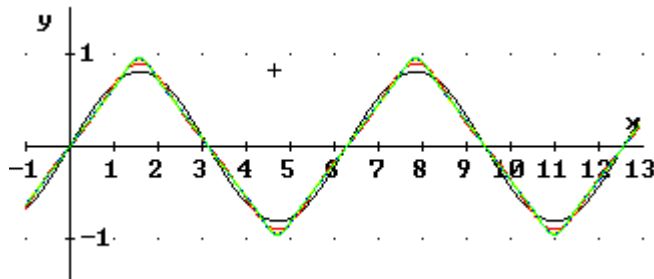
$$\#9: \begin{bmatrix} 1.273239544 & 2.098202372 \\ 0.4244131815 & -7.444222721 \\ 0.2546479089 & -11.88119771 \\ 0.1818913635 & -14.80375842 \\ 0.1414710605 & -16.98664781 \\ 0.1157490495 & -18.72965133 \\ 0.09794150344 & -20.18066467 \\ 0.08488263631 & -21.4236228 \end{bmatrix}$$

$$\#10: \text{triangle}(t, n) := \frac{8}{\pi^2} \cdot \sum_{k=1}^n \frac{(-1)^{k-1} \cdot \text{SIN}((2 \cdot k - 1) \cdot t)}{(2 \cdot k - 1)^2}$$

#11: $\text{triangle}(t, 5)$

$$\#12: \frac{8 \cdot \sin(9 \cdot t)}{81 \cdot \pi^2} - \frac{8 \cdot \sin(7 \cdot t)}{49 \cdot \pi^2} + \frac{8 \cdot \sin(5 \cdot t)}{25 \cdot \pi^2} - \frac{8 \cdot \sin(3 \cdot t)}{9 \cdot \pi^2} + \frac{8 \cdot \sin(t)}{\pi^2}$$

#13: VECTOR(triangle(t, n), n, 1, 5)



#14: triangle wave component amplitudes in Vpk and dBVpk

$$\#15: \text{VECTOR} \left(\left[\frac{8}{\pi^2 \cdot (2 \cdot k - 1)^2}, 20 \cdot \log \left(\frac{8}{\pi^2 \cdot (2 \cdot k - 1)^2}, 10 \right) \right], k, 1, 8 \right)$$

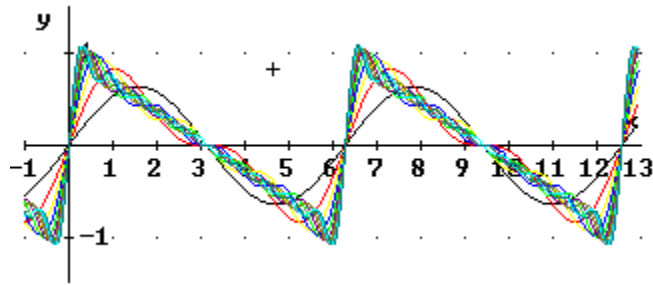
$$\#16: \begin{bmatrix} 0.8105694691 & -1.824195167 \\ 0.09006327434 & -20.90904535 \\ 0.03242277876 & -29.78299534 \\ 0.01654223406 & -35.62811676 \\ 0.01000703048 & -39.99389554 \\ 0.006698921232 & -43.47990257 \\ 0.004796269048 & -46.38192926 \\ 0.003602530973 & -48.86784553 \end{bmatrix}$$

$$\#17: \text{ramp_down}(t, n) := \frac{2}{\pi} \cdot \sum_{k=1}^n \frac{\sin(k \cdot t)}{k}$$

#18: ramp_down(t, 5)

$$\#19: \frac{2 \cdot \sin(5 \cdot t)}{5 \cdot \pi} + \frac{\sin(4 \cdot t)}{2 \cdot \pi} + \frac{2 \cdot \sin(3 \cdot t)}{3 \cdot \pi} + \frac{\sin(2 \cdot t)}{\pi} + \frac{2 \cdot \sin(t)}{\pi}$$

#20: VECTOR(ramp_down(t, n), n, 1, 10)

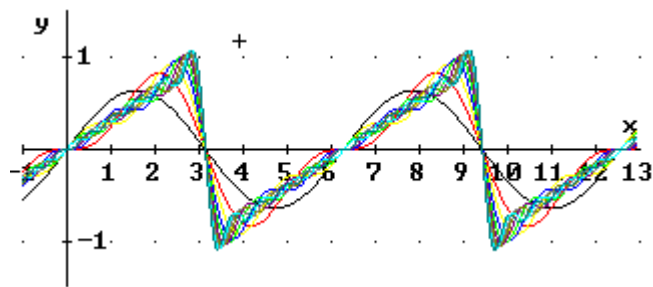


$$\#21: \text{ramp_up}(t, n) := \frac{2}{\pi} \cdot \sum_{k=1}^n \frac{(-1)^{k+1} \cdot \text{SIN}(k \cdot t)}{k}$$

$$\#22: \text{ramp_up}(t, 5)$$

$$\#23: \frac{2 \cdot \text{SIN}(5 \cdot t)}{5 \cdot \pi} - \frac{\text{SIN}(4 \cdot t)}{2 \cdot \pi} + \frac{2 \cdot \text{SIN}(3 \cdot t)}{3 \cdot \pi} - \frac{\text{SIN}(2 \cdot t)}{\pi} + \frac{2 \cdot \text{SIN}(t)}{\pi}$$

$$\#24: \text{VECTOR}(\text{ramp_up}(t, n), n, 1, 10)$$



$$\#25: \text{ramp wave component amplitudes in Vpk and dBVpk}$$

$$\#26: \text{VECTOR}\left(\left[\frac{2}{\pi \cdot k}, 20 \cdot \text{LOG}\left(\frac{2}{\pi \cdot k}, 10\right)\right], k, 1, 16\right)$$

#27:

0.6366197723	-3.92239754
0.3183098861	-9.942997453
0.2122065907	-13.46482263
0.159154943	-15.96359736
0.1273239544	-17.90179762
0.1061032953	-19.48542254
0.09094568176	-20.82435834
0.07957747154	-21.98419728
0.07073553026	-23.00724772
0.06366197723	-23.92239754
0.05787452476	-24.75025124
0.05305164769	-25.50602246
0.04897075172	-26.20126458
0.04547284088	-26.84495825
0.04244131815	-27.44422272
0.03978873577	-28.00479719