Zheng Yin
V00915261
CSC349a
Assignment 1

Question 1:

(a)

```
function Euler(m,c,g,t0,v0,tn,n)
fprintf('values of t   approximations v(t)\n')
fprintf('%8.3f',t0),fprintf('%19.4f\n',v0)
h=(tn-t0)/n;
t=t0;
v=v0;
for i=1:n
    v=v+(g-c/m*v)*h;
    t=t+h;
    fprintf('%8.3f',t),fprintf('%19.4f\n',v)
end
```

(b)

```
>> Euler(86.2, 12.5, 9.81, 0, 0, 12, 15)
values of t approximations v(t)
   0.000              0.0000
   0.800              7.8480
   1.600             14.7856
   2.400             20.9183
   3.200             26.3396
   4.000             31.1319
   4.800             35.3684
   5.600             39.1133
   6.400             42.4238
   7.200             45.3502
   8.000             47.9372
   8.800             50.2240
   9.600             52.2456
  10.400             54.0326
  11.200             55.6123
  12.000             57.0088
>>
```

(c)

```
>> Euler(86.2, 3.71, 9.81, 0, 0, 12, 15)
values of t approximations v(t)
    0.000            0.0000
    0.800            7.8480
    1.600           15.4258
    2.400           22.7426
    3.200           29.8076
    4.000           36.6293
    4.800           43.2161
    5.600           49.5761
    6.400           55.7171
    7.200           61.6467
    8.000           67.3721
    8.800           72.9003
    9.600           78.2383
   10.400           83.3924
   11.200           88.3691
   12.000           93.1744
>>
```

(d)

```
function relativeError(m,c,g,t0, v0, tn, n)
fprintf('values of t    RelativeError(V1 as VE)  RelativeError(V2 as
VE)\n')
fprintf('%8.3f',t0),fprintf('%19.4f',v0),fprintf('%30.5f\n',v0)
h = (tn-t0)/n;
t = t0;
v1 = v0;
v2 =v0;
for i=1:n
    v1= g*m/c*(1-exp(-(c*(t+h)/m)));
    v2 =v2+(g-c/m*v2)*h;
    RE1 = abs((v1-v2)/v2);
    RE2 = abs((v2-v1)/v1);
    t = t+h;

fprintf('%8.3f',t),fprintf('%19.4f%%',RE1*100),fprintf('%30.5f%%\n',R
E2)
end
```

```
>> relativeError(86.2,12.5,9.81,0,0,12,15)
values of t       RelativeError(V1 as VE)    RelativeError(V2 as VE)
    0.000                    0.0000                              0.00000
```

0.800	5.5825%	0.05913%
1.600	5.2580%	0.05550%
2.400	4.9460%	0.05203%
3.200	4.6468%	0.04873%
4.000	4.3602%	0.04559%
4.800	4.0862%	0.04260%
5.600	3.8248%	0.03977%
6.400	3.5757%	0.03708%
7.200	3.3388%	0.03454%
8.000	3.1139%	0.03214%
8.800	2.9008%	0.02987%
9.600	2.6991%	0.02774%
10.400	2.5086%	0.02573%
11.200	2.3289%	0.02384%
12.000	2.1598%	0.02207%

Question 2

(a)

```
function Euler(m,k,g,t0,v0,tn,n)
% print headings and initial conditions
fprintf('values of t   approximations v(t)      dv/dt\n    ')
fprintf('%8.3f',t0),fprintf('%19.4f',v0), fprintf('%30.5f\n',v0)
% compute step size h
h=(tn-t0)/n;
% set t,v to the initial values
t=t0;
v=v0;
% compute v(t) over n time steps using Euler¡¯s method
for i=1:n
    dv = g-k/m*v^2;
    v=v+dv*h;
    t=t+h;
    fprintf('%8.3f',t),fprintf('%19.4f',v),fprintf('%30.5f\n',dv )
end
```

(b)

