ICE for ODE with I.C.

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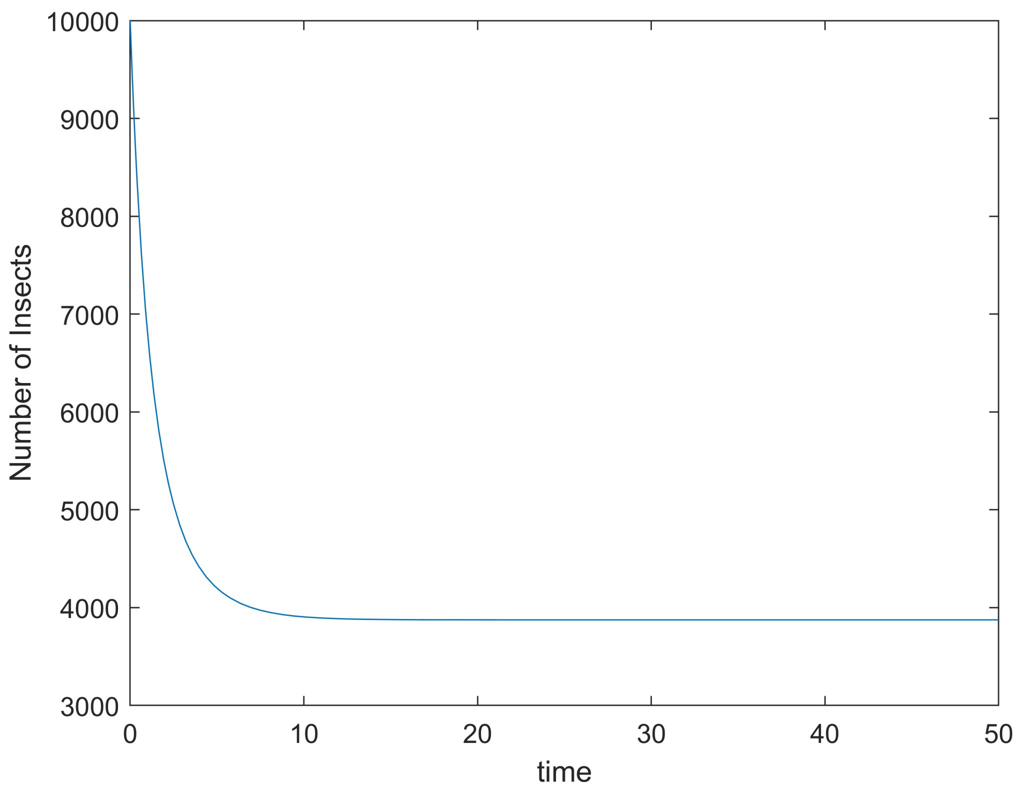
Problem 1

```
clear all; clc;
R = 0.55; C = 10000; NC = 10000; r = 10000; % given values
tr = [0 50]; % time interval
initv = 10000; % innitial condition
f1 = @(t,N) R*N*(1-N/C)-r*N^2/(NC^2+N^2); % function
[t,y] = ode45(f1,tr,initv);
plot(t,y)
ylabel('Number of Insects');
xlabel('time');
```




```
fprintf('The steady state population is %.f \n',y(end));
```

```
The steady state population is 3875
```

