Problem 1

Ultimate period 1

```
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/12, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [0.2804250993, 0.2804250993, 0.2804250993, 0.2804250993, 0.2804250993, 0.2804250993, 0.2804250993,
    0.2804250993, 0.2804250993, 0.2804250993]
                                    1
>
>
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/11, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [0.2953460398, 0.2953460398, 0.2953460398, 0.2953460398, 0.2953460398, 0.2953460398, 0.2953460398,
    0.2953460398, 0.2953460398, 0.2953460398]
                                    1
```

Ult period 1 is
$12 < r_1 > 11$

Ultimate period 2:

```
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/8, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [0.3527798426, 0.3527798382, 0.3527798426, 0.3527798382, 0.3527798426, 0.3527798382, 0.3527798426, 0.3527798382,
    0.3527798426, 0.3527798382, 0.3527798426]
                                    2
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/7, x, 0.5, 1000, 1010), 5);
  nops(convert(orb, set));
          orb := [0.38046, 0.37544, 0.38046, 0.37544, 0.38046, 0.37544, 0.38046, 0.37544, 0.38046, 0.37544, 0.38046]
                                    2
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/6, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
           orb := [1.000000000, 0., 1.000000000, 0., 1.000000000, 0., 1.000000000, 0., 1.000000000, 0., 1.000000000]
                                    2
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/5, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [1.374595800, -0.07615791934, 1.374595800, -0.07615791934, 1.374595800, -0.07615791934, 1.374595800,
    -0.07615791934, 1.374595800, -0.07615791934, 1.374595800]
                                    2
>
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/4.2, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [1.634333755, -0.07542198862, 1.634333755, -0.07542198862, 1.634333755, -0.07542198862, 1.634333755,
    -0.07542198862, 1.634333755, -0.07542198862, 1.634333755]
                                    2
```

Ult period 2

$8 < r_2 > 4.2$

Ultimate period 4:

```
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/4.3, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [1.602892462, -0.07778741962, 1.602892465, -0.07778741922, 1.602892462, -0.07778741962, 1.602892465,
    -0.07778741922, 1.602892462, -0.07778741962, 1.602892465]
                                    4
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/3, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [0.1183980956, 1.593356628, -0.1131337663, 2.440904982, 0.1183980956, 1.593356628, -0.1131337663, 2.440904982,
    0.1183980956, 1.593356628, -0.1131337663]
                                    4
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/2.9, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [0.1315760575, 1.604916910, -0.1149704533, 2.532932385, 0.1315760575, 1.604916910, -0.1149704533, 2.532932385,
    0.1315760575, 1.604916910, -0.1149704533]
                                    4
```

Ult period 4

$4.3 < r_3 > 2.9$

Ultimate period 8:

```
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/2.8, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [-0.1110071952, 2.605850937, 0.1369536087, 1.644099753, -0.1110071955, 2.605850943, 0.1369536085, 1.644099754,
    -0.1110071952, 2.605850937, 0.1369536087]
                                    8
> orb := evalf(Orb(((1-x)*(2-x)*(3-x))/2.5, x, 0.5, 1000, 1010), 10);
  nops(convert(orb, set));
orb := [0.1194622810, 1.907934982, -0.03651387116, 2.563880336, 0.1538353447, 1.778465010, -0.08426502028,
    2.788046846, 0.1194622810, 1.907934982, -0.03651387116]
                                    8
```

