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Tarea 2

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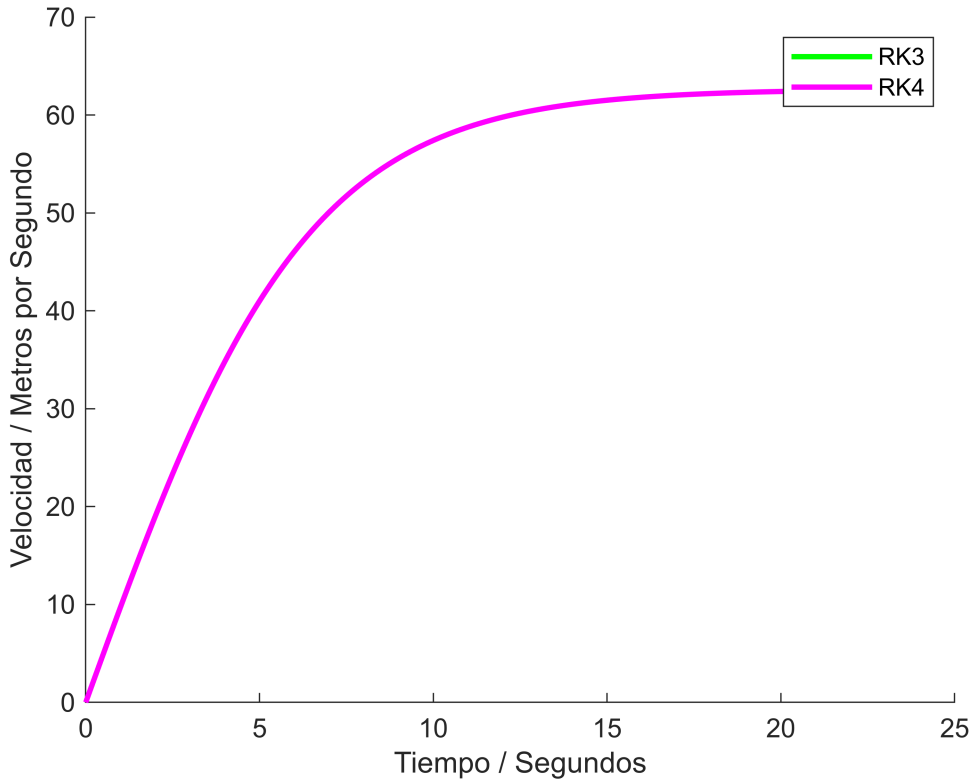
26 de mayo de 2023

```
clear all
clc
```

