Absorption correction with Radial collimator

Pomjakushin, December 2014, corrected

(no sample shift from the RC center.) \alpha denotes theta, \phi and *r* are polar coordinates of the radius vector over with we integrate between 0..2pi, and 0..1, respectively. *rci* is the ratio of the sample radius *R* tc the FWHM of RC. *mu* is the the attenuation coefficient in the reciprocal to *R* units. Actually *mu* and *R* are enter the formular only as a product and are given separately only for convenience.

Absorption correction with Radial collimator

```
> with(plots) :
```

Calculate neutron path. The path goes in at -theta and goes out at +theta.

Calculate neutron path. The path goes in at -theta and goes out at +theta.

```
> s1 := (1-(r * sin (alpha+phi))^2)^(0.5)+r*cos(alpha+phi);
> h2 := abs(r * sin(phi-alpha));
> s2 := (1-(r * sin (alpha-phi))^2)^(0.5)-r*cos(alpha-phi);
> s:= s1+s2;
```

$$s1 := \sqrt{1 - r^2 \sin(\alpha + \phi)^2} + r\cos(\alpha + \phi)$$

$$h2 := |r \sin(-\phi + \alpha)|$$

$$s2 := \sqrt{1 - r^2 \sin(-\phi + \alpha)^2} - r\cos(-\phi + \alpha)$$

$$s := \sqrt{1 - r^2 \sin(\alpha + \phi)^2} + r\cos(\alpha + \phi) + \sqrt{1 - r^2 \sin(-\phi + \alpha)^2} - r\cos(-\phi + \alpha) \qquad (1.1.1)$$

Intensity for full cylinder

s is the total neutron path in the sample for the scattering angle \alpha.
The integral runs over dimensionless var r. To get the integral in real cm^2/pi it has to be multiplied by R^2. In case when for the comparison the Volume should be constant R^2 is not needed. InrV_ we

divide also by Pi to get 1 in case of full cylinder.

$$> Inr\_ := (Int(Int(r\, e^{-(mu\_ R\_ s)} \max(-(h2\, rci\_)+1, 0), \phi=0..2\pi), r=0..1))\, R\_^2;$$

$$InrV\_ := \frac{(Int(Int(r\, e^{-(mu\_ R\_ s)} \max(-(h2\, rci\_)+1, 0), \phi=0..2\pi), r=0..1))}{\pi};$$

$$Inr\_ := \int_0^1 \int_0^{2\pi} r\, e^{-mu\_ R\_ \left(\sqrt{1-r^2 \sin(\alpha+\phi)^2} + r\cos(\alpha+\phi) + \sqrt{1-r^2\sin(-\phi+\alpha)^2} - r\cos(-\phi+\alpha)\right)} \max(0, -|r\sin(-\phi+\alpha)|\, rci\_ + 1)\, d\phi\, dr\, R\_^2$$

$$InrV\_ := \frac{\int_0^1 \int_0^{2\pi} r\, e^{-mu\_ R\_ \left(\sqrt{1-r^2 \sin(\alpha+\phi)^2} + r\cos(\alpha+\phi) + \sqrt{1-r^2\sin(-\phi+\alpha)^2} - r\cos(-\phi+\alpha)\right)} \max(0, -|r\sin(-\phi+\alpha)|\, rci\_ + 1)\, d\phi\, dr}{\pi} \quad (1.2.1$$

```
> #Inr_ :=    Int(Int(r*exp(-mu_*R_*s)*max((1-(rci_*h2)),0),phi=0..2*Pi),r=0..1)*R_^2;
  #Inrdw_ :=  Int(Int(r*exp(-mu_*R_*s*(1-r1))*max((1-(rci_*h2)),0),phi=0..2*Pi),r=r1..1)*R_^2;
  #Inr_ :=  Int(Int(r*exp(-mu_*R_*s)*(1-(rci_*h2)),phi=0..2*Pi),r=0..1)/(Pi);
  #Inrdw_ :=  Int(Int(r*exp(-mu_*R_*s)*(1-(rci_*h2)),phi=0..2*Pi),r=r1..1)/(Pi);
> # mu:=0.387/5; maxi:=10; dia:=10; R:=dia/2; rci:=R/7.; mu*R;
```

Double wall sample holder.

Double wall sample holder. Note: the neutron path s is multiplied by $(1-r1)$! For the const V one has additionally divide by reduced sample surface

$$> Inrdw\_ := \left(\int_{r1}^1 \int_0^{2\pi} r\, e^{-mu\_ R\_ \left(\sqrt{1-r^2 \sin(\alpha+\phi)^2} + r\cos(\alpha+\phi) + \sqrt{1-r^2\sin(-\phi+\alpha)^2} - r\cos(-\phi+\alpha)\right)(1-r1)} \max(0, -|r\sin(-\phi+\alpha)|\, rci\_ + 1)\, d\phi\, dr\right) R\_^2;$$

$$InrdwV\_ := \frac{1}{\pi \cdot (1-r1^2)} \left(\int_{r1}^1\right.$$

$$\int_0^{2\pi} r\, e^{-mu\_R\_\left(\sqrt{1-r^2\sin(\alpha+\phi)^2}+r\cos(\alpha+\phi)+\sqrt{1-r^2\sin(-\phi+\alpha)^2}-r\cos(-\phi+\alpha)\right)(1-r1)} \max\left(0, -|r\sin(-\phi+\alpha)|\, rci\_ + 1\right) d\phi\, dr\Bigg);$$

\>

$$Inrdw\_ := \int_{r1}^{1}\int_0^{2\pi} r\, e^{-mu\_R\_\left(\sqrt{1-r^2\sin(\alpha+\phi)^2}+r\cos(\alpha+\phi)+\sqrt{1-r^2\sin(-\phi+\alpha)^2}-r\cos(-\phi+\alpha)\right)(1-r1)} \max\left(0, -|r\sin(-\phi+\alpha)|\, rci\_ + 1\right) d\phi\, dr\, R\_^2$$

$$InrdwV\_ := \frac{\int_{r1}^{1}\int_0^{2\pi} r\, e^{-mu\_R\_\left(\sqrt{1-r^2\sin(\alpha+\phi)^2}+r\cos(\alpha+\phi)+\sqrt{1-r^2\sin(-\phi+\alpha)^2}-r\cos(-\phi+\alpha)\right)(1-r1)} \max\left(0, -|r\sin(-\phi+\alpha)|\, rci\_ + 1\right) d\phi\, dr}{\pi\left(-r1^2+1\right)} \quad (1.3.1)$$

Calculations for different sample holders and attenuations

rci is (sample radius)/(FWHM of radial collimator), e.g. (6/2)/7 for RC2

```
> mu:=1/2.5; # in [1/mm]
  maxi:=9;
```

$$\mu := 0.4000000000$$

$$maxi := 9 \quad (1.4.1)$$

RC2, full hight vs constant volume: 6mm, 10/7, 10/8, 10/9 double wall (color code is red, green, blue, black)

rc2, constant volume μ=0.4

$$> nump := 9 : xx := \left[\frac{j\cdot 90}{nump}\$(j=0..nump)\right]; col := seq(red, J=0..nump), seq(green, J=0..nump), seq(blue, J=0..nump), seq(black, J=0..nump) :$$

$$\mu_1 := 0.4 :$$

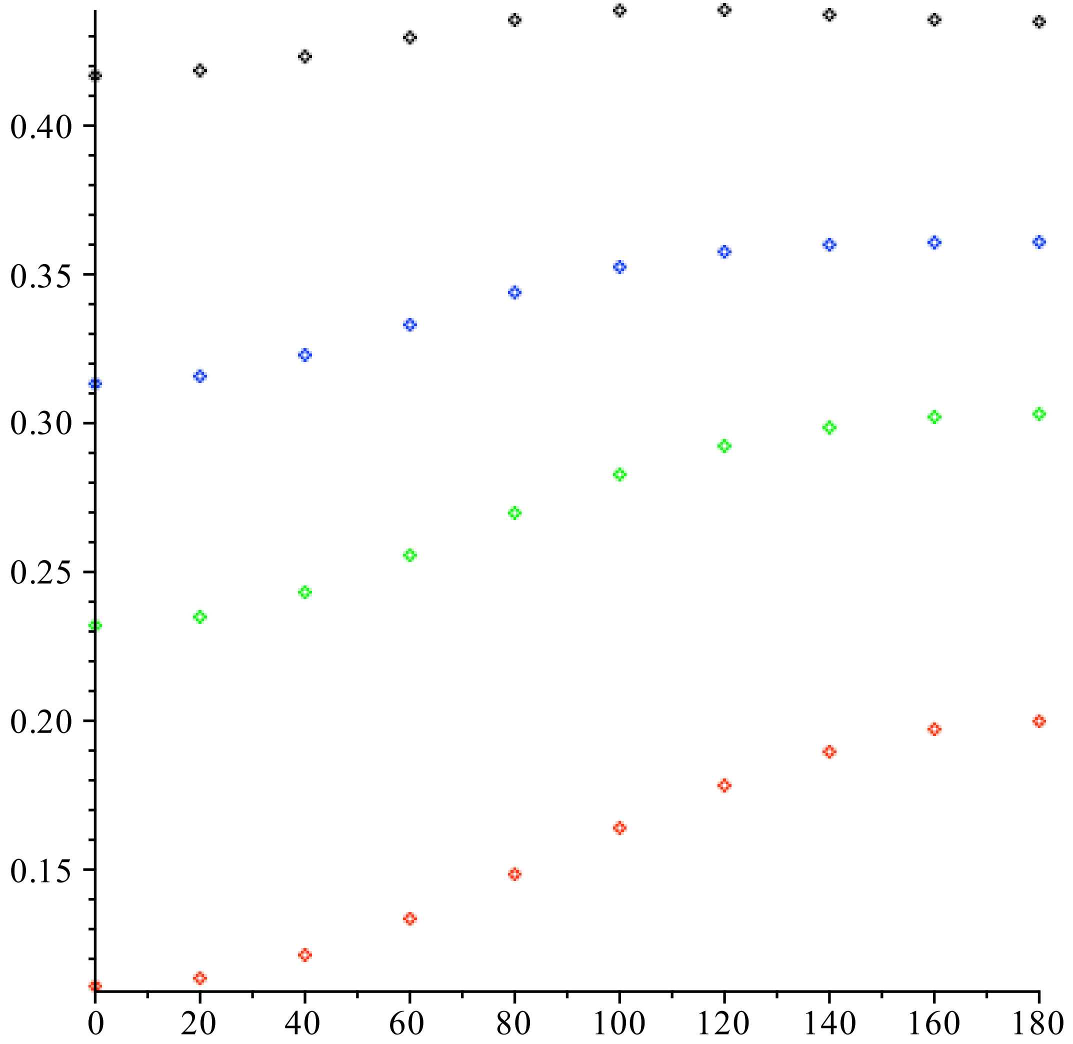
$$pointplot\left(\left[seq\left(\left[2\cdot x,\ evalf\left(subs\left(\mathrm{mu\_}=\mu_1,\ \mathrm{rci\_}=\frac{\mathrm{R\_}}{7},\ \mathrm{R\_}=\frac{6}{2},\ \alpha=\mathrm{x}*\mathrm{Pi}/180,\ InrV\_\right)\right)\right],\ x=xx\right),\right.$$

