Contents

HW2 Prob 4

```
clear all; close all; clc
```

a.)

```
a = 2.445;
ecc = 0.9;

period = 2*pi*sqrt(a^3)

mean_motion = 2*pi/period
```

```
period =

   24.0214


mean_motion =

    0.2616
```

b.)

```
disp('nu = 0 at periapsis')
vp = sqrt((1 + 2*ecc*cosd(0) + ecc^2)/(a*(1-ecc^2)))

disp('nu = 180 at apogee')
va = sqrt((1 + 2*ecc*cosd(180) + ecc^2)/(a*(1-ecc^2)))
```

```
nu = 0 at periapsis

vp =

    2.7876

nu = 180 at apogee

va =

    0.1467
```

c.)

```
ecc = 0;
v_circular = sqrt((1 + 2*ecc*cosd(180) + ecc^2)/(a*(1-ecc^2)))
```

```
v_circular =

    0.6395
```

d.)

```
disp('Test case for EccentricAnomaly function works')
EccAnom = EccentricAnomaly(1,0.5,1E-10)
```

```
Test case for EccentricAnomaly function works

EccAnom =

    1.4987
```

e.)

```
clear all; close all; %just to be safe

a = 2.445;
ecc = 0.9;
period = 2*pi*sqrt(a^3);
mean_motion = 2*pi/period;

p = a*(1-ecc^2);

t = [0:0.1:24]';    %TU
len = length(t);

% assuming the orbit starts are periapsis
MeanAnom = mean_motion*(t-t(1));
```

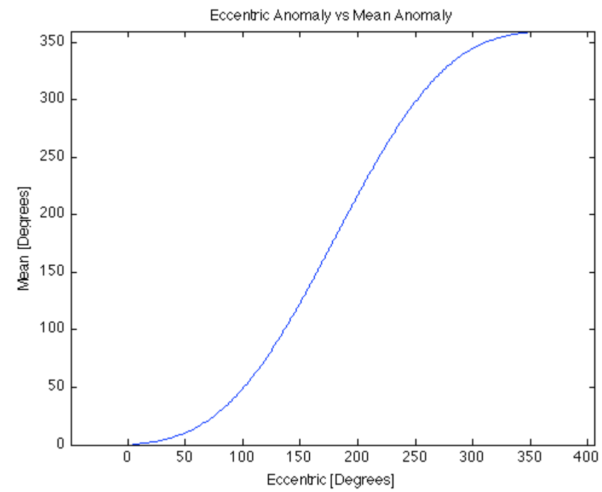
```
EccAnom = EccentricAnomaly(MeanAnom,ecc,1E-10);

num = cos(EccAnom) - ecc;
den = 1 - ecc*cos(EccAnom);

half_plane = floor(MeanAnom/pi);  %which half plane are we in?

TrueAnom = half_plane*pi + acos((-1).^mod(half_plane,2) .* num./den);

% [MeanAnom EccAnom TrueAnom]*180/pi

r = p./(1+ecc*cos(TrueAnom));
x = r.*cos(TrueAnom);
y = r.*sin(TrueAnom);

figure(1)
lim = len;
plot(x(1:lim),y(1:lim))
hold on
scatter(0,0,'black','filled')
axis equal
title('Orbit for part e.) and f.)')
ylabel('[DU]')
xlabel('[DU]')
set(gcf, 'Visible', 'off')
```

f.) It's easier for me to do the full graph for e.) and f.) a little later

g.) Yes they makes sense. Vp is very fast, so the tick marks are spaced far apart around perigee. Conversely, Va is much slower, so there are a lot tick marks bunched up at apogee.

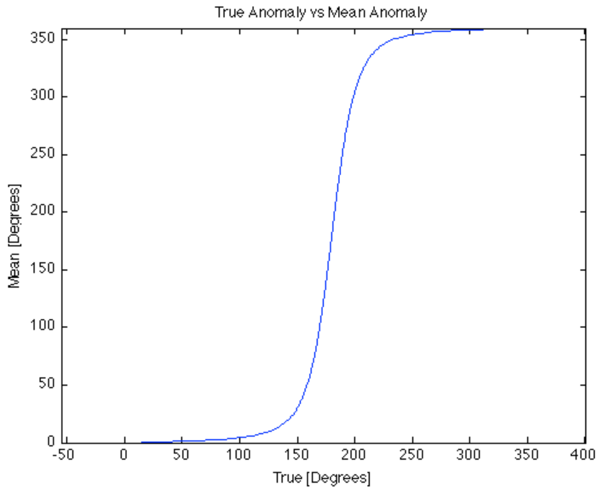
h.)