Velocidad x Tiempo

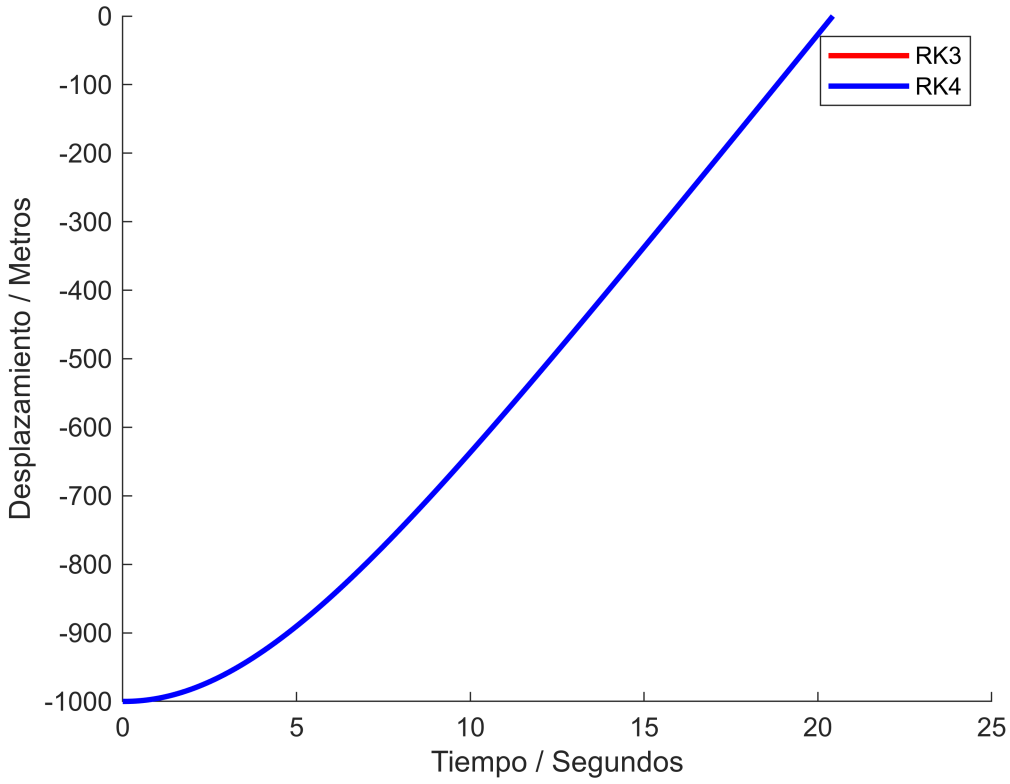
```
g = 9.81; % ms^-2
c_d = 0.225; % kg/m.
m = 90; % kg

t_1 = 0; % t inicial
t_f = 21; % t final
h = 0.1; % Paso delta h

dvdt = @(t,v) g-c_d*(v.^2)/m; % eq dif
v(1) = 0; % v inicial

[t, v_RK3] = RK3(dvdt,t_1,t_f,v,h);
[t, v_RK4] = RK4(dvdt,t_1,t_f,v,h);

figure(1)
hold on

a1 = plot(t, v_RK3, 'g', 'LineWidth', 2); % RK3 - verde
a2 = plot(t, v_RK4, 'm', 'LineWidth', 2); % RK4 - morado

hold off

xlabel('Tiempo / Segundos')
ylabel('Velocidad / Metros por Segundo')
legend([a1,a2], 'RK3', 'RK4')
```



Desplazamiento

```
d_RK3(1) = -1000;
d_RK4(1) = -1000;

for i = 1:length(t)-1
    d_RK3(i+1) = d_RK3(i) + v_RK3(i)*h;
end

for i = 1:length(t)-1
    d_RK4(i+1) = d_RK4(i) + v_RK4(i)*h;
end

figure(2)
hold on

a3 = plot(t,d_RK3, 'r', 'LineWidth', 2);
a4 = plot(t,d_RK4, 'b', 'LineWidth', 2);

hold off

xlabel('Tiempo / Segundos')
ylabel('Desplazamiento / Metros')
y_min = min([d_RK3, d_RK4]);
y_max = 0;
```

```
ylim([y_min y_max])
legend([a3,a4], 'RK3', 'RK4')
```



Resultados

```
T = table(t', d_RK3', d_RK4', v_RK3', v_RK4', 'VariableNames', {'t', 'd_RK3', 'd_RK4','v_RK3',
disp(T)
```

t	d_RK3	d_RK4	v_RK3	v_RK4
0	-1000	-1000	0	0
0.1	-1000	-1000	0.98092	0.98092
0.2	-999.9	-999.9	1.9614	1.9614
0.3	-999.71	-999.71	2.9408	2.9408
0.4	-999.41	-999.41	3.9189	3.9189
0.5	-999.02	-999.02	4.895	4.895
0.6	-998.53	-998.53	5.8687	5.8687
0.7	-997.94	-997.94	6.8396	6.8396
0.8	-997.26	-997.26	7.8072	7.8072
0.9	-996.48	-996.48	8.771	8.771
1	-995.6	-995.6	9.7306	9.7306
1.1	-994.63	-994.63	10.686	10.686
1.2	-993.56	-993.56	11.635	11.635
1.3	-992.4	-992.4	12.58	12.58
1.4	-991.14	-991.14	13.518	13.518
1.5	-989.79	-989.79	14.45	14.45
1.6	-988.34	-988.34	15.376	15.376
1.7	-986.8	-986.8	16.294	16.294