$$seq\left(\left[2\cdot x,\ evalf\left(subs\left(mu\_=\mu_1,\ rci\_=\frac{\mathrm{R\_}}{7},\ r1=\left(\frac{7}{2}\right)/\mathrm{R\_},\ \mathrm{R\_}=10/2,\ \alpha=\mathrm{x}*\mathrm{Pi}/180,\ InrdwV\_\right)\right)\right],\ x=xx\right),$$

$$seq\left(\left[2\cdot x,\ evalf\left(subs\left(mu\_=\mu_1,\ rci\_=\frac{\mathrm{R\_}}{7},\ r1=\left(\frac{8}{2}\right)/\mathrm{R\_},\ \mathrm{R\_}=10/2,\ \alpha=\mathrm{x}*\mathrm{Pi}/180,\ InrdwV\_\right)\right)\right],\ x=xx\right),$$

$$\left.seq\left(\left[2\cdot x,\ evalf\left(subs\left(mu\_=\mu_1,\ rci\_=\frac{\mathrm{R\_}}{7},\ r1=\left(\frac{9}{2}\right)/\mathrm{R\_},\ \mathrm{R\_}=10/2,\ \alpha=\mathrm{x}*\mathrm{Pi}/180,\ InrdwV\_\right)\right)\right],\ x=xx\right)\right],\ color=[col]\right);$$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



rc2, constant hight μ=0.25

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump) \right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 0.25:$

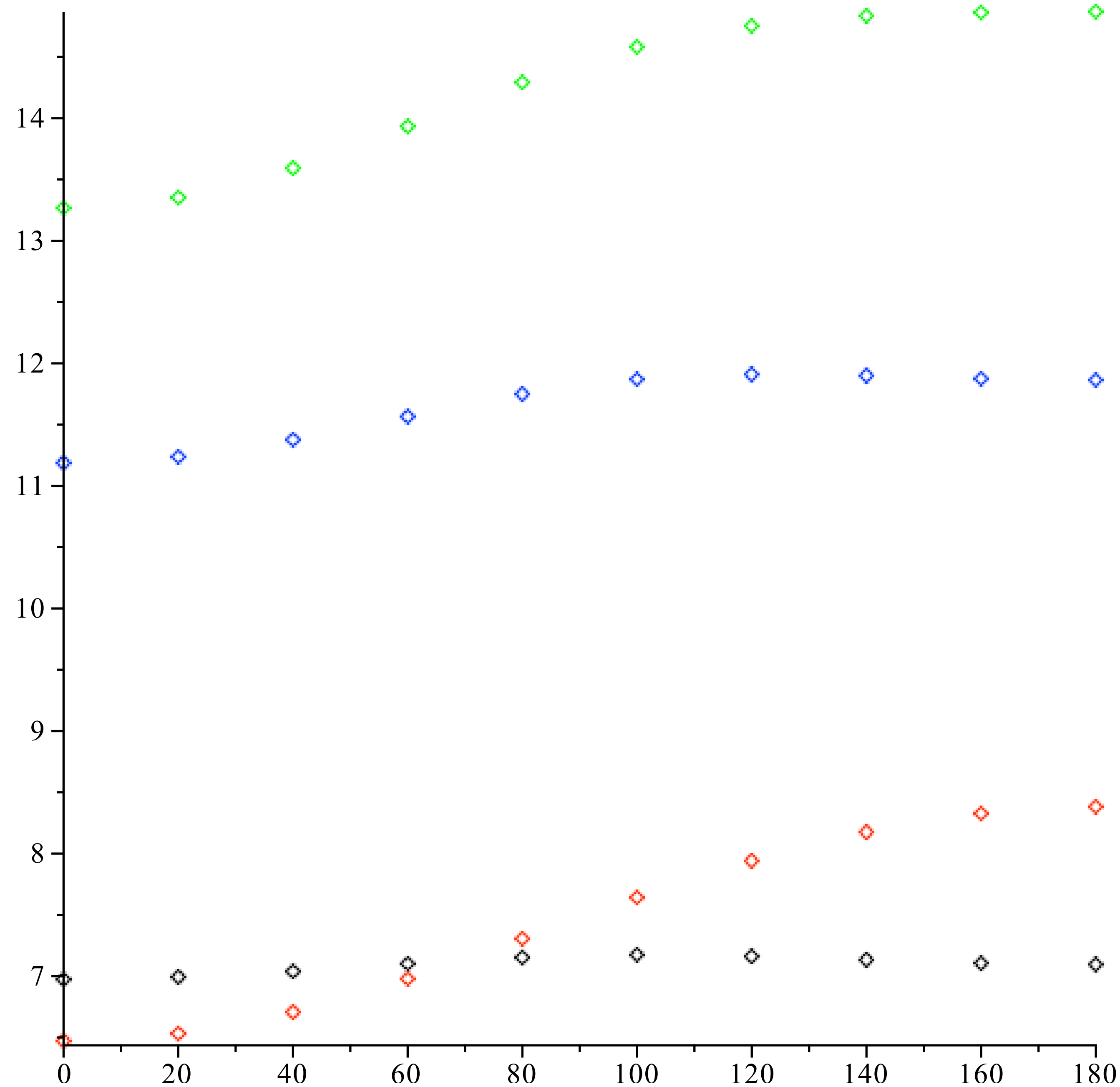
$$pointplot\left(\left[seq\left(\left[2\cdot x, evalf\left(subs\left(\text{mu\_}=\mu_1, \text{rci\_}=\frac{\text{R\_}}{7}, \text{R\_}=\frac{6}{2}, \alpha=\text{x}*\text{Pi}/180, Inr\_\right)\right)\right], x=xx\right),\right.$$

$$seq\left(\left[2\cdot x, evalf\left(subs\left(mu\_=\mu_1, rci\_=\frac{\text{R\_}}{7}, r1=\left(\frac{7}{2}\right)/\text{R\_}, \text{R\_}=10/2, \alpha=\text{x}*\text{Pi}/180, Inrdw\_\right)\right)\right], x=xx\right),$$

$$seq\left(\left[2\cdot x, evalf\left(subs\left(mu\_=\mu_1, rci\_=\frac{\text{R\_}}{7}, r1=\left(\frac{8}{2}\right)/\text{R\_}, \text{R\_}=10/2, \alpha=\text{x}*\text{Pi}/180, Inrdw\_\right)\right)\right], x=xx\right),$$

$$\left.seq\left(\left[2\cdot x, evalf\left(subs\left(mu\_=\mu_1, rci\_=\frac{\text{R\_}}{7}, r1=\left(\frac{9}{2}\right)/\text{R\_}, \text{R\_}=10/2, \alpha=\text{x}*\text{Pi}/180, Inrdw\_\right)\right)\right], x=xx\right)\right], color=[col]\right);$$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



