Problem Set B
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Math 308-510
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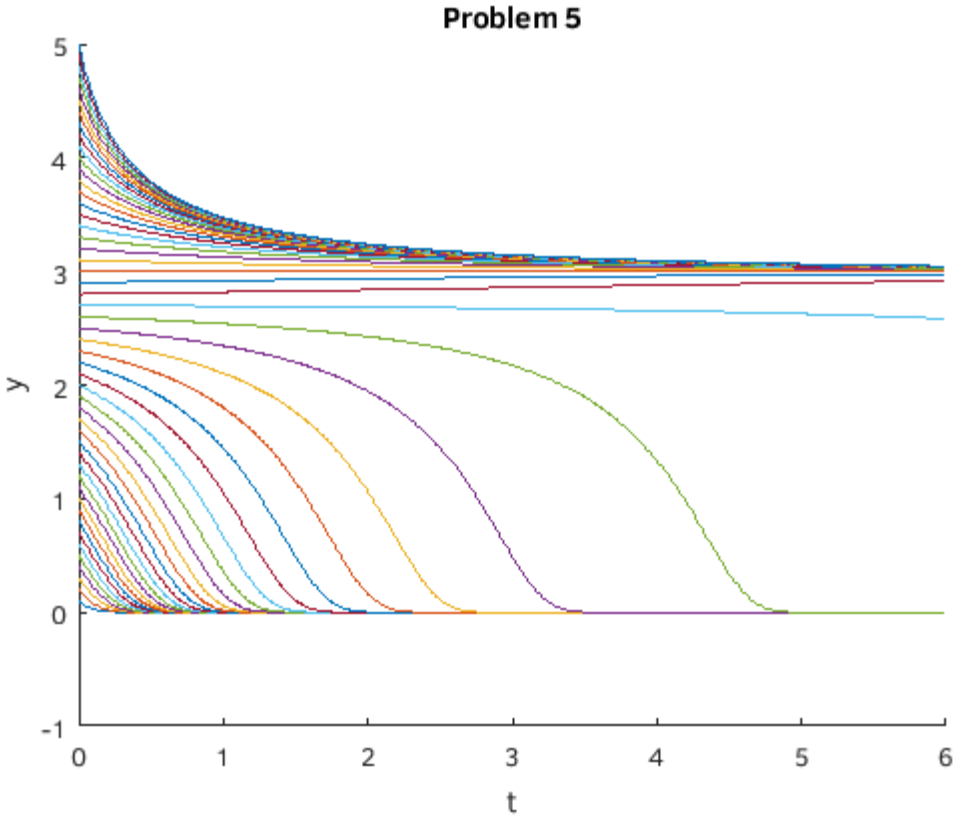
Contents

Problem 5

```
fprintf('Problem 5\n\n')
y0= 0.1:0.1:5; % initialising y(0)
[t,y] = ode45(@problem05,[0 6],[ y0 ]);
hold on;
plot(t,y);

title('Problem 5')
xlabel('t')
ylabel('y')
hold off;
```

```
Problem 5

Warning: Imaginary parts of complex X and/or Y arguments ignored
```



Problem 6

```
fprintf('Problem 6\n\n')

% Part A
fprintf('Part A\n')
clear;
[pt,py] = ode45(@problem06,[1.5 6],[ .5 ]);
[pt1,py1] = ode45(@problem06,[1.5 0],[ .5 ]);

sol = ode45(@problem06,[1.5 6],[ .5 ]);
sol1 = ode45(@problem06,[1.5 0],[ .5 ]);

figure; hold on; grid on;
plot(pt,py,'b');
plot(pt1, py1, 'b')
title('Problem 6 - Part A')
xlabel('t')
ylabel('y')
hold off;

a = deval(sol1, 0);
b = deval(sol1, 1);
c = deval(sol, 1.8);
d = deval(sol, 2.1);
fprintf('Actual Solutions\n')
fprintf(' t \t     y\n')
fprintf('-----------------\n')
fprintf('0\t%.2d\n1\t%.2d\n1.8\t%.2d\n2.1\t%.2d\n\n',a,b,c,d)

% Part B
syms t y
dsolve('Dy = (t - exp(-t))/(y + exp(y))','y(1.5) = .5' ,'t')
```

