2) N, kg, m and second are consistent units.

$Po := 50 \quad m := 17.5 \quad k := 7000 \quad td := 0.2 \quad dt := 0.025 \quad tmax := 2$

$\omega n := \sqrt{\frac{k}{m}} \quad T := \frac{2 \cdot \pi}{\omega n} \quad \omega n = 20 \quad T = 0.31416$

$$P(Po, td, dt, tmax) := \left| \begin{array}{l} t \leftarrow -dt \\ i \leftarrow -1 \\ \text{while } t \le tmax - dt \\ \quad \left| \begin{array}{l} t \leftarrow t + dt \\ i \leftarrow i + 1 \\ P_{i,0} \leftarrow t \\ P_{i,1} \leftarrow Po \cdot \frac{t}{td} \quad \text{if } t \le td \\ P_{i,1} \leftarrow 0 \quad \text{otherwise} \end{array} \right. \\ P \end{array} \right.$$

$P(Po, td, dt, tmax) =$

	0	1
0	0	0
1	0.025	6.25
2	0.05	12.5
3	0.075	18.75
4	0.1	25
5	0.125	31.25
6	0.15	37.5
7	0.175	43.75
8	0.2	50
9	0.225	0
10	0.25	0
11	0.275	0
12	0.3	0
13	0.325	0
14	0.35	0
15	0.375	0

$Force := P(Po, td, dt, tmax)$

Q2) Subroutine which calculates the displacement response using Newmark Algorithm.

$$
\mathrm{Newmark}(k, m, dt, \gamma, \beta, \zeta, force, v0, u0) :=
\begin{array}{|l}
countert \leftarrow rows(force) \\
forcev \leftarrow force^{\langle 1 \rangle} \\
time \leftarrow force^{\langle 0 \rangle} \\
\omega n \leftarrow \sqrt{\dfrac{k}{m}} \\
c \leftarrow 2 \cdot \zeta \cdot m \cdot \omega n \\
v_0 \leftarrow v0 \\
u_{0,1} \leftarrow u0 \\
u_{0,0} \leftarrow time_0 \\
a_0 \leftarrow \dfrac{forcev_0 - c \cdot v_0 - k \cdot u_{0,1}}{m} \\
kh \leftarrow k + \dfrac{\gamma}{\beta \cdot dt} \cdot c + \dfrac{1}{\beta \cdot dt^2} \cdot m \\
ca \leftarrow \dfrac{1}{\beta \cdot dt} \cdot m + \dfrac{\gamma}{\beta} \cdot c \\
cb \leftarrow \dfrac{1}{2 \cdot \beta} \cdot m + dt \cdot \left(\dfrac{\gamma}{2 \cdot \beta} - 1 \right) \cdot c \\
\text{for } i \in 0 .. countert - 2 \\
\quad \begin{array}{|l}
dp_i \leftarrow forcev_{i+1} - forcev_i + ca \cdot v_i + cb \cdot a_i \\
du_i \leftarrow \dfrac{dp_i}{kh} \\
dv_i \leftarrow \dfrac{\gamma}{\beta \cdot dt} \cdot du_i - \dfrac{\gamma}{\beta} \cdot v_i + dt \cdot \left(1 - \dfrac{\gamma}{2 \cdot \beta} \right) \cdot a_i \\
da_i \leftarrow \dfrac{1}{\beta \cdot dt^2} \cdot du_i - \dfrac{1}{\beta \cdot dt} \cdot v_i - \dfrac{1}{2 \cdot \beta} \cdot a_i \\
u_{i+1,0} \leftarrow time_{i+1} \\
u_{i+1,1} \leftarrow u_{i,1} + du_i \\
v_{i+1} \leftarrow v_i + dv_i \\
a_{i+1} \leftarrow a_i + da_i
\end{array} \\
u
\end{array}
$$

k : stiffness of the SDOF system.

m : mass of the SDOF system.

dt : Time step.

γ, β : Parameters of Newmark's method.

ζ : Damping ratio.

Force : Matrix which contains the force vector. First column is the time column and second column is the force column.

v0 : initial velocity.

u0 : initial displacement.

A matrix consisting of two columns is the output, first column is the time column and second is the displacement column.

Note : γ = 1/2, β = 1/4 represents the average acceleration method and γ = 1/2, β = 1/6 represents the linear acceleration method. Linear acceleration method is stable when dt/Tn < 0.551 and average acceleration method is stable for any value of dt.

Average acceleration method

$\gamma := \frac{1}{2}$ $\quad \beta := \frac{1}{4}$ $\quad \zeta := 0$ $\quad v0 := 0$ $\quad u0 := 0$

$\text{Newmark}(k, m, dt, \gamma, \beta, \zeta, \text{Force}, v0, u0) =$

	0	1
0	0	0
1	0.025	0.0000525
2	0.05	0.0003028
3	0.075	0.0009019
4	0.1	0.0019191
5	0.125	0.0033251
6	0.15	0.0049991
7	0.175	0.0067574
8	0.2	0.0083963
9	0.225	0.0092675
10	0.25	0.0083783
11	0.275	0.0055178
12	0.3	0.001359
13	0.325	-0.0031196
14	0.35	-0.0068642
15	0.375	-0.0089937

Displacements are in meters.

Linear acceleration method

$\gamma := \frac{1}{2}$ $\beta := \frac{1}{6}$ $\zeta := 0$ $v0 := 0$ $u0 := 0$

$\text{Newmark}(k, m, dt, \gamma, \beta, \zeta, \text{Force}, v0, u0) =$

	0	1
0	0	0
1	0.025	0.0000357
2	0.05	0.0002771
3	0.075	0.0008806
4	0.1	0.0019156
5	0.125	0.003348
6	0.15	0.0050483
7	0.175	0.0068227
8	0.2	0.0084597
9	0.225	0.0094592
10	0.25	0.0084742
11	0.275	0.0054554
12	0.3	0.0011273
13	0.325	-0.0034713
14	0.35	-0.0072369
15	0.375	-0.0092655

Displacements are in meters.