

General 1st Order Ordinary Differential Equation

$$a \frac{dy}{dt} + by = F(t) \quad (1)$$

solve for highest order derivative ($\frac{dy}{dt}$) in (1)

$$\frac{dy}{dt} = \frac{1}{a} [F(t) - by] \quad (1a)$$

introduce 1 variable:

let:

$$x_1 = y$$

differentiate:

$$\frac{dx_1}{dt} = \frac{1}{a} [F(t) - bx_1] \quad (1b)$$

equiv. (1a) replacing
values with x's

setup calculation table:

index	time	F(t)	x_1	$\frac{dx_1}{dt}$
1	t_0	use	$x_{1,0}$	equiv. (1b)
2	$t_0 + \Delta t$	$F(t) = A \sin(\omega t)$	Numerical Method	
3	$t_0 + 2\Delta t$			
...	...			

initial conditions

General 1st Order Ordinary Differential Equation Numerical Solution

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Variables
a      2      s
b      1

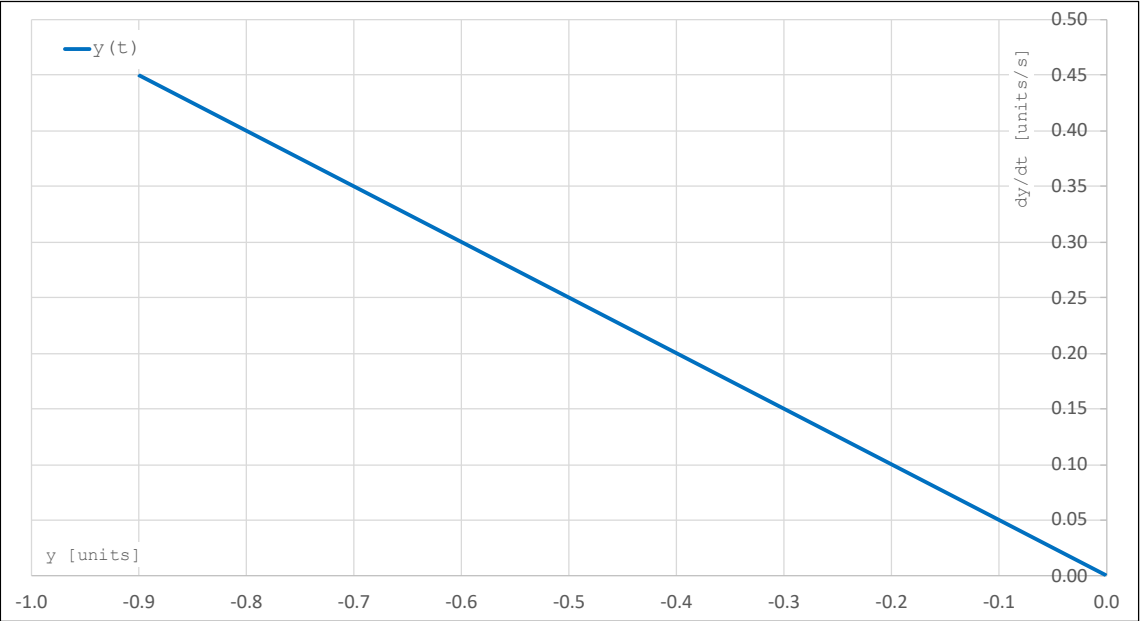
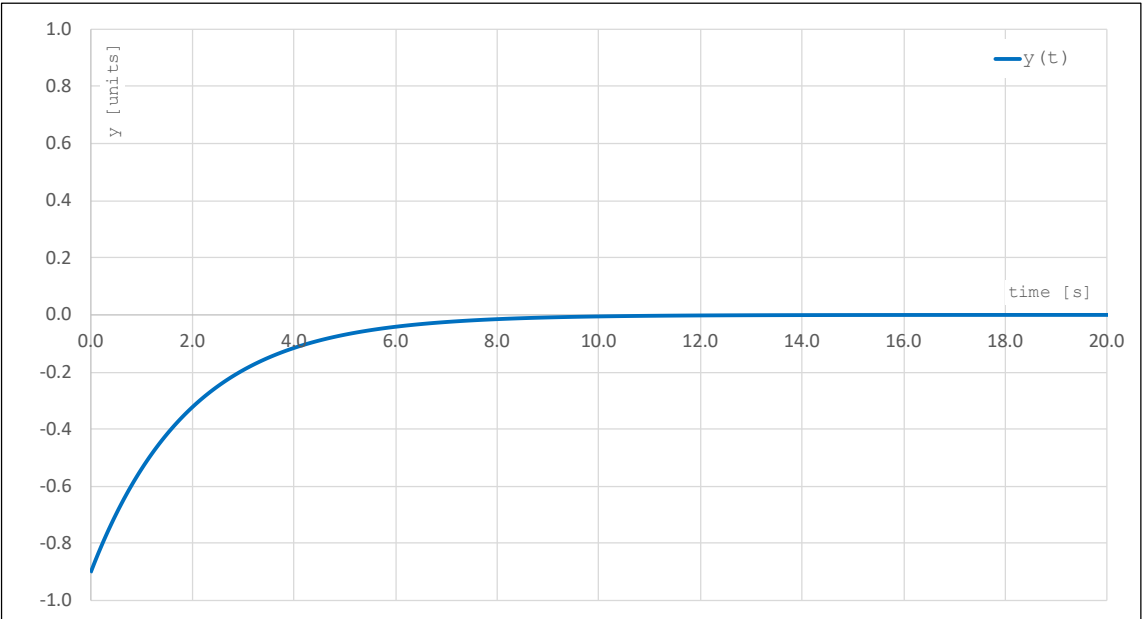
Initial Conditions
t_o    0      s
y_o    -0.9   units    <- non-zero initial position

