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Mehrin Farzana
2101013

1.a) Given the differential equation that models the behavior of the motor-cycle suspension system,

$$m x'' + b x' + k x = 0$$

$$\therefore 12x'' + 240x' + 1152x = 0$$

$$\therefore x'' + 20x' + 96x = 0$$

is the differential equation.

Given,
Weight of motorcycle with rider, mg,
$= (204 + 180)$
$= 384 = mg$ [m = mass]

Gravitational acceleration,
$g = 32\ ft\ s^{-2}$

$\therefore$ mass, $m = (384/32)$
$= 12$

Displacement, $s = 4/12$ [converting inch to ft]

$\therefore$ spring force, $k = \frac{mg}{s}$

$= \frac{384}{4/12}$

$= 1152$

damping $= bx' = 240x'$ [b = damping coefficient]

$\therefore b = 240$

(P.T.O)

1. b) Finding the equation of motion, $x(t)$, of the motorcycle after jump,

Gotter DE from '1. a)'

$$x'' + 20x' + 96x = 0$$

which is a 2nd order, linear, homogeneous with constant coeefficint differential equation.

let, the solution, $x = e^{mt}$

$\therefore m^2 + 20m + 96 = 0$

$\therefore m = -8, -12$

$\therefore$ The general solution is, $x(t) = C_1 e^{-8t} + C_2 e^{-12t}$

Given the initial conditions,

$x(0) = \frac{4}{12} = \frac{1}{3}$

$x'(0) = 10$

Now,

$x'(t) = -8C_1 e^{-8t} - 12C_2 e^{-12t}$

$x'(0) = -8C_1 - 12C_2 = 10,$

and, $\Rightarrow -4C_1 - 6C_2 = 5 \quad \ldots\ldots (i)$

$x(0) =$

and,

$x(0) = C_1 + C_2 = \frac{1}{3}$

$\Rightarrow 3C_1 + 3C_2 = 1 \quad \ldots\ldots (ii)$

solving (i) & (ii),

$C_1 = \frac{7}{2}$

$C_2 = -\frac{19}{6}$

$\therefore$ Equation of motion, $x(t) = \frac{7}{2} e^{-8t} - \frac{19}{6} e^{-12t}$

(P.T.O)

c) Gotter equation of motion from "1.b)":

$x(t) = \frac{7}{2} e^{-8t} - \frac{19}{6} e^{-12t}$

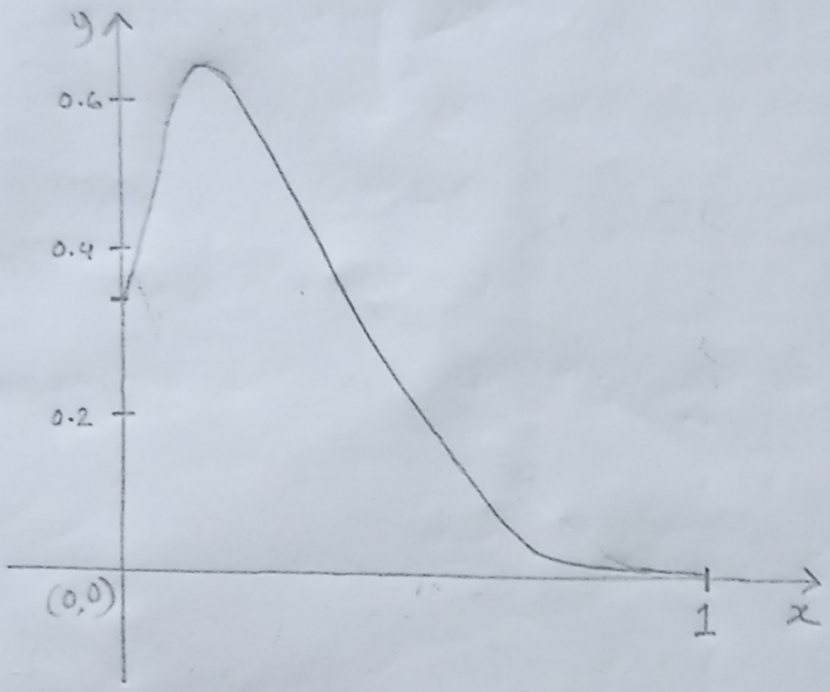

Figure1. : Graph.

table

x	x(t)
0	0.33333
0.1	0.61886
0.2	0.41936
0.3	0.23098
0.4	0.11660
0.5	0.05625
0.6	0.02643
0.7	0.01223
0.8	0.00560
0.9	0.00254
1	0.00115

Figure2 : Table