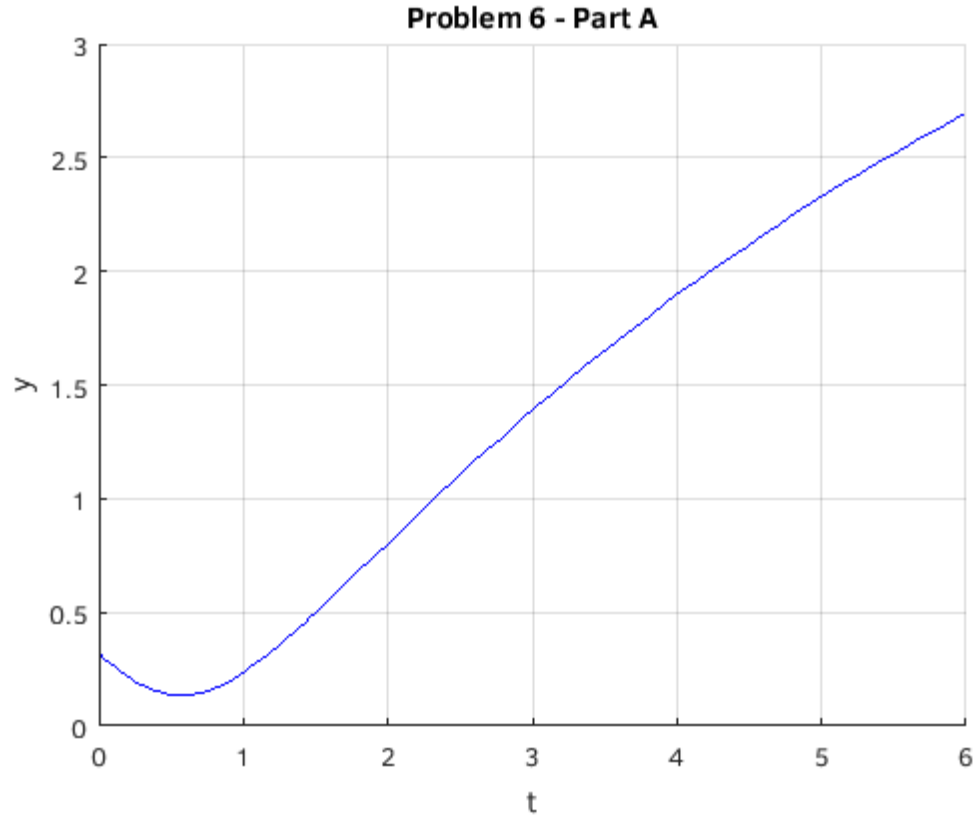
```
f = 1/exp(t) - exp(y) + t^2/2 - y^2/2;
c = subs(f, [t, y], [1.5, 0.5]);

figure; hold on; grid on;
plot(pt,py,'b');
plot(pt1, py1, 'b')
ezplot(f-c, [-1, 3, -2, 2])
title('Problem 6 - Part B')
xlabel('t')
ylabel('y')
legend('show')
legend('Actual Solution', 'Actual Solution', 'Numerical Solution')

fprintf('Numerical Solutions\n')
fprintf(' t \t     y\n')
fprintf('-----------------\n')
for j = [0, 1, 1.8, 2.1]
    f1 = @(y) eval(subs(f, t, j) - c);
    y1 = fzero(f1, 0.5);
    fprintf('%.1d\t%.2d\n',j, double(y1))
    plot(j, double(y1), 'o')
end
fprintf('\nThe Actual and Numerical solutions are the same when rounded to 3 digits.\n\n')
hold off

% Part C
fprintf('Part C\n\n')
figure; hold on; grid on;
ezplot(f-c, [1.5, 10000, -2, 100])
title('Problem 6 - Part C')
xlabel('t')
ylabel('y')
fprintf('From looking at the graph, as t approaches inf, y approaches infinity\n\n')
```