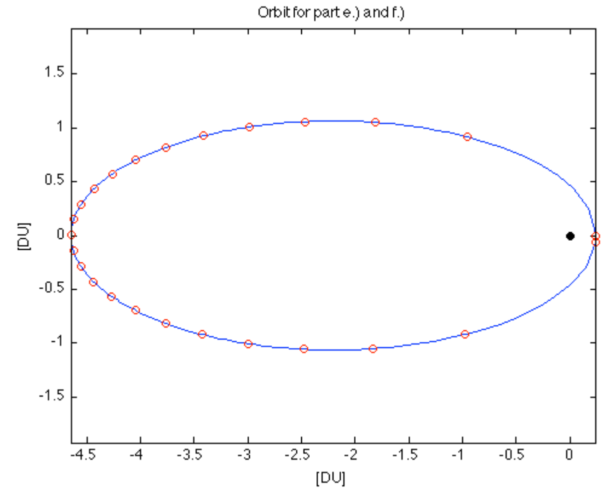
```
figure(2)
plot(EccAnom*180/pi,MeanAnom*180/pi)
title('Eccentric Anomaly vs Mean Anomaly')
xlabel('Eccentric [Degrees]')
ylabel('Mean [Degrees]')
axis equal
```



i.)

```
figure(3)
plot(TrueAnom*180/pi,MeanAnom*180/pi)
title('True Anomaly vs Mean Anomaly')
xlabel('True [Degrees]')
ylabel('Mean [Degrees]')
axis equal
```





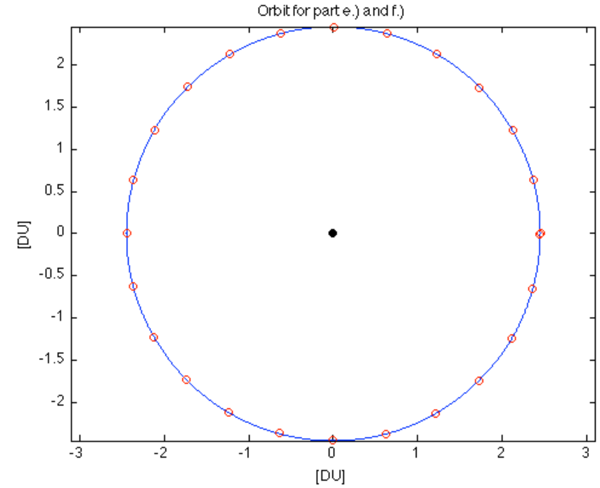
f.) This part contains the graph from e.)

```
t = [0:1:24]';    %TU
len = length(t);

% assuming the orbit starts are periapsis
MeanAnom = mean_motion*(t-t(1));

EccAnom = EccentricAnomaly(MeanAnom,ecc,1E-10);

num = cos(EccAnom) - ecc;
den = 1 - ecc*cos(EccAnom);

half_plane = floor(MeanAnom/pi);  %which half plane are we in?

TrueAnom = half_plane*pi + acos((-1).^mod(half_plane,2) .* num./den);

% [MeanAnom EccAnom TrueAnom]*180/pi

r = p./(1+ecc*cos(TrueAnom));
x = r.*cos(TrueAnom);
y = r.*sin(TrueAnom);

figure(1)
hold on
scatter(x,y)
```

j.)

```
clear all;  %just to be safe

a = 2.445;
ecc = 0.0;
period = 2*pi*sqrt(a^3);
mean_motion = 2*pi/period;

p = a*(1-ecc^2);

t = [0:0.01:24]';    %TU
len = length(t);

% assuming the orbit starts are periapsis
MeanAnom = mean_motion*(t-t(1));

EccAnom = EccentricAnomaly(MeanAnom,ecc,1E-10);

num = cos(EccAnom) - ecc;
den = 1 - ecc*cos(EccAnom);

half_plane = floor(MeanAnom/pi);  %which half plane are we in?

TrueAnom = half_plane*pi + acos((-1).^mod(half_plane,2) .* num./den);

% [MeanAnom EccAnom TrueAnom]*180/pi
```

```
r = p./(1+ecc*cos(TrueAnom));
x = r.*cos(TrueAnom);
y = r.*sin(TrueAnom);

figure(4)
lim = len;
plot(x(1:lim),y(1:lim))
hold on
scatter(0,0,'black','filled')
axis equal
title('Orbit for part e.) and f.)')
ylabel('[DU]')
xlabel('[DU]')
set(gcf, 'Visible', 'off')


t = [0:1:24]';    %TU
len = length(t);

% assuming the orbit starts are periapsis
MeanAnom = mean_motion*(t-t(1));

EccAnom = EccentricAnomaly(MeanAnom,ecc,1E-10);

num = cos(EccAnom) - ecc;
den = 1 - ecc*cos(EccAnom);

half_plane = floor(MeanAnom/pi);  %which half plane are we in?

TrueAnom = half_plane*pi + acos((-1).^mod(half_plane,2) .* num./den);

% [MeanAnom EccAnom TrueAnom]*180/pi

r = p./(1+ecc*cos(TrueAnom));
x = r.*cos(TrueAnom);
y = r.*sin(TrueAnom);

figure(4)
hold on
scatter(x,y)
```



k.) These tick marks make sense because they're equally spaced, as they should be for v_circular, which is known to be constant.