1.8	-985.17	-985.17	17.205	17.205
1.9	-983.45	-983.45	18.108	18.108
2	-981.64	-981.64	19.003	19.003
2.1	-979.74	-979.74	19.889	19.889
2.2	-977.75	-977.75	20.767	20.767
2.3	-975.68	-975.68	21.635	21.635
2.4	-973.51	-973.51	22.495	22.495
2.5	-971.26	-971.26	23.344	23.344
2.6	-968.93	-968.93	24.184	24.184
2.7	-966.51	-966.51	25.014	25.014
2.8	-964.01	-964.01	25.833	25.833
2.9	-961.43	-961.43	26.642	26.642
3	-958.76	-958.76	27.44	27.44
3.1	-956.02	-956.02	28.227	28.227
3.2	-953.2	-953.2	29.004	29.004
3.3	-950.3	-950.3	29.769	29.769
3.4	-947.32	-947.32	30.523	30.523
3.5	-944.27	-944.27	31.265	31.265
3.6	-941.14	-941.14	31.996	31.996
3.7	-937.94	-937.94	32.715	32.715
3.8	-934.67	-934.67	33.423	33.423
3.9	-931.33	-931.33	34.119	34.119
4	-927.91	-927.91	34.803	34.803
4.1	-924.43	-924.43	35.475	35.475
4.2	-920.89	-920.89	36.135	36.135
4.3	-917.27	-917.27	36.784	36.784
4.4	-913.6	-913.6	37.421	37.421
4.5	-909.85	-909.85	38.046	38.046
4.6	-906.05	-906.05	38.659	38.659
4.7	-902.18	-902.18	39.261	39.261
4.8	-898.26	-898.26	39.85	39.85
4.9	-894.27	-894.27	40.429	40.429
5	-890.23	-890.23	40.995	40.995
5.1	-886.13	-886.13	41.55	41.55
5.2	-881.97	-881.97	42.094	42.094
5.3	-877.76	-877.76	42.626	42.626
5.4	-873.5	-873.5	43.148	43.148
5.5	-869.19	-869.19	43.658	43.658
5.6	-864.82	-864.82	44.157	44.157
5.7	-860.41	-860.41	44.645	44.645
5.8	-855.94	-855.94	45.122	45.122
5.9	-851.43	-851.43	45.589	45.589
6	-846.87	-846.87	46.045	46.045
6.1	-842.27	-842.27	46.491	46.491
6.2	-837.62	-837.62	46.926	46.926
6.3	-832.92	-832.92	47.352	47.352
6.4	-828.19	-828.19	47.767	47.767
6.5	-823.41	-823.41	48.173	48.173
6.6	-818.59	-818.59	48.569	48.569
6.7	-813.74	-813.74	48.956	48.956
6.8	-808.84	-808.84	49.333	49.333
6.9	-803.91	-803.91	49.701	49.701
7	-798.94	-798.94	50.06	50.06
7.1	-793.93	-793.93	50.41	50.41
7.2	-788.89	-788.89	50.751	50.751
7.3	-783.82	-783.82	51.084	51.084
7.4	-778.71	-778.71	51.408	51.408
7.5	-773.57	-773.57	51.725	51.725
7.6	-768.4	-768.4	52.033	52.033
7.7	-763.19	-763.19	52.333	52.333
7.8	-757.96	-757.96	52.625	52.625
7.9	-752.7	-752.7	52.91	52.91
8	-747.41	-747.41	53.188	53.188
8.1	-742.09	-742.09	53.458	53.458