Ult period 8

$2.8 < r_4 > 2.5$

Problem 2:

```
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[1.702668856, 2.883800265]]
                                  [1.702668856, 2.883800265]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[1.466338223, 0.6401409548]]
                                  [1.466338223, 0.6401409548]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[−0.8760268425, 0.08683426983]]
                                  [1.178265185, 0.9462708737]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[1.318882008, 1.006391603]]
                                  [1.318882008, 1.006391604]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.937436317, 0.9843108572]]
                                  [0.9374363181, 0.9843108572]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.2937599210, 0.9823180131]]
                                  [0.2937599211, 0.9823180131]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[1.267038967, 0.8520863946]]
                                  [1.267038967, 0.8520863957]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.5532750373, −0.9126574511]]
                                  [1.069877440, 1.075515526]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.05503676534, −3.299145587]]
                                  [1.106322109, 0.7950352790]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.6304591181, 0.5488110759]]
                                  [0.6304591184, 0.5488110759]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  Page Break
                                  [[0.5660622069, 1.613168712]]
                                  [0.5660622075, 1.613168712]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.8655431888, 1.019965719]]
                                  [0.8655431888, 1.019965720]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[−1.452981083, 0.2227264123]]
                                  [1.512537664, 1.038976820]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.800450793, 0.1454795385]]
                                  [0.8004507932, 0.1454795385]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.8266516079, 0.962738662]]
                                  [0.8266516079, 0.9627386626]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.8069457545, 1.058781627]]
                                  [0.8069457545, 1.058781626]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[3.59190321, 0.7407104028]]
                                  [3.591903211, 0.7407104028]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[−0.6268219224, 0.1933515201]]
                                  [1.006383440, 1.459009550]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[0.5385368928, 0.6061718956]]
                                  [0.5385368928, 0.6061718956]
> T := RT([x, y], 30) : SSg(T, [x, y]); ORB(T, [x, y], [100., 200.1], 1000, 1020)[−1];
                                  [[−1.145939322, 0.05072354173]]
                                  [0.9514143582, 0.7464262948]
```

first output : S.S from SSg
Sec. output : UH. pts from Orbit

UH. pt doesn't match S.S

UH. pt doesn't match S.S

UH. pt doesn't match S.S

UH. pt doesn't match S.S

UH. pt doesn't match S.S

Problem 3

```
> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[-0.53184839, 0.2314715919, -0.76706422]]
                    [1.076980050, 0.4973474758, 0.6392660360]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[2.277215714, 1.574190333, 1.778068583]]
                    [2.277215714, 1.574190324, 1.778068575]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[1.06780784, 1.287785074, 0.6648983474]]
                    [1.067807818, 1.287785074, 0.6648983438]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[1.212016385, 1.4868696, 1.393561]]
                    [1.212016385, 1.486869655, 1.393560441]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.8294454100, 1.058357925, 0.8811039882]]
                    [0.8294454100, 1.058357925, 0.8811039870]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.9837386094, 0.8007236198, 1.071229556]]
                    [0.9837386094, 0.8007236197, 1.071229554]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[1.317151631, 0.382119640, 0.7970571275]]
                    [1.317151631, 0.3821196386, 0.7970571275]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.5548426429, 2.14636501, -18.4840981]]
                    [0.7807260002, 1.169212653, 0.9040734947]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                                        Page Break
                    [[0.8261113276, 0.4251406034, 0.6525679713]]
                    [0.8261113267, 0.4251406034, 0.6525679721]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[-1.3718372, 0.5988620261, -0.0821864]]
                    [0.7051750481, 0.8270623734, 1.485938599]
```

```
> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                                        Page Break
                    [[-0.7193601735, -0.6342927658, 0.003276029276]]
                    [1.447438650, 1.138077622, 0.6484857211]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[-5.287356129, 2.680856828, 0.7284795616]]
                    [1.059942347, 1.116199883, 0.7859238319]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[1.596315108, 2.433613142, 1.152569719]]
                    [1.596315108, 2.433613137, 1.152569719]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[1.724483990, 0.829468229, 1.826865352]]
                    [1.724483990, 0.8294682321, 1.826865351]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[1.633902377, 0.428369446, 0.8060629422]]
                    [1.633902377, 0.4283694458, 0.8060629422]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.1610602916, 0.1960553503, -3.234000881]]
                    [1.464759879, 1.129923487, 0.7268896551]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.3746156094, -1.509491927, 0.7842192236]]
                    [0.7147430698, 1.192392793, 0.9622157879]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.623347061, 1.343712327, 1.553819683]]
                    [0.6233470736, 1.343712304, 1.553819683]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.5973782847, 1.0856080, 1.3058327]]
                    [0.5973782847, 1.085608013, 1.305833740]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[0.1236861632, -0.9719333971, 0.0927932650]]
                    [1.389299115, 0.9440293632, 1.010727626]

> T := RT([x, y, z], 10) : SSg(T, [x, y, z]); ORB(T, [x, y, z], [100., 200., 300.], 1000, 1020)[-1];
                    [[4.998778453, 0.7295422156, 1.348571588]]
                    [4.998778452, 0.7295422157, 1.348571588]
```

8 cases are mismatched (highlighted)

first out put : S.S from SSg

Sec. output : Init. pts from Orbit (last point)