14
13
12
11
10
9
8
7
0
20
40
60
80
100
120
140
160
180

rc2, constant hight μ=0.18

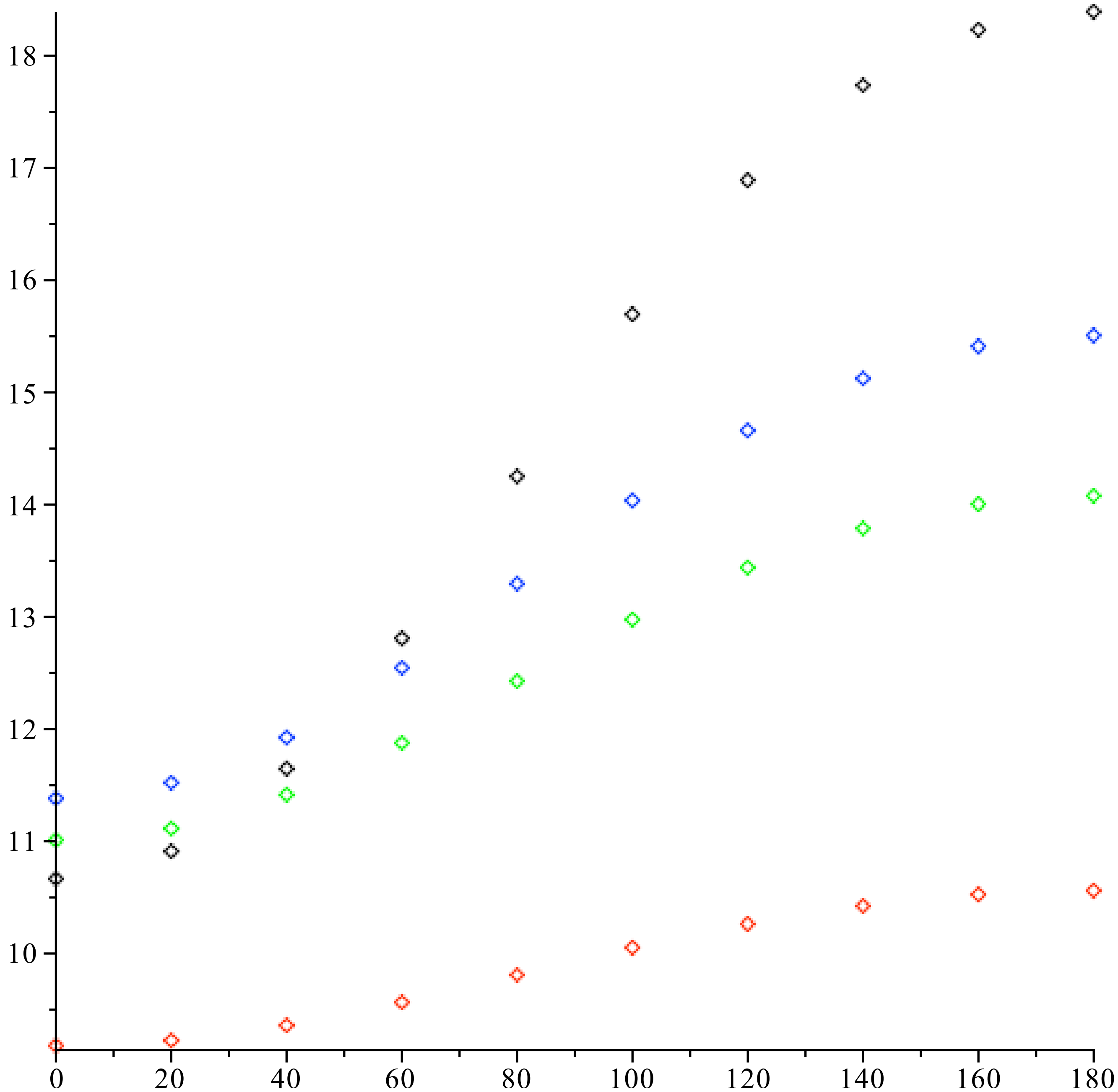
> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump) \right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 0.18 :$

$$pointplot\Big(\Big[seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x * Pi / 180}, Inr\_\Big)\Big)\Big], x = xx\Big),$$
$$seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{8}{2}, \alpha = \mathrm{x * Pi / 180}, Inr\_\Big)\Big)\Big], x = xx\Big),$$
$$seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{9}{2}, \alpha = \mathrm{x * Pi / 180}, Inr\_\Big)\Big)\Big], x = xx\Big),$$
$$seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{12}{2}, \alpha = \mathrm{x * Pi / 180}, Inr\_\Big)\Big)\Big], x = xx\Big)\Big], color = [col]\Big);$$

>

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



18
17
16
15
14
13
12
11
10
0
20
40
60
80
100
120
140
160
180

rc2, constant hight μ=2

$$> nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 ..nump) \right]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J = 0 ..nump), seq(black, J = 0 ..nump) :$$

$$\mu_1 := 2 :$$

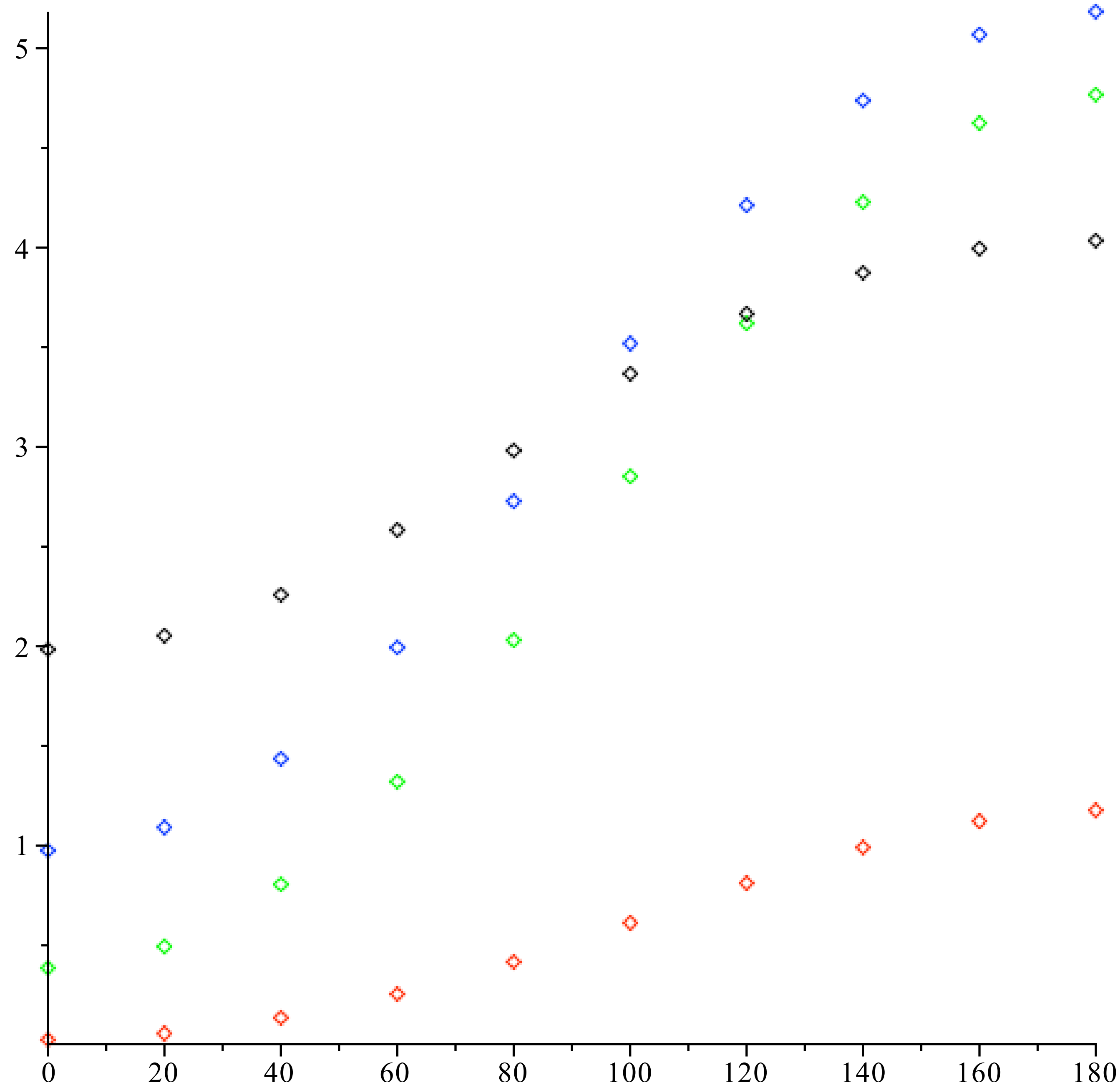
$$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inr\_\right)\right)\right], x = xx\right),\right.$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi}/180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi}/180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi}/180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\right);$$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



5
4
3
2
1
0
20
40
60
80
100
120
140
160
180

rc2, constant volume μ=2

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 ..nump) \right]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J = 0 ..nump), seq(black, J = 0 ..nump) :$

$\mu_1 := 2 :$

$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x * Pi / 180}, InrV\_\right)\right)\right], x = xx\right),\right.\right.$