8.2	-736.74	-736.74	53.721	53.721
8.3	-731.37	-731.37	53.977	53.977
8.4	-725.97	-725.97	54.226	54.226
8.5	-720.55	-720.55	54.469	54.469
8.6	-715.1	-715.1	54.705	54.705
8.7	-709.63	-709.63	54.935	54.935
8.8	-704.14	-704.14	55.158	55.158
8.9	-698.62	-698.62	55.375	55.375
9	-693.08	-693.08	55.587	55.587
9.1	-687.53	-687.53	55.792	55.792
9.2	-681.95	-681.95	55.992	55.992
9.3	-676.35	-676.35	56.187	56.187
9.4	-670.73	-670.73	56.376	56.376
9.5	-665.09	-665.09	56.56	56.56
9.6	-659.43	-659.43	56.739	56.739
9.7	-653.76	-653.76	56.912	56.912
9.8	-648.07	-648.07	57.081	57.081
9.9	-642.36	-642.36	57.245	57.245
10	-636.64	-636.64	57.405	57.405
10.1	-630.9	-630.9	57.56	57.56
10.2	-625.14	-625.14	57.71	57.71
10.3	-619.37	-619.37	57.856	57.856
10.4	-613.58	-613.58	57.998	57.998
10.5	-607.78	-607.78	58.137	58.137
10.6	-601.97	-601.97	58.271	58.271
10.7	-596.14	-596.14	58.401	58.401
10.8	-590.3	-590.3	58.527	58.527
10.9	-584.45	-584.45	58.65	58.65
11	-578.59	-578.59	58.769	58.769
11.1	-572.71	-572.71	58.885	58.885
11.2	-566.82	-566.82	58.998	58.998
11.3	-560.92	-560.92	59.107	59.107
11.4	-555.01	-555.01	59.213	59.213
11.5	-549.09	-549.09	59.316	59.316
11.6	-543.16	-543.16	59.416	59.416
11.7	-537.22	-537.22	59.513	59.513
11.8	-531.26	-531.26	59.607	59.607
11.9	-525.3	-525.3	59.698	59.698
12	-519.33	-519.33	59.787	59.787
12.1	-513.35	-513.35	59.873	59.873
12.2	-507.37	-507.37	59.957	59.957
12.3	-501.37	-501.37	60.038	60.038
12.4	-495.37	-495.37	60.116	60.116
12.5	-489.36	-489.36	60.193	60.193
12.6	-483.34	-483.34	60.267	60.267
12.7	-477.31	-477.31	60.339	60.339
12.8	-471.28	-471.28	60.408	60.408
12.9	-465.24	-465.24	60.476	60.476
13	-459.19	-459.19	60.542	60.542
13.1	-453.13	-453.13	60.606	60.606
13.2	-447.07	-447.07	60.667	60.667
13.3	-441.01	-441.01	60.727	60.727
13.4	-434.93	-434.93	60.785	60.785
13.5	-428.86	-428.86	60.842	60.842
13.6	-422.77	-422.77	60.897	60.897
13.7	-416.68	-416.68	60.95	60.95
13.8	-410.59	-410.59	61.001	61.001
13.9	-404.49	-404.49	61.051	61.051
14	-398.38	-398.38	61.1	61.1
14.1	-392.27	-392.27	61.147	61.147
14.2	-386.16	-386.16	61.192	61.192
14.3	-380.04	-380.04	61.236	61.236
14.4	-373.91	-373.91	61.279	61.279
14.5	-367.79	-367.79	61.321	61.321