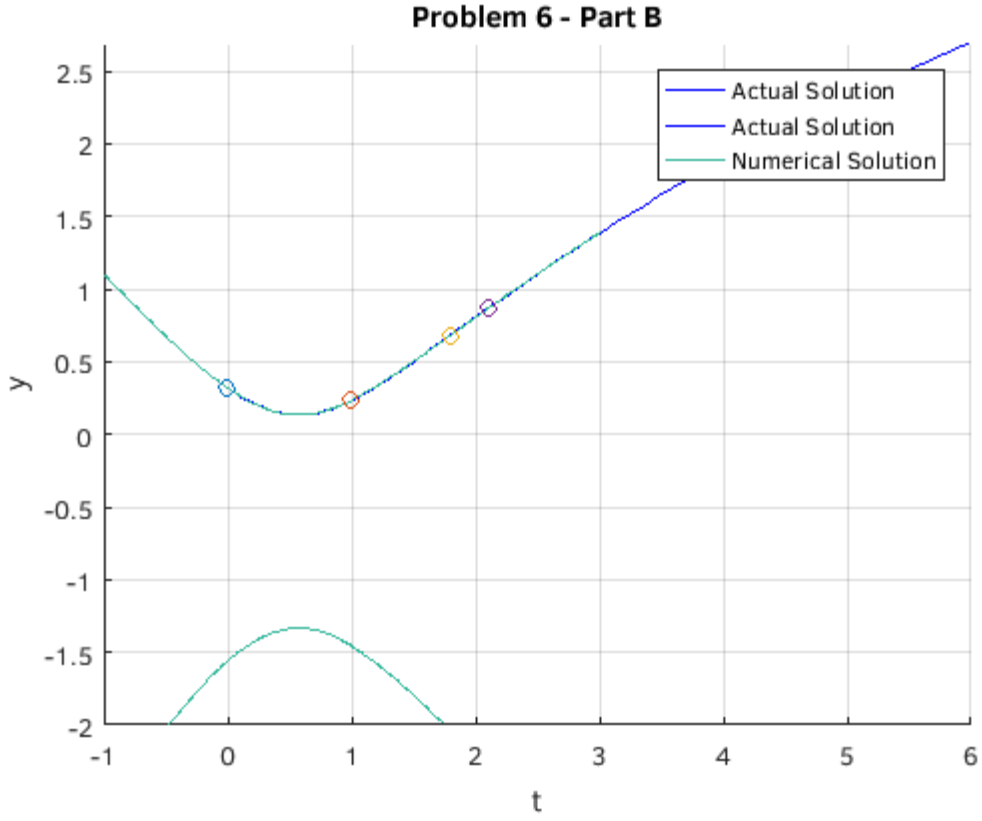
```
Problem 6

Part A
Actual Solutions
 t           y
-----------------
0       3.18e-01
1       2.36e-01
1.8     6.82e-01
2.1     8.66e-01

Warning: Explicit solution could not be found; implicit solution returned.

ans =

solve(2*exp(y) + y^2 == 2*exp(-t) + 2*exp(1/2) - 2*exp(-3/2) + t^2 - 2, y)

Numerical Solutions
 t           y
-----------------
0       3.18e-01
1       2.36e-01
1.8e+00 6.82e-01
2.1e+00 8.66e-01
```