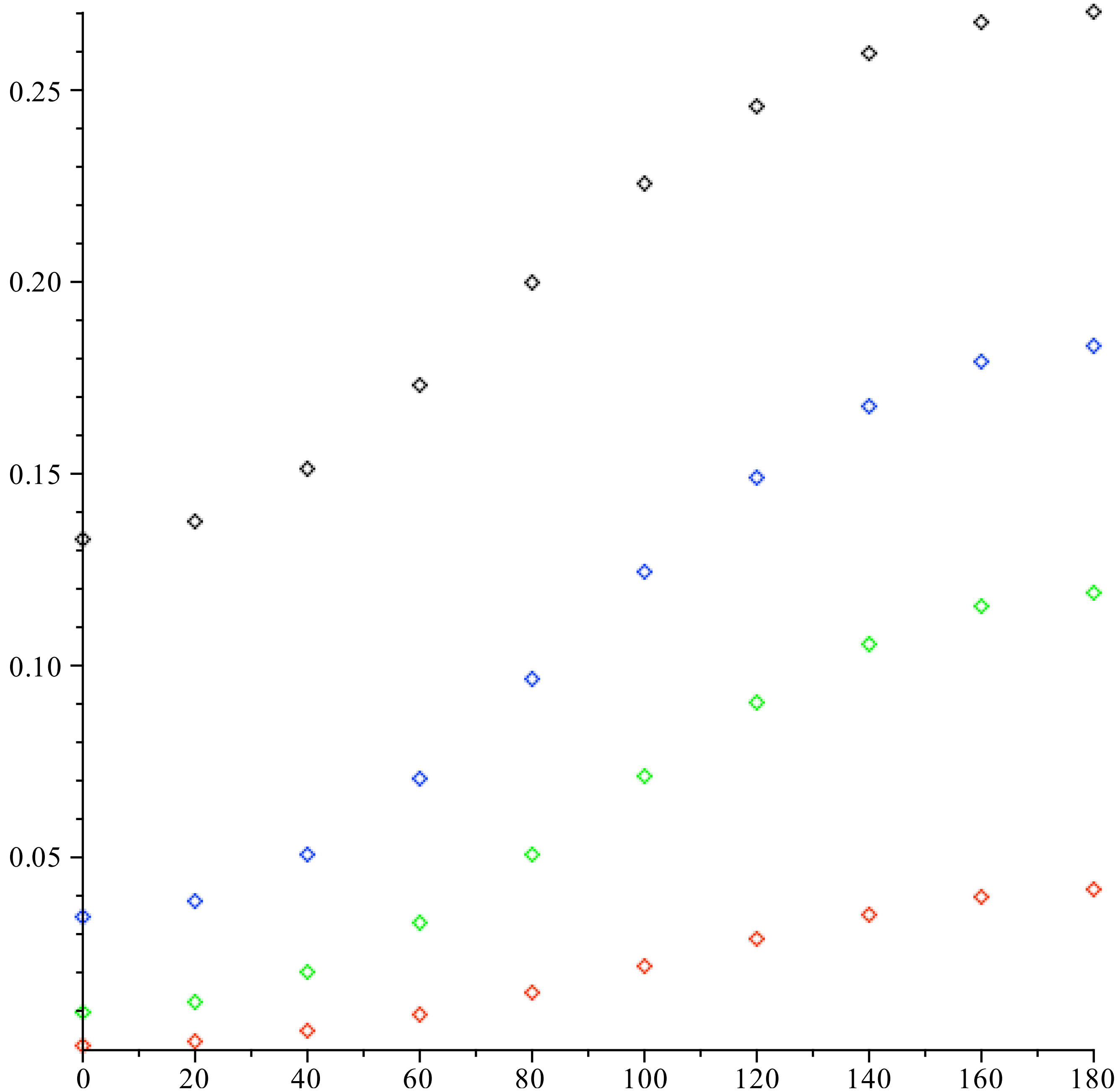
$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x * Pi / 180}, InrdwV\_\right)\right)\right], x = xx\right),$

$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x * Pi / 180}, InrdwV\_\right)\right)\right], x = xx\right),$

$\left.\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x * Pi / 180}, InrdwV\_\right)\right)\right], x = xx\right)\right], color = [col]\right);$

>

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$


0.25
0.20
0.15
0.10
0.05
0
20
40
60
80
100
120
140
160
180

rc2, constant hight μ=1

$$> nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump)\right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$$

$$\mu_1 := 1 :$$

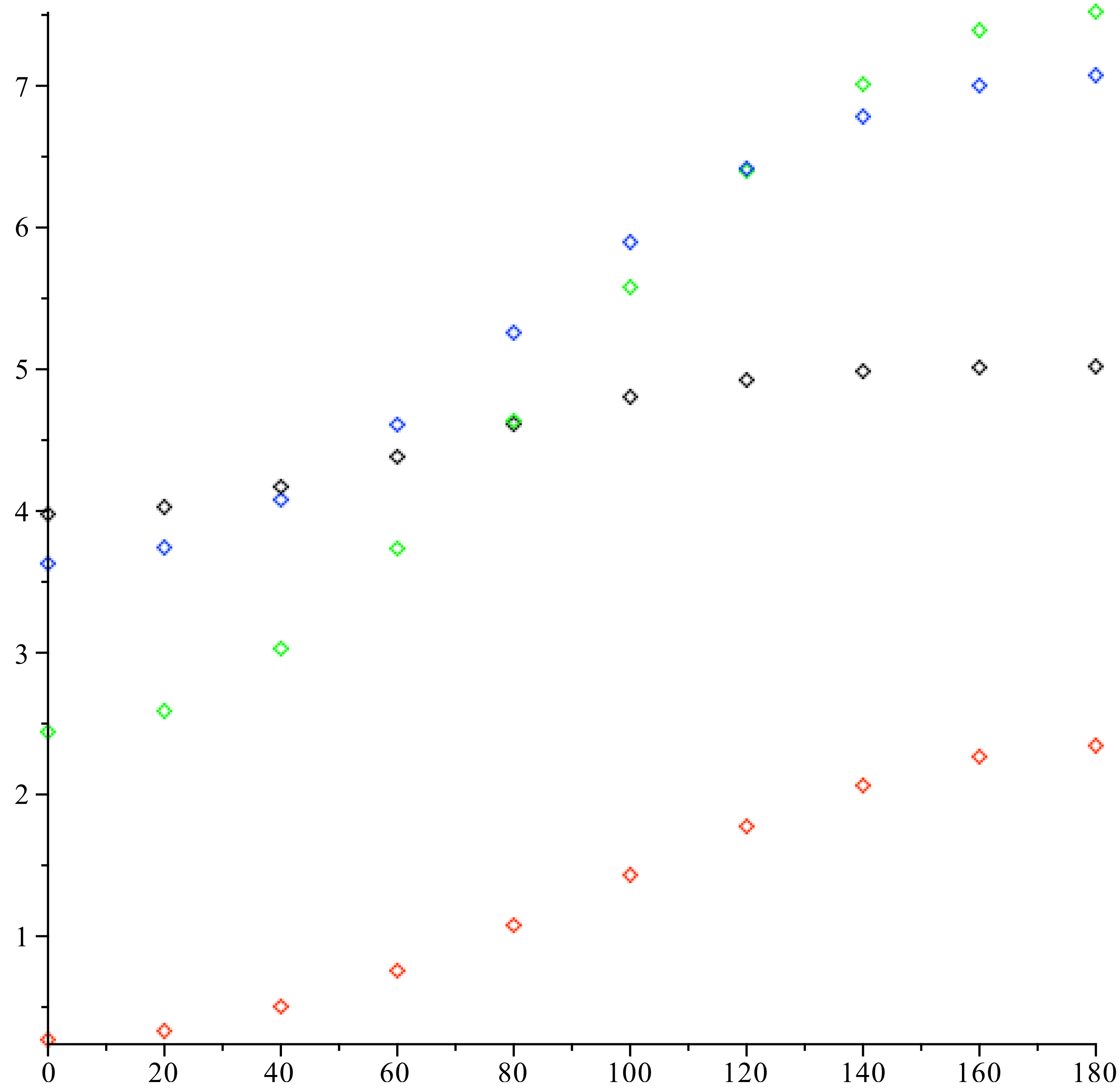
$$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{R\_}{7}, R\_ = \frac{6}{2}, \alpha = x * Pi / 180, Inr\_\right)\right)\right], x = xx\right),\right.$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{R\_}{7}, r1 = \left(\frac{7}{2}\right) / R\_, R\_ = 10/2, \alpha = x * Pi / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{R\_}{7}, r1 = \left(\frac{8}{2}\right) / R\_, R\_ = 10/2, \alpha = x * Pi / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{R\_}{7}, r1 = \left(\frac{9}{2}\right) / R\_, R\_ = 10/2, \alpha = x * Pi / 180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\Big);$$

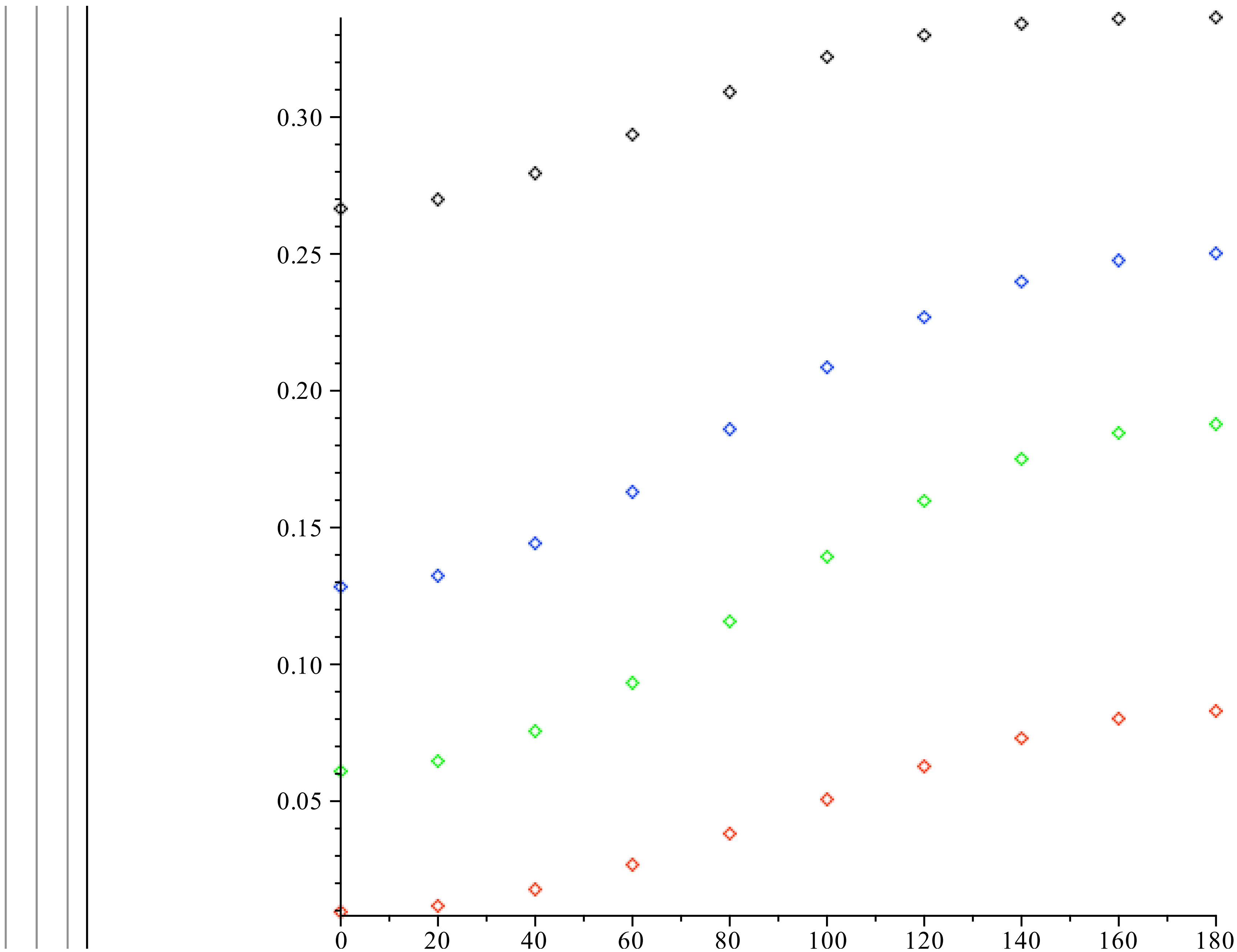
$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