14.6	-361.65	-361.65	61.361	61.361
14.7	-355.52	-355.52	61.4	61.4
14.8	-349.38	-349.38	61.438	61.438
14.9	-343.23	-343.23	61.475	61.475
15	-337.09	-337.09	61.511	61.511
15.1	-330.94	-330.94	61.545	61.545
15.2	-324.78	-324.78	61.579	61.579
15.3	-318.62	-318.62	61.611	61.611
15.4	-312.46	-312.46	61.643	61.643
15.5	-306.3	-306.3	61.673	61.673
15.6	-300.13	-300.13	61.703	61.703
15.7	-293.96	-293.96	61.732	61.732
15.8	-287.79	-287.79	61.76	61.76
15.9	-281.61	-281.61	61.787	61.787
16	-275.43	-275.43	61.813	61.813
16.1	-269.25	-269.25	61.838	61.838
16.2	-263.07	-263.07	61.863	61.863
16.3	-256.88	-256.88	61.887	61.887
16.4	-250.69	-250.69	61.91	61.91
16.5	-244.5	-244.5	61.932	61.932
16.6	-238.31	-238.31	61.954	61.954
16.7	-232.11	-232.11	61.975	61.975
16.8	-225.91	-225.91	61.996	61.996
16.9	-219.72	-219.72	62.015	62.015
17	-213.51	-213.51	62.035	62.035
17.1	-207.31	-207.31	62.053	62.053
17.2	-201.1	-201.11	62.071	62.071
17.3	-194.9	-194.9	62.089	62.089
17.4	-188.69	-188.69	62.106	62.106
17.5	-182.48	-182.48	62.122	62.122
17.6	-176.27	-176.27	62.138	62.138
17.7	-170.05	-170.05	62.154	62.154
17.8	-163.84	-163.84	62.169	62.169
17.9	-157.62	-157.62	62.183	62.183
18	-151.4	-151.4	62.197	62.197
18.1	-145.18	-145.18	62.211	62.211
18.2	-138.96	-138.96	62.224	62.224
18.3	-132.74	-132.74	62.237	62.237
18.4	-126.51	-126.51	62.249	62.249
18.5	-120.29	-120.29	62.262	62.262
18.6	-114.06	-114.06	62.273	62.273
18.7	-107.84	-107.84	62.285	62.285
18.8	-101.61	-101.61	62.296	62.296
18.9	-95.378	-95.379	62.306	62.306
19	-89.148	-89.148	62.317	62.317
19.1	-82.916	-82.916	62.327	62.327
19.2	-76.683	-76.684	62.336	62.336
19.3	-70.45	-70.45	62.346	62.346
19.4	-64.215	-64.215	62.355	62.355
19.5	-57.98	-57.98	62.364	62.364
19.6	-51.743	-51.744	62.372	62.372
19.7	-45.506	-45.506	62.38	62.38
19.8	-39.268	-39.268	62.388	62.388
19.9	-33.029	-33.029	62.396	62.396
20	-26.79	-26.79	62.404	62.404
20.1	-20.549	-20.549	62.411	62.411
20.2	-14.308	-14.308	62.418	62.418
20.3	-8.0664	-8.0665	62.425	62.425
20.4	-1.8239	-1.824	62.432	62.432
20.5	4.4193	4.4192	62.438	62.438
20.6	10.663	10.663	62.445	62.445
20.7	16.908	16.907	62.451	62.451
20.8	23.153	23.153	62.457	62.457

```
    20.9     29.398     29.398     62.462     62.462
      21     35.645     35.644     62.468     62.468
```

Por lo tanto se estima que al rededor del segundo 20.42 (s), el paracaidista llega al piso.

Método de Runge Kutta Orden 3

```
function [x,y] = RK3(f,x_1,x_f,y,h)
    x = x_1:h:x_f;
    for i = 1:length(x)-1
        k1 = f(x(i), y(i));
        k2 = f(x(i) + h/2, y(i) + k1*h/2);
        k3 = f(x(i) + h, y(i) - k1*h + 2*k2*h);
        y(i+1) = y(i) + (k1 + 4*k2 + k3)*h/6;
    end
end
```

Método de Runge Kutta Orden 4

```
function [x,y] = RK4(f,x_1,x_f,y,h)
    x = x_1:h:x_f;
    for i = 1:length(x)-1
        k1 = f(x(i), y(i));
        k2 = f(x(i) + h/2, y(i) + k1*h/2);
        k3 = f(x(i) + h/2, y(i) + k2*h/2);
        k4 = f(x(i) + h, y(i) + k3*h);
        y(i+1) = y(i) + (k1 + 2*k2 + 2*k3 + k4)*h/6;
    end
end
```