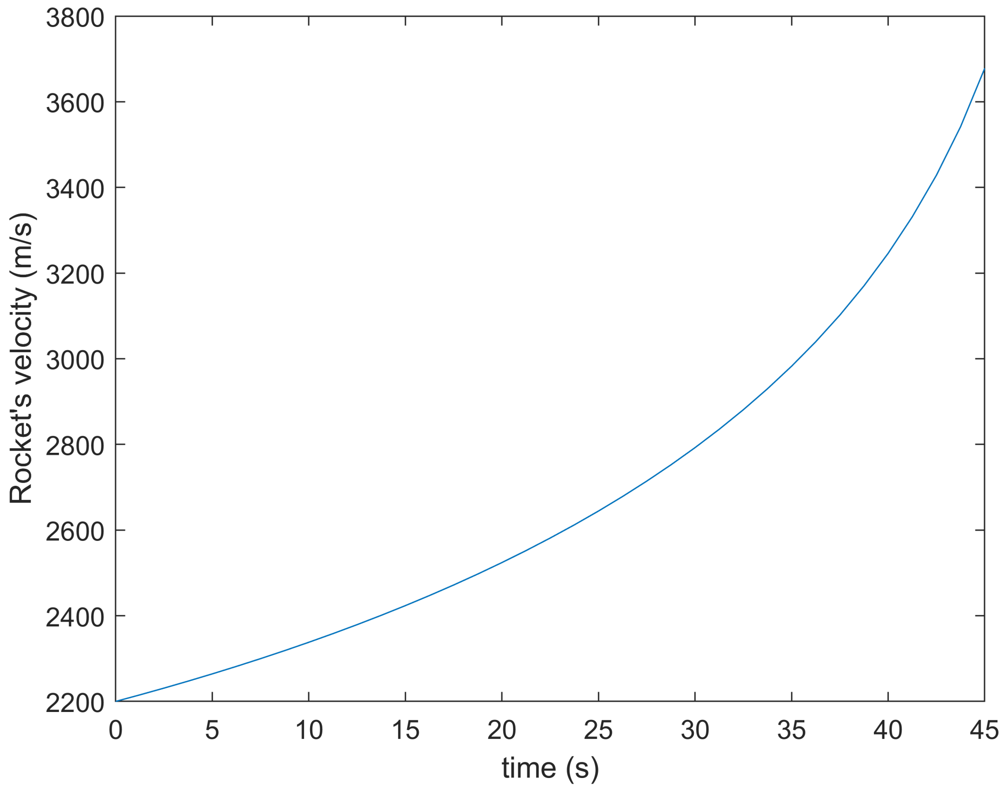
```
fprintf('It takes %.2f days to get there. \n',min(t(fix(y)==fix(y(end)))));
```

```
It takes 21.58 days to get there.
```

Problem 2

```
clear all; clc;
r = 0.8; b = 40; % given values
```

```
tr = [0 b/r]; % time interval
m0 = 2200; % initial condition
[t,y] = ode45(@f2,tr,m0);
plot(t,y);
ylabel('Rocket''s velocity (m/s)');
xlabel('time (s)');
```



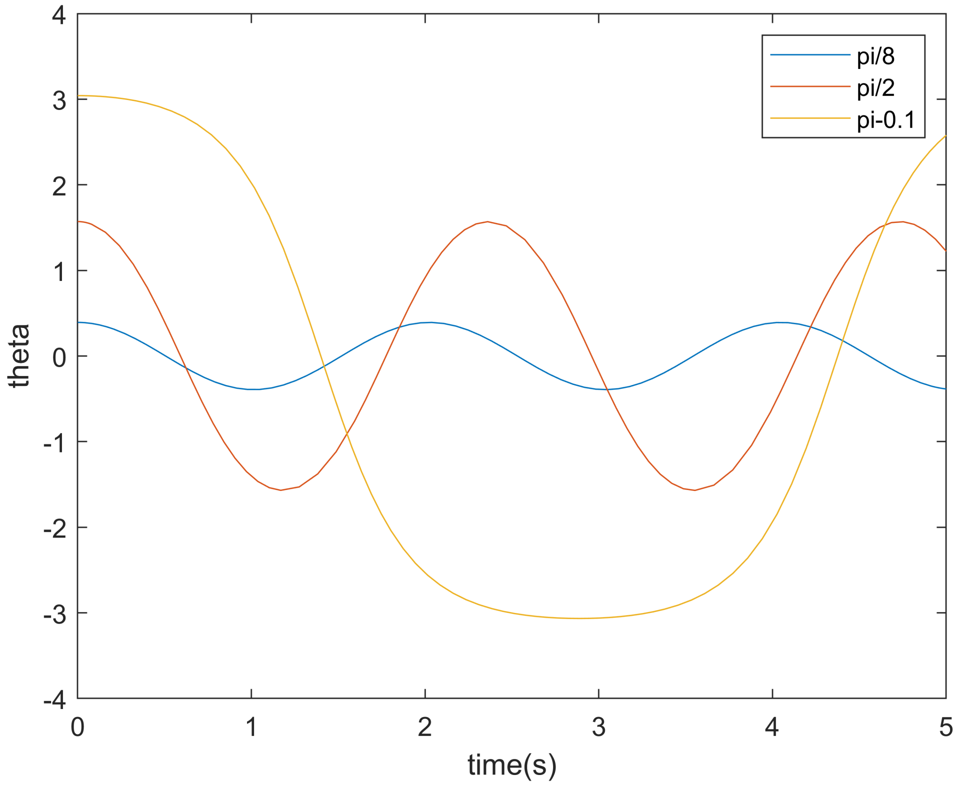

```
fprintf('The final velocity is %.f m/s', y(end-4));
```

```
The final velocity is 3678 m/s
```

