CSC 349A Assignment 1
Allan Liu
V00806981

Q1. (a)

```
function Euler(m,c,g,t0,v0,tn,n)
% print headings and initial conditions
fprintf('values of t approximations v(t)\n')
fprintf('%8.3f',t0),fprintf('%19.4f\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
    v=v+(g-c/m*v)*h;
    t=t+h;
    fprintf('%8.3f',t),fprintf('%19.4f\n',v)
end
```

Q1. (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
```

Q1. (c)

```
>> Euler(86.2, 12.5, 3.71, 0, 0, 12, 15)
values of t approximations v(t)
   0.000             0.0000
   0.800             2.9680
   1.600             5.5917
   2.400             7.9110
   3.200             9.9612
   4.000            11.7737
   4.800            13.3758
   5.600            14.7921
   6.400            16.0441
   7.200            17.1508
   8.000            18.1292
   8.800            18.9940
```

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```
   9.600              19.7585
  10.400              20.4343
  11.200              21.0318
  12.000              21.5599
```

Q1. (d)

```
>> (9.81*86.2/12.5)*(1-exp(-12.5*12/86.2))

ans =

   55.7775

>> abs((55.7775-57.0088)/55.7775)

ans =

    0.0221
```

Q2. (a)

```
function Euler2(m,k,g,t0,v0,tn,n)
% print headings and initial conditions
fprintf('values of t approximations v(t)\n')
fprintf('%8.3f',t0),fprintf('%19.4f\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
    v=v+(g-k/m*v^2)*h;
    t=t+h;
    fprintf('%8.3f',t),fprintf('%19.4f\n',v)
end
```

Q2. (b)

```
>> Euler2(73.5, 0.234, 9.81, 0, 0, 18, 72)
values of t approximations v(t)
   0.000             0.0000
   0.250             2.4525
   0.500             4.9002
   0.750             7.3336
   1.000             9.7433
   1.250            12.1202
   1.500            14.4558
   1.750            16.7420
   2.000            18.9714
   2.250            21.1374
   2.500            23.2343
   2.750            25.2572
   3.000            27.2019
   3.250            29.0655
```

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3.500	30.8456
3.750	32.5408
4.000	34.1505
4.250	35.6748
4.500	37.1143
4.750	38.4705
5.000	39.7450
5.250	40.9402
5.500	42.0587
5.750	43.1033
6.000	44.0770
6.250	44.9832
6.500	45.8252
6.750	46.6063
7.000	47.3300
7.250	47.9995
7.500	48.6182
7.750	49.1894
8.000	49.7161
8.250	50.2013
8.500	50.6480
8.750	51.0588
9.000	51.4363
9.250	51.7831
9.500	52.1013
9.750	52.3933
10.000	52.6609
10.250	52.9062
10.500	53.1309
10.750	53.3366
11.000	53.5249
11.250	53.6971
11.500	53.8547
11.750	53.9988
12.000	54.1305
12.250	54.2509
12.500	54.3608
12.750	54.4613
13.000	54.5531
13.250	54.6369
13.500	54.7134
13.750	54.7833
14.000	54.8471
14.250	54.9053
14.500	54.9584
14.750	55.0069
15.000	55.0512
15.250	55.0915
15.500	55.1284
15.750	55.1620
16.000	55.1926
16.250	55.2206
16.500	55.2461
16.750	55.2693
17.000	55.2905

```
  17.250             55.3099
  17.500             55.3275
  17.750             55.3436
  18.000             55.3583
```

Q2. (c)

```
>> sqrt((9.81*73.5)/0.234)*tanh(sqrt((9.81*0.234)/73.5)*18)

ans =

   55.3186

>> abs((55.3186-55.3583)/55.3186)

ans =

   7.1766e-04
```

The relative error at t = 18 is:
|εt| = 0.071766%

Q3.

```
>> 1-2+(2^2/factorial(2))-(2^3/factorial(3))+(2^4/factorial(4))-
(2^5/factorial(5))

ans =

    0.0667

>> abs((exp(-2)-0.0667)/exp(-2))

ans =

    0.5071
```

= 50.71%

```
>>
1/(1+2+(2^2/factorial(2))+(2^3/factorial(3))+(2^4/factorial(4))+(2^5/factoria
l(5)))

ans =

    0.1376

>> abs((exp(-2)-0.1376)/exp(-2))

ans =

    0.0167
```

= 1.67%

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The true relative error is closer to the true value when it is approximated by 1 over the MacLaurin series. Both methods will eventually converge to e^{-2} value, but the second method will approach at a faster rate.