Sine Forcing Function
amplitude  0      units    <- zero forcing function
frequency  10     Hz = cycles/s
omega     = 62.83  rads/s  (omega = 2*pi*frequency)
Period    = 0.10   s      (Period = 1/frequency)
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Numerical Parameters
dt      = 0.1000  s
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Numerical Solution				
index []	time [s]	F(t) [units]	x_1 (y) [units]	dx_1/dt (dy/dt) [units/s]
1	0.0000	0.0000	-0.9000	0.4500
2	0.1000	0.0000	-0.8550	0.4275
3	0.2000	0.0000	-0.8123	0.4061
4	0.3000	0.0000	-0.7716	0.3858
5	0.4000	0.0000	-0.7331	0.3665
6	0.5000	0.0000	-0.6964	0.3482
7	0.6000	0.0000	-0.6616	0.3308
8	0.7000	0.0000	-0.6285	0.3143
9	0.8000	0.0000	-0.5971	0.2985
10	0.9000	0.0000	-0.5672	0.2836
11	1.0000	0.0000	-0.5389	0.2694
12	1.1000	0.0000	-0.5119	0.2560
13	1.2000	0.0000	-0.4863	0.2432
14	1.3000	0.0000	-0.4620	0.2310
15	1.4000	0.0000	-0.4389	0.2195
16	1.5000	0.0000	-0.4170	0.2085
17	1.6000	0.0000	-0.3961	0.1981
18	1.7000	0.0000	-0.3763	0.1882
19	1.8000	0.0000	-0.3575	0.1787
20	1.9000	0.0000	-0.3396	0.1698
21	2.0000	0.0000	-0.3226	0.1613
22	2.1000	0.0000	-0.3065	0.1533
23	2.2000	0.0000	-0.2912	0.1456
24	2.3000	0.0000	-0.2766	0.1383
25	2.4000	0.0000	-0.2628	0.1314
26	2.5000	0.0000	-0.2497	0.1248
27	2.6000	0.0000	-0.2372	0.1186
28	2.7000	0.0000	-0.2253	0.1127
29	2.8000	0.0000	-0.2140	0.1070
30	2.9000	0.0000	-0.2033	0.1017
31	3.0000	0.0000	-0.1932	0.0966
32	3.1000	0.0000	-0.1835	0.0918
33	3.2000	0.0000	-0.1743	0.0872
34	3.3000	0.0000	-0.1656	0.0828
35	3.4000	0.0000	-0.1573	0.0787
36	3.5000	0.0000	-0.1495	0.0747
37	3.6000	0.0000	-0.1420	0.0710
38	3.7000	0.0000	-0.1349	0.0675
39	3.8000	0.0000	-0.1282	0.0641
40	3.9000	0.0000	-0.1217	0.0609

simulates a
step response



General 1st Order Ordinary Differential Equation Numerical Solution

Variables
a 1 s
b 1

Initial Conditions
t_o 0 s
y_o 0 units

Sine Forcing Function
amplitude 1 units
frequency 0.1 Hz = cycles/s
omega = 0.63 rads/s (omega = 2*pi*frequency)
Period = 10.00 s (Period = 1/frequency)

Numerical Parameters
dt = 0.1000 s

Numerical Solution				
index []	time [s]	F(t) [units]	x_1 (y) [units]	dx_1/dt (dy/dt) [units/s]
1	0.0000	0.0000	0.0000	0.0000
2	0.1000	0.0628	0.0000	0.0628
3	0.2000	0.1253	0.0063	0.1191
4	0.3000	0.1874	0.0182	0.1692
5	0.4000	0.2487	0.0351	0.2136
6	0.5000	0.3090	0.0565	0.2526
7	0.6000	0.3681	0.0817	0.2864
8	0.7000	0.4258	0.1104	0.3154
9	0.8000	0.4818	0.1419	0.3399
10	0.9000	0.5358	0.1759	0.3599
11	1.0000	0.5878	0.2119	0.3759
12	1.1000	0.6374	0.2495	0.3880
13	1.2000	0.6845	0.2883	0.3963
14	1.3000	0.7290	0.3279	0.4011
15	1.4000	0.7705	0.3680	0.4025
16	1.5000	0.8090	0.4083	0.4008
17	1.6000	0.8443	0.4483	0.3960
18	1.7000	0.8763	0.4879	0.3884
19	1.8000	0.9048	0.5268	0.3781
20	1.9000	0.9298	0.5646	0.3652
21	2.0000	0.9511	0.6011	0.3500
22	2.1000	0.9686	0.6361	0.3325
23	2.2000	0.9823	0.6693	0.3129
24	2.3000	0.9921	0.7006	0.2915
25	2.4000	0.9980	0.7298	0.2682
26	2.5000	1.0000	0.7566	0.2434
27	2.6000	0.9980	0.7809	0.2171
28	2.7000	0.9921	0.8027	0.1895
29	2.8000	0.9823	0.8216	0.1607
30	2.9000	0.9686	0.8377	0.1309
31	3.0000	0.9511	0.8508	0.1003
32	3.1000	0.9298	0.8608	0.0690
33	3.2000	0.9048	0.8677	0.0371
34	3.3000	0.8763	0.8714	0.0049
35	3.4000	0.8443	0.8719	-0.0276
36	3.5000	0.8090	0.8691	-0.0601
37	3.6000	0.7705	0.8631	-0.0926
38	3.7000	0.7290	0.8539	-0.1249
39	3.8000	0.6845	0.8414	-0.1568
40	3.9000	0.6374	0.8257	-0.1883