Problem 3

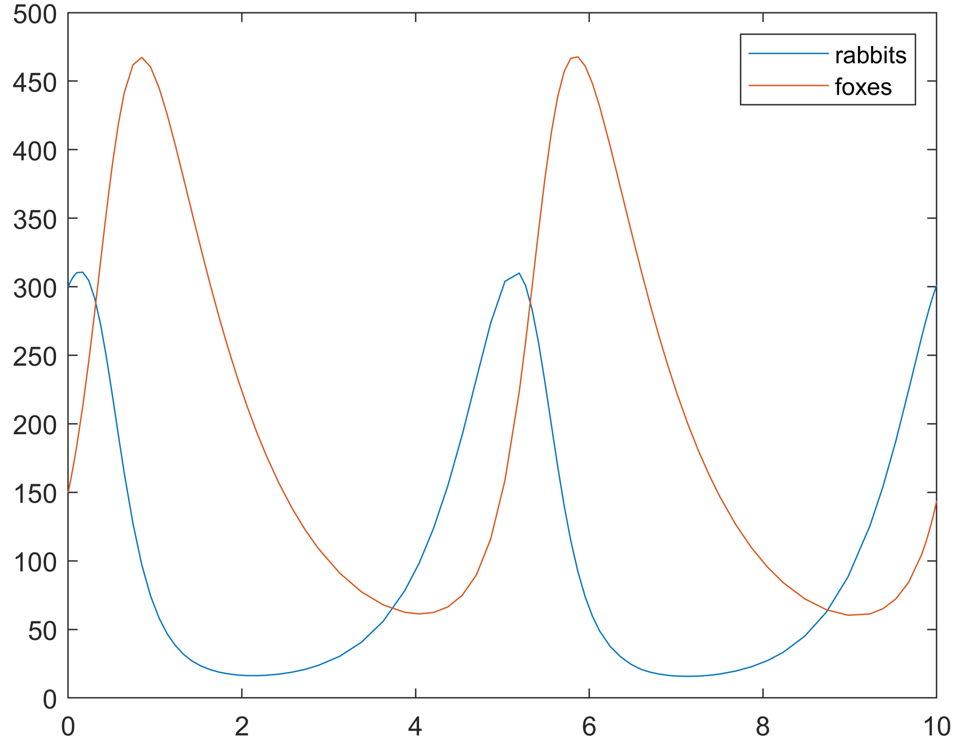
```
clear all; clc;
tr=[0 5]; %seconds
init=[pi/8 0]; %start at pi/8
[t,y]=ode45(@rkpend, tr, init);
plot(t,y(:,1));
ylabel('theta');
xlabel('time(s)');
hold on;

init=[pi/2 0]; %start at pi/2
[t,y]=ode45(@rkpend, tr, init);
plot(t,y(:,1));
hold on;

init=[pi-0.1 0]; %start at pi-0.1
```

```
[t,y]=ode45(@rkpend, tr, init);
plot(t,y(:,1));
hold off;
legend('pi/8','pi/2','pi-0.1');
```



Problem 4

```
clear all; clc;
w0 = [300 150];
tr = [0 10];
[t,y]=ode45(@rkfox, tr, w0);
plot(t,y);
legend('rabbits','foxes');
```



Functions

```
function rk = f2(t,m0)
T = 48000; r = 0.8; g = 9.81; b = 40;
m = m0*(1-r*t/b);
rk = T/m - g;
end

function p = rkpend(t,w)
r = 1; g = 9.81;
p = zeros(2,1);
p(1) = w(2);
p(2) = -g/r*sin(w(1));
end

function z = rkfox(t,w)
alpha = 0.01;
z = zeros(2,1);
z(1) = 2*w(1)-alpha*w(1)*w(2);
z(2) = -w(2)+alpha*w(1)*w(2);
end
```