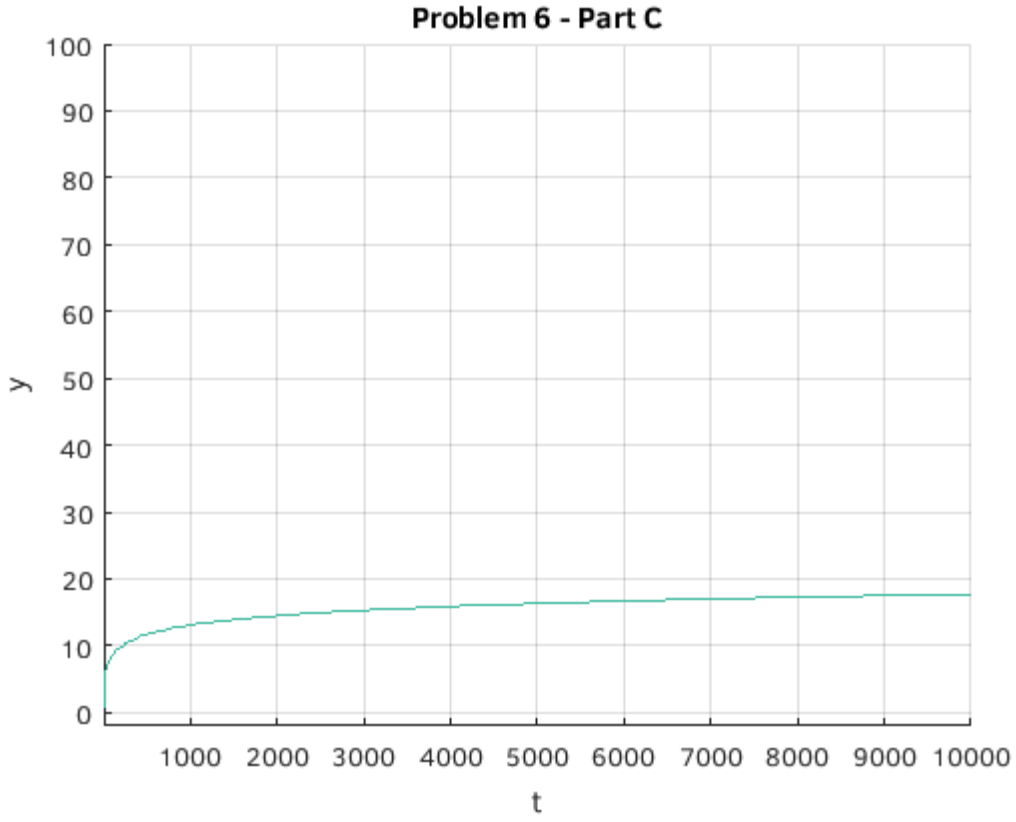
The Actual and Numerical solutions are the same when rounded to 3 digits.

Part C

From looking at the graph, as t approaches inf, y approaches infinity


Problem 6 - Part A
y
t
0
0.5
1
1.5
2
2.5
3
0
1
2
3
4
5
6


Problem 6 - Part B
Actual Solution
Actual Solution
Numerical Solution
y
t
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
-1
0
1
2
3
4
5
6