7
6
5
4
3
2
1
0
20
40
60
80
100
120
140
160
180

rc2, constant volume μ=1

```
> nump := 9 : xx := [ (j·90)/nump $(j = 0 ..nump) ] : col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J
      = 0 ..nump), seq(black, J = 0 ..nump) :
  μ_1 := 1 :
  pointplot([ seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, R_ = 6/2, α = x * Pi / 180, InrV_))], x = xx),
              seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, r1 = (7/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx),
              seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, r1 = (8/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx),
              seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, r1 = (9/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx)], color = [col]);
>
```


0.30
0.25
0.20
0.15
0.10
0.05
0
20
40
60
80
100
120
140
160
180

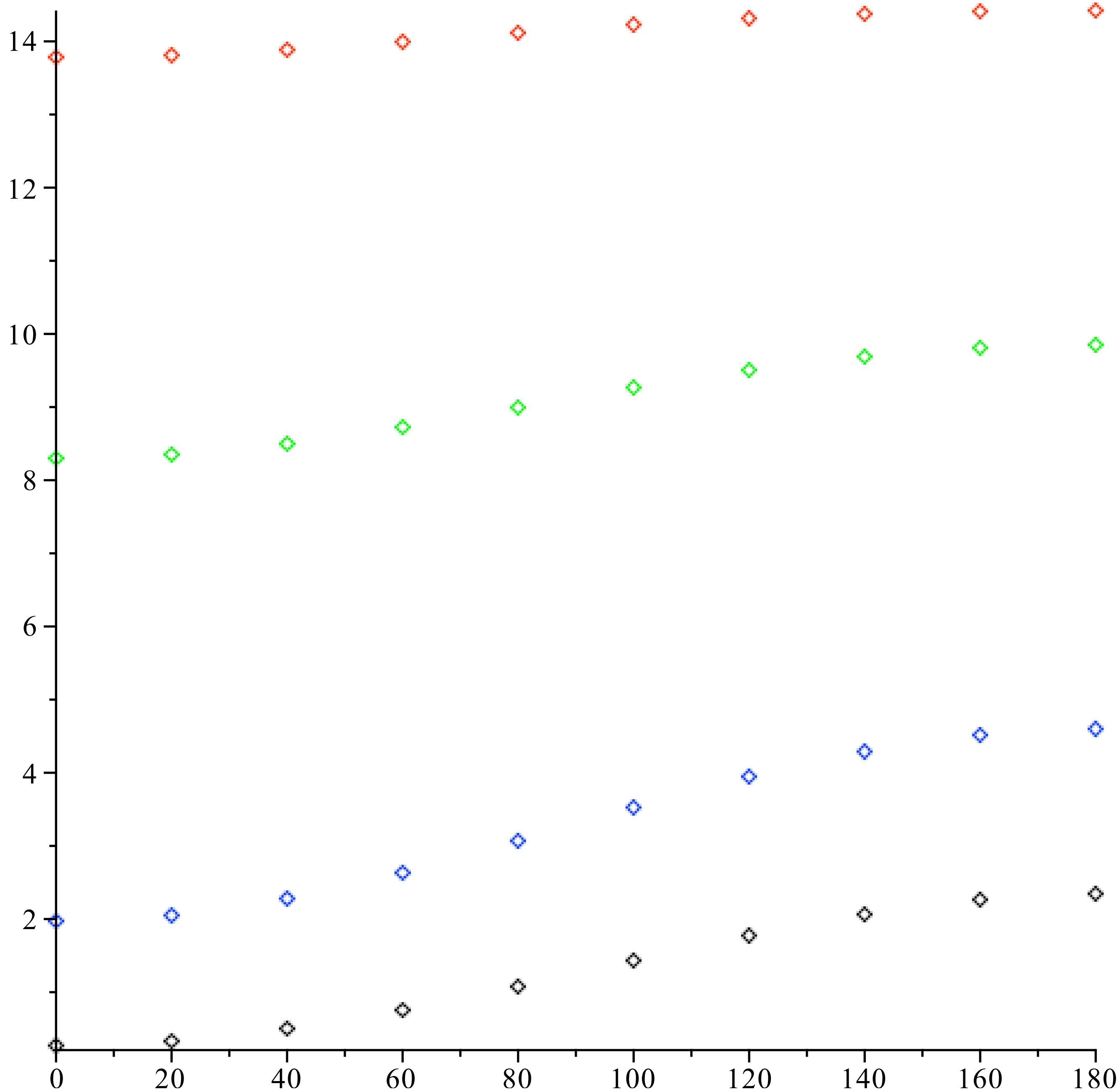
>

Different μ in 6mm can

Different mu in 6mm can

```
> nump := 9 : xx := [ (j·90)/nump $(j = 0 ..nump) ]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J
    = 0 ..nump), seq(black, J = 0 ..nump) :

  pointplot([seq([2· x, evalf(subs(mu_ = 0.1, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, Inr_))], x = xx),
             seq([2· x, evalf(subs(mu_ = 0.2, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, Inr_))], x = xx),
             seq([2· x, evalf(subs(mu_ = 0.5, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, Inr_))], x = xx),
             seq([2· x, evalf(subs(mu_ = 1, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, Inr_))], x = xx)], color
    = [col]);
```

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



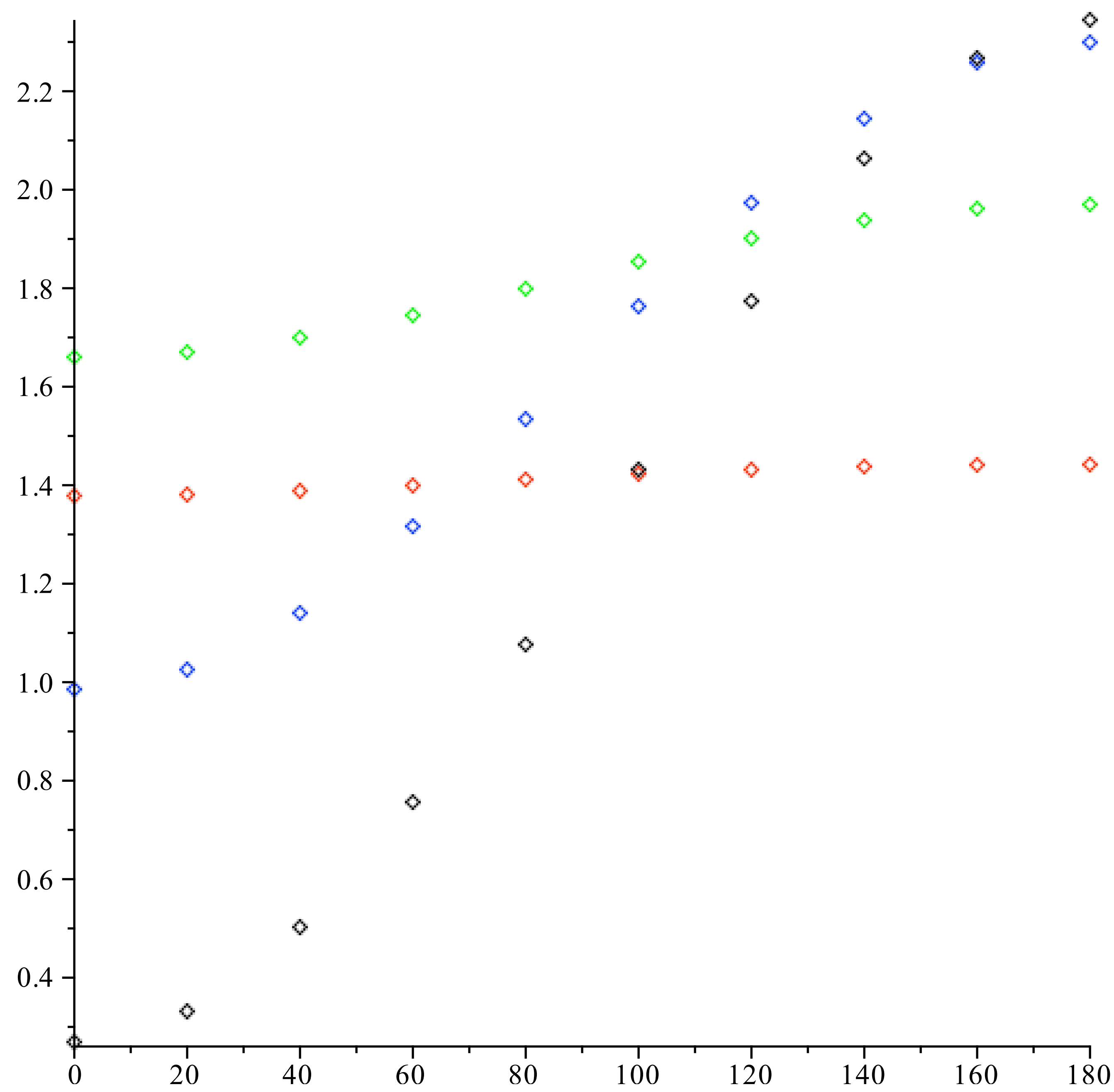
14
12
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180