>> Euler2(73.5,0.234,9.81, 0,0,18,72)

values of t	approximations v(t)	dv/dt
0.000	0.0000	0.00000
0.250	2.4525	9.81000
0.500	4.9002	9.79085
0.750	7.3336	9.73355
1.000	9.7433	9.63878
1.250	12.1202	9.50777
1.500	14.4558	9.34232
1.750	16.7420	9.14471
2.000	18.9714	8.91763
2.250	21.1374	8.66415
2.500	23.2343	8.38756
2.750	25.2572	8.09134
3.000	27.2019	7.77906
3.250	29.0655	7.45426
3.500	30.8456	7.12042
3.750	32.5408	6.78089
4.000	34.1505	6.43879
4.250	35.6748	6.09702
4.500	37.1143	5.75817
4.750	38.4705	5.42458
5.000	39.7450	5.09824

5.250	40.9402	4.78086
5.500	42.0587	4.47384
5.750	43.1033	4.17829
6.000	44.0770	3.89508
6.250	44.9832	3.62481
6.500	45.8252	3.36786
6.750	46.6063	3.12445
7.000	47.3300	2.89459
7.250	47.9995	2.67817
7.500	48.6182	2.47497
7.750	49.1894	2.28464
8.000	49.7161	2.10679
8.250	50.2013	1.94094
8.500	50.6480	1.78659
8.750	51.0588	1.64318
9.000	51.4363	1.51017
9.250	51.7831	1.38697
9.500	52.1013	1.27302
9.750	52.3933	1.16777
10.000	52.6609	1.07064
10.250	52.9062	0.98112
10.500	53.1309	0.89869
10.750	53.3366	0.82284
11.000	53.5249	0.75311
11.250	53.6971	0.68906
11.500	53.8547	0.63025
11.750	53.9988	0.57630
12.000	54.1305	0.52683
12.250	54.2509	0.48149
12.500	54.3608	0.43996
12.750	54.4613	0.40192
13.000	54.5531	0.36711
13.250	54.6369	0.33526
13.500	54.7134	0.30612
13.750	54.7833	0.27948
14.000	54.8471	0.25512
14.250	54.9053	0.23286
14.500	54.9584	0.21252
14.750	55.0069	0.19394
15.000	55.0512	0.17696
15.250	55.0915	0.16146
15.500	55.1284	0.14731
15.750	55.1620	0.13438
16.000	55.1926	0.12259

16.250	55.2206	0.11182
16.500	55.2461	0.10199
16.750	55.2693	0.09303
17.000	55.2905	0.08484
17.250	55.3099	0.07738
17.500	55.3275	0.07057
17.750	55.3436	0.06435
18.000	55.3583	0.05868

(c) When t =18, the relative error is about 0.0717% by dv/dt=g-k\m*v^2 function.
The relative error is about 0.00072% by exact (c) function.

Question 3

```
function MLseries(x,t)
fprintf('terms        first function        second function
RE by 1st fun       RE by 2nd fun\n')
FFun = 0;
SFun0 = 0;
trueValue = 0.135335;
for i=0:t
    FFun = FFun+ (-x)^i/factorial(i);
    SFun0 = SFun0 + x^i/factorial(i);
    SFun = 1/SFun0;
    RE1 = abs((trueValue-FFun)/FFun)*100;
    RE2 = abs((trueValue-SFun)/SFun)*100;

fprintf('%8.3f',i),fprintf('%19.4f',FFun),fprintf('%25.5f',SFun),fpri
ntf('%20.5f%%',RE1),fprintf('%20.5f%%\n',RE2)
end
```

```
>> MLseries(2,7)
terms          first function          second function          RE by 1st fun          RE by 2nd fun
   0.000              1.0000                 1.00000              86.46650%              86.46650%
   1.000             -1.0000                 0.33333             113.53350%              59.39950%
   2.000              1.0000                 0.20000              86.46650%              32.33250%
   3.000             -0.3333                 0.15789             140.60050%              14.28783%
   4.000              0.3333                 0.14286              59.39950%               5.26550%
   5.000              0.0667                 0.13761             103.00250%               1.65657%
   6.000              0.1556                 0.13595              12.99893%               0.45359%
   7.000              0.1302                 0.13548               3.97689%               0.10988%
>>
```