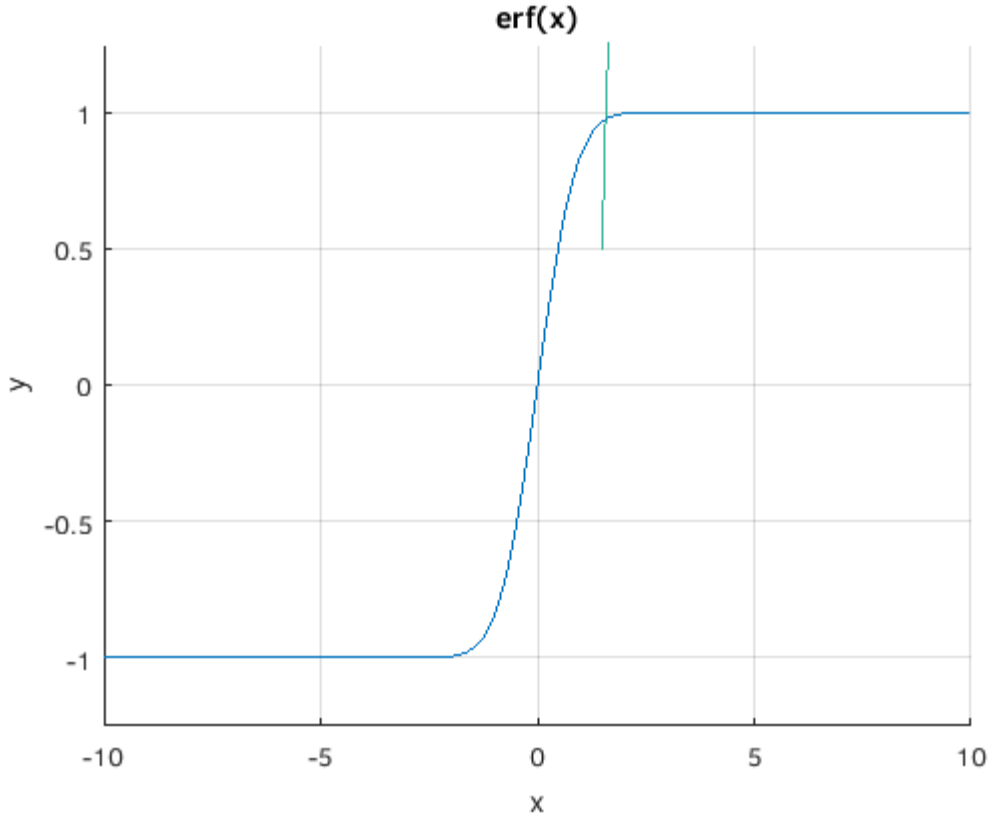


Problem 8

```
fprintf('Problem 8\n\n')
clear;
% Part A
fprintf('Part A\n\n Using dsolve, the solution is below')
dsolve('Dy = exp(-t^2)', 't')

% Part B
syms t x
diff(erf(t),x)
help erf

% Part C
c = [ 0 1 10.5];
erf(c)

ezplot(erf(x), [-10 10])

% Part D
limit(erf(t),t,inf)
int(exp(-t^2),-inf,inf)

% Part E
dsolve('Dy = 1 - 2*t*y','y(0)=0','t')
```

```
Problem 8

Part A

 Using dsolve, the solution is below
```

```
ans =

C5 + (pi^(1/2)*erf(t))/2


ans =

0

 ERF Error function.
    Y = ERF(X) is the error function for each element of X.  X must be
    real. The error function is defined as:

      erf(x) = 2/sqrt(pi) * integral from 0 to x of exp(-t^2) dt.

    See also ERFC, ERFCX, ERFINV, ERFCINV.

    Reference page in Doc Center
       doc erf

    Other functions named erf

       codistributed/erf    gpuArray/erf    sym/erf


ans =

         0    0.8427    1.0000


ans =

1


ans =

pi^(1/2)


ans =

(pi^(1/2)*exp(-t^2)*erfi(t))/2
```



Problem 17

```
clear;
format long
options = odeset('AbsTol', 1e-10, 'RelTol', 1e-10);
sol = ode45(@problem17,[0 6],[ 0 ], options);

t = 0.1:0.1:1;
Ode45Solutions = deval(sol, t);
erfFunc = erf(t);
t = t';

digits(10)
Ode45Solutions = double(vpa(Ode45Solutions))';
erfFunc = double(vpa(erfFunc))';

T = table(t, Ode45Solutions ,erfFunc)
```

```
T =

     t     Ode45Solutions      erfFunc
    ___    ______________    ____________

    0.1    0.1124629162       0.112462916
    0.2    0.2227025894      0.2227025892
    0.3    0.3286267596      0.3286267595
    0.4    0.4283923552       0.428392355
    0.5    0.5204998778      0.5204998778
    0.6    0.6038560909      0.6038560908
    0.7    0.6778011937      0.6778011938
    0.8    0.7421009648      0.7421009647
```

```
    0.9    0.7969082126      0.7969082124
      1    0.8427007932      0.8427007929
```

Functions

problem05

```
function [ dy] = problem05( t, y)
    dy = y.*(1-log(y)).*(y-3);
end
```

problem06

```
function [ dy] = problem06( t, y)
    dy = (t - exp(-t))/(y + exp(y));

end
```

problem17

```
function [ dy] = problem17( t, y)
    dy = 2*exp(-t.^2)/pi^(.5);

end
```

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