>

Dilution with NaCl

to.

```
> nump := 9 : xx := [j·90/nump $(j = 0 ..nump)] : col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J
    = 0 ..nump), seq(black, J = 0 ..nump) :
  pointplot([seq([2· x, evalf(subs(mu_ = 0.1, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, mu_·  Inr_))], x = xx),
                    seq([2· x, evalf(subs(mu_ = 0.2, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, mu_·Inr_))], x = xx),
                    seq([2· x, evalf(subs(mu_ = 0.5, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, mu_·Inr_))], x = xx),
                    seq([2· x, evalf(subs(mu_ = 1, rci_ = R_/7, R_ = 3, alpha = x * Pi/180, mu_·Inr_))], x = xx)],
      color = [col]);
>
```



2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0
20
40
60
80
100
120
140
160
180

No rc, full hight vs constant volume: 6mm, 10/7, 10/8, 10/9 double wall

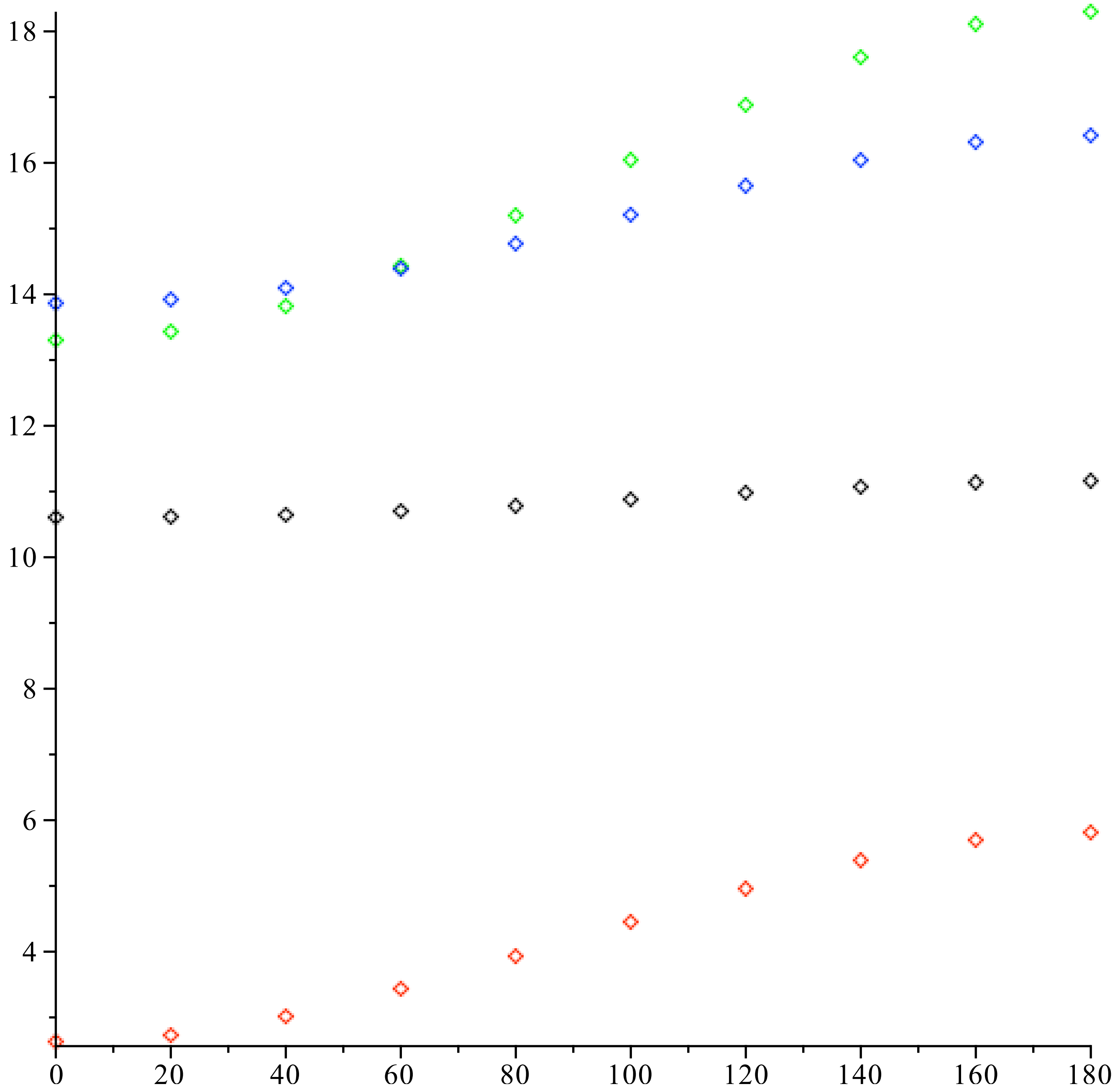
No rc, full hight, different volumes.

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 ..nump)\right]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J = 0 ..nump), seq(black, J = 0 ..nump) :$

$\mu_1 := 0.5 :$

$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = 0, \mathrm{R\_} = \frac{6}{2}, \alpha = x * \mathrm{Pi}/180, Inr\_\right)\right)\right], x = xx\right),\right.$
$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{7}{2}\right)/\mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = x * \mathrm{Pi}/180, Inrdw\_\right)\right)\right], x = xx\right),$
$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{8}{2}\right)/\mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = x * \mathrm{Pi}/180, Inrdw\_\right)\right)\right], x = xx\right),$
$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{9}{2}\right)/\mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = x * \mathrm{Pi}/180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\Big);$

$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$


18
16
14
12
10
8
6
4
0
20
40
60
80
100
120
140
160
180

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump) \right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 1 :$

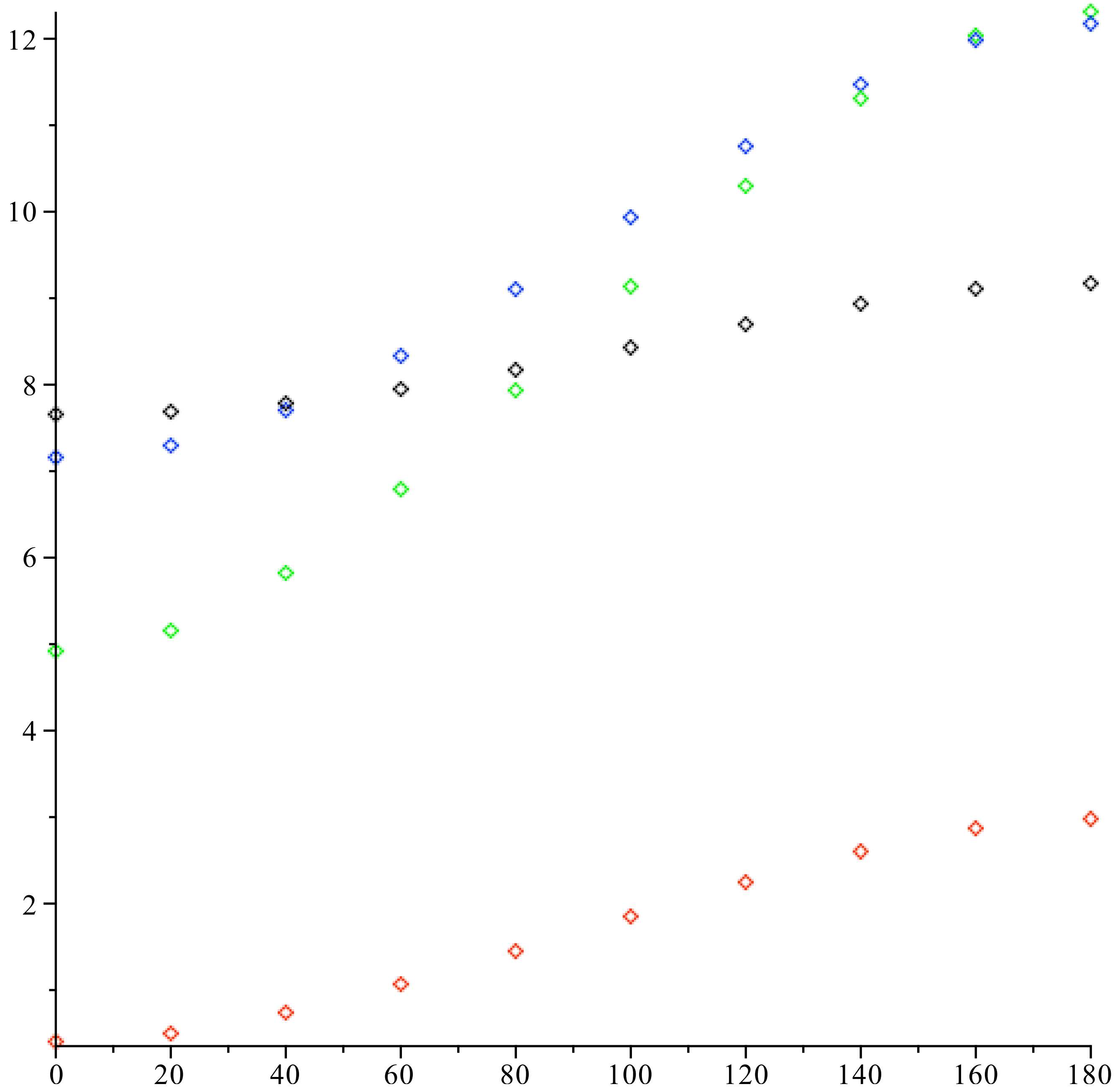
$$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = 0, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inr\_\right)\right)\right], x = xx\right),\right.\right.$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$\left.\left. seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\right);$$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$

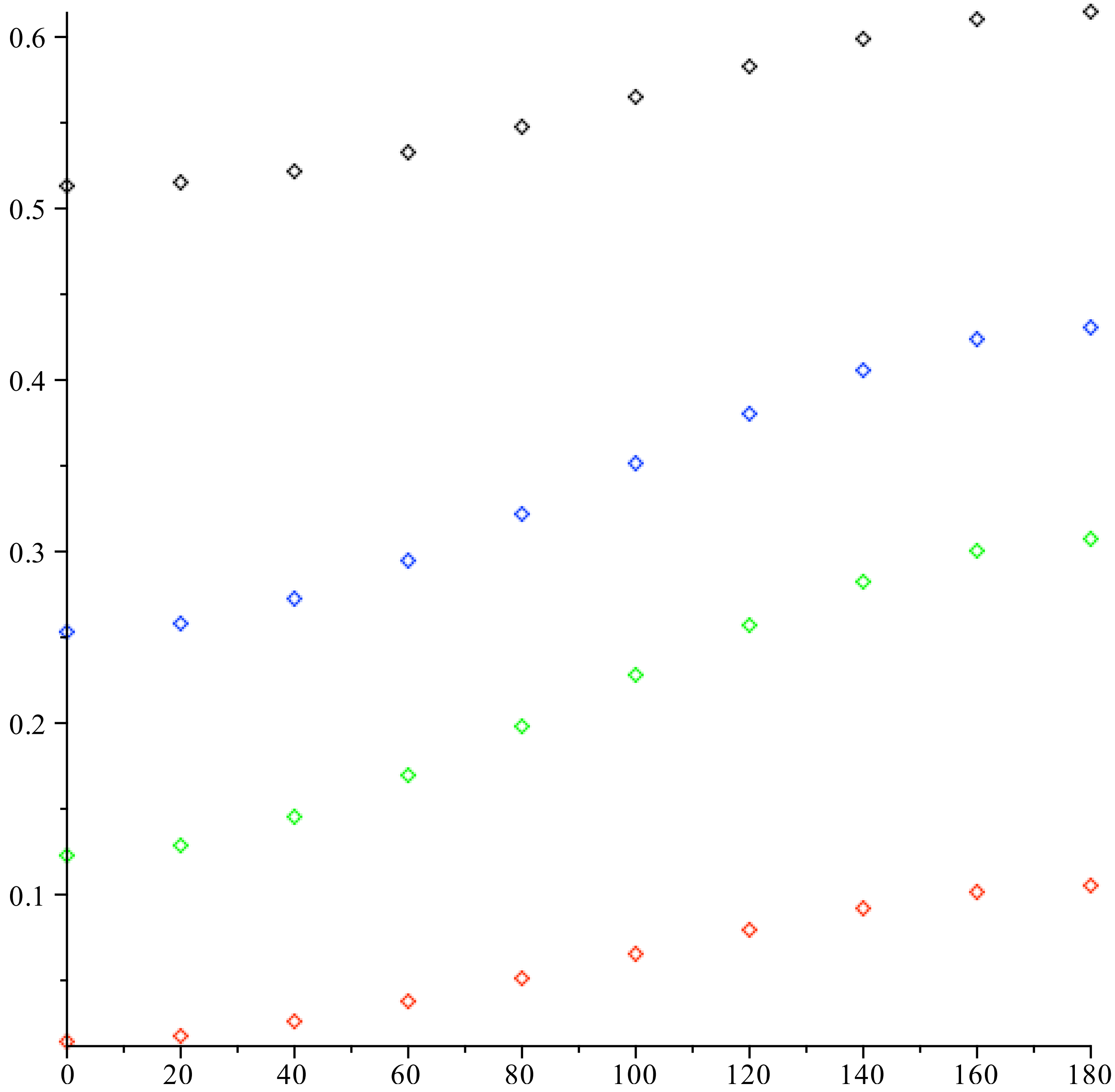


12
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180

No rc, constant volume

```
> nump := 9 : xx := [ j·90/nump $(j = 0 ..nump) ]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J
      = 0 ..nump), seq(black, J = 0 ..nump) :
  μ_1 := 1. :
  pointplot([seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, R_ = 6/2, α = x * Pi / 180, InrV_))], x = xx),
            seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, r1 = (7/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx),
            seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, r1 = (8/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx),
            seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, r1 = (9/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx)], color = [col]);
```

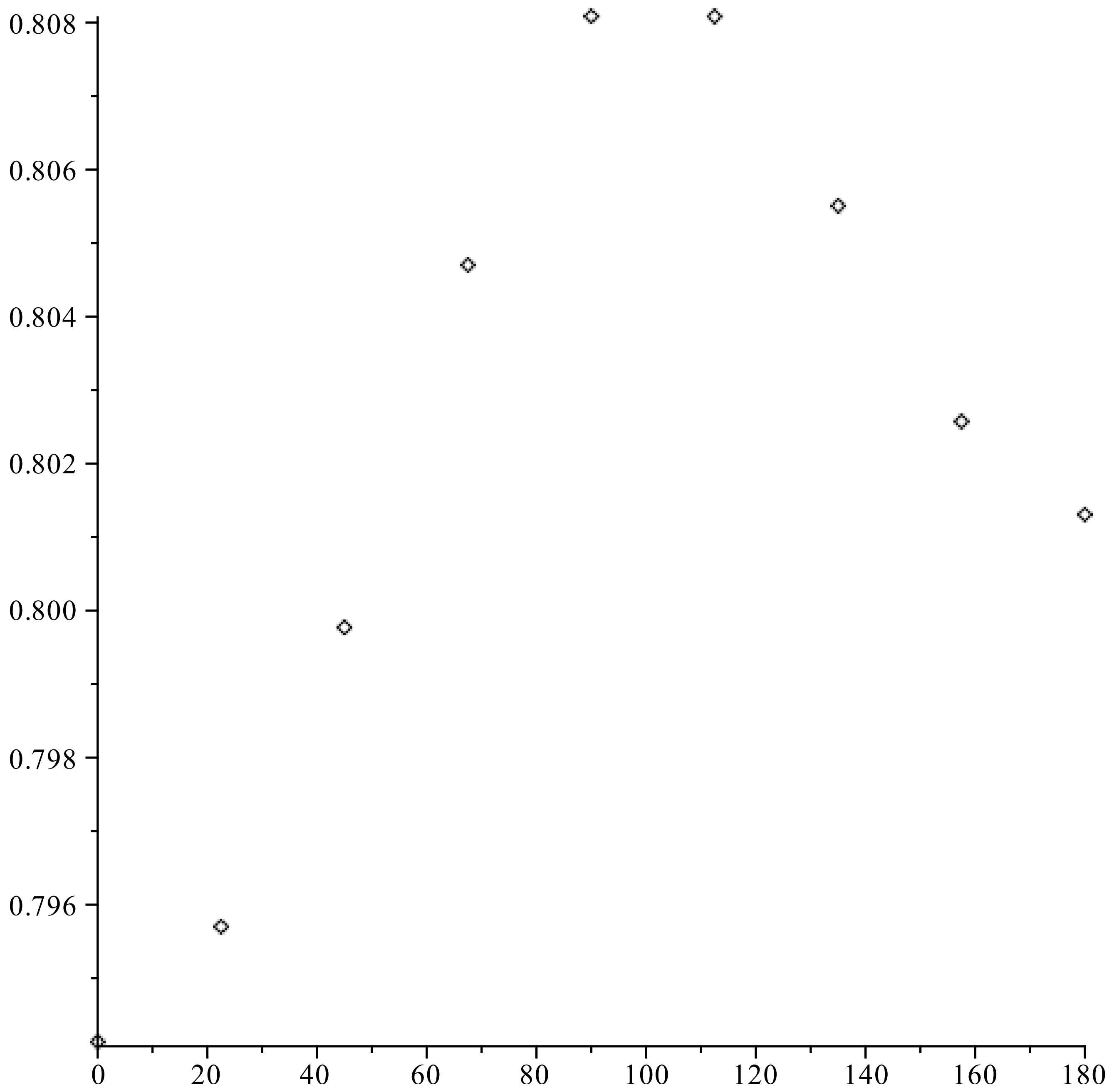
$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$


0.6
0.5
0.4
0.3
0.2
0.1
0
20
40
60
80
100
120
140
160
180

```
>
```

Calculate the intensity ratio of a sample in 6mm container with rci for RC2 to the same 6mm sample but without RC.

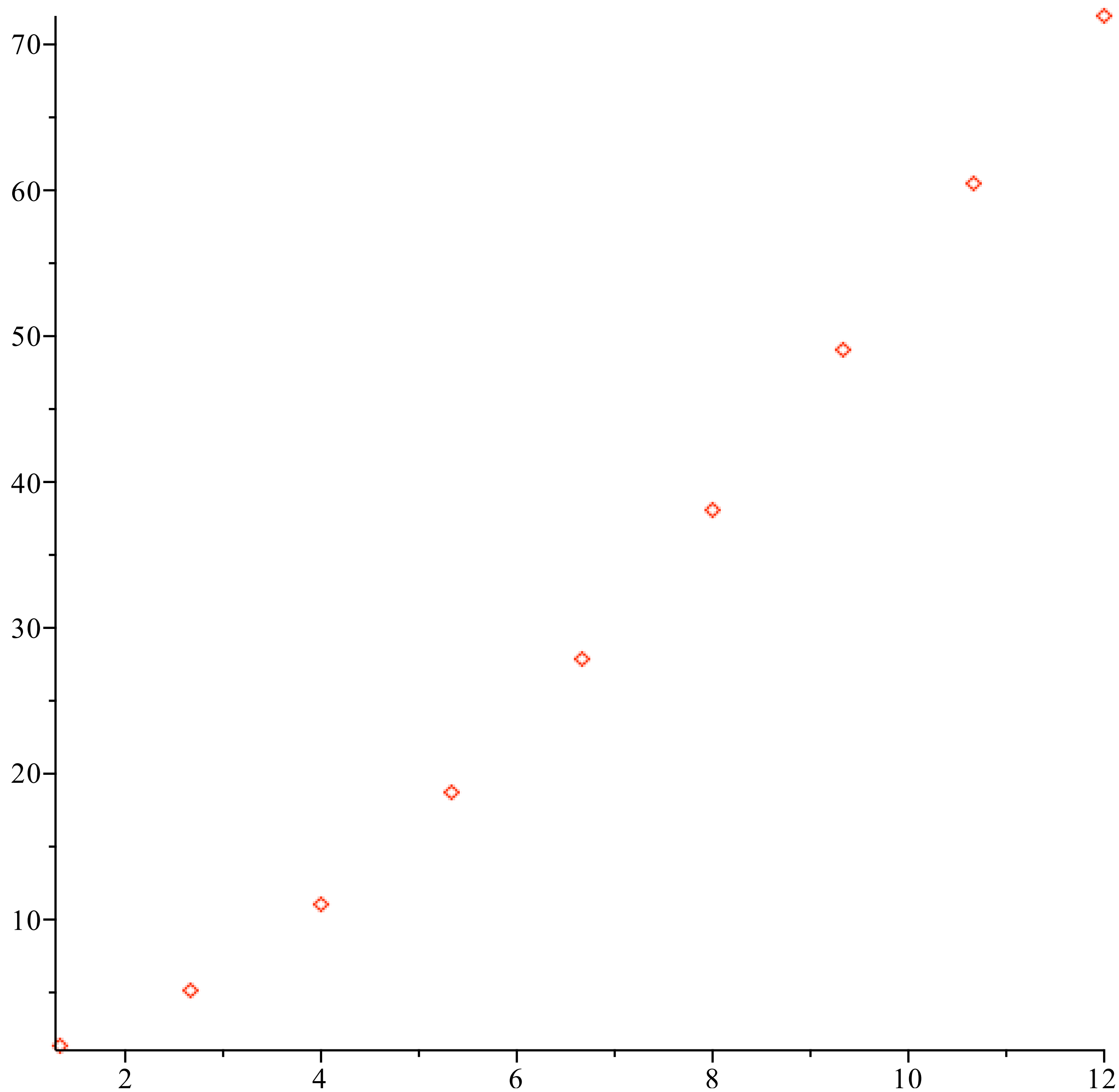
```
> Calculate the intensity ratio of a sample in 6mm container with rci for RC2  to the same 6mm
  sample but without RC.
  Inr6mu0:=subs(mu_=0.2,subs(R_=3,subs(rci_=R_/7,Inr_))):
  Inrc0mu0:=subs(mu_=0.2,subs(R_=3,subs(rci_=0,Inr_))):
>
> maxi:=9:

> for i from 1 by 1 to maxi
> do x := (i-1)*90/(maxi-1): t[i]:=2*x: y[i]:=evalf(subs(alpha=x*Pi/180,Inr6mu0/Inrc0mu0));

> end do:
> pointplot({seq([t[i],(y[i])],i=1..maxi)});
```



0.808
0.806
0.804
0.802
0.800
0.798
0.796
0
20
40
60
80
100
120
140
160
180

Intensity as a function of sample diameter

> $nump := 9 : xx := \left[\frac{6 \cdot j}{nump} \$ j = 1 ..nump \right] : col := seq(red, J = 1 ..nump) :$
$pointplot([seq([2 \cdot x, evalf(subs(\mathrm{mu\_} = 0, \mathrm{rci\_} = \mathrm{R\_}/7, \mathrm{R\_} = \mathrm{x}, \mathrm{alpha} = 0, Inr\_))], x = xx)], color = [col]);$


70
60
50
40
30
20
10
2
4
6
8
10
12

Intensity as a function of sample diameter

> $nump := 9 : xx := \left[\frac{6 \cdot j}{nump} \$ j = 1 ..nump \right] : col := seq(red, J = 1 ..nump) :$

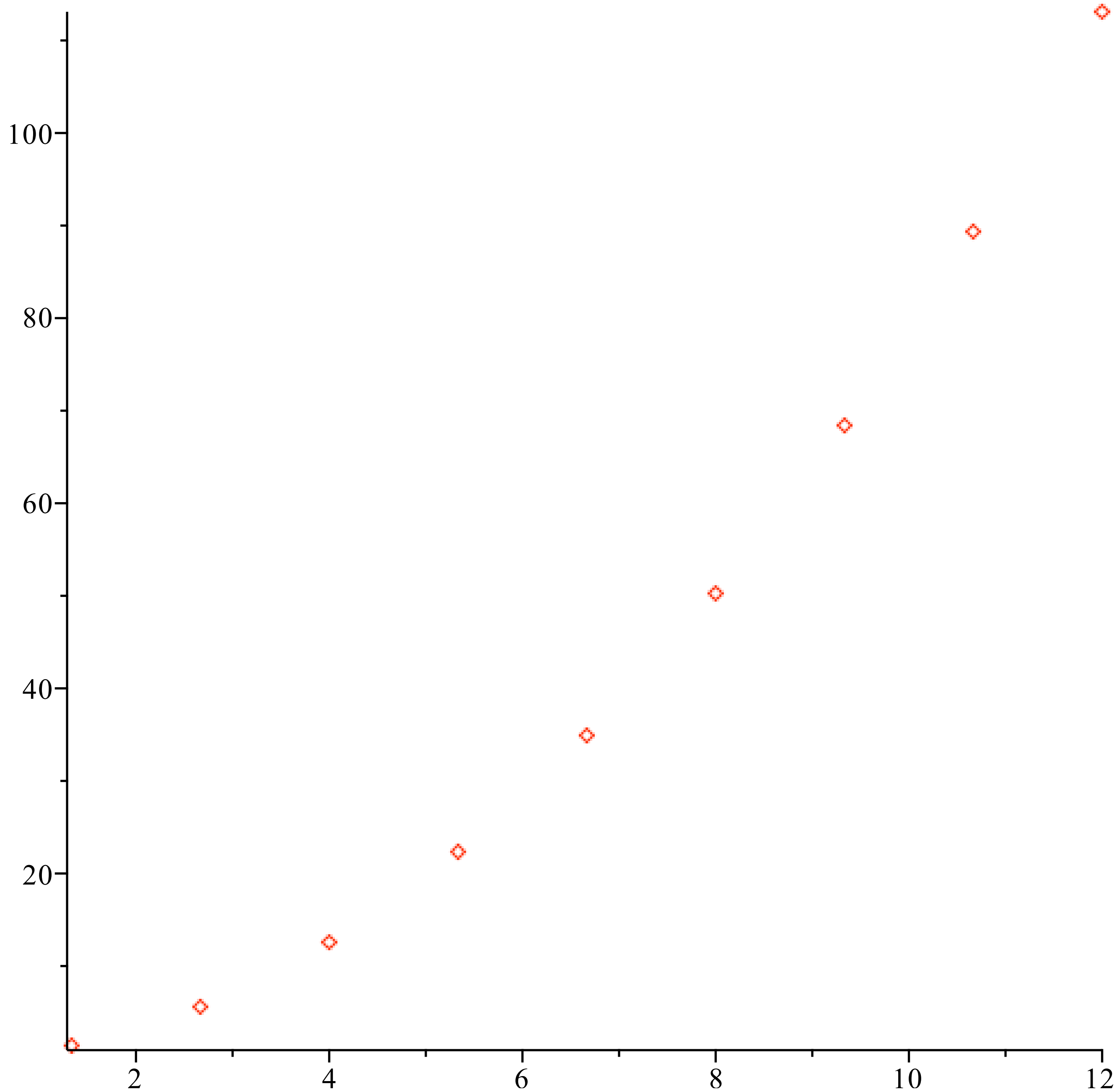
$pointplot([seq([2 \cdot x, evalf(subs(\mathrm{mu\_} = 0, \mathrm{rci\_} = 0, \mathrm{R\_} = \mathrm{x}, \mathrm{alpha} = 0, Inr\_))], x = xx)], color = [col]);$

Intensity as a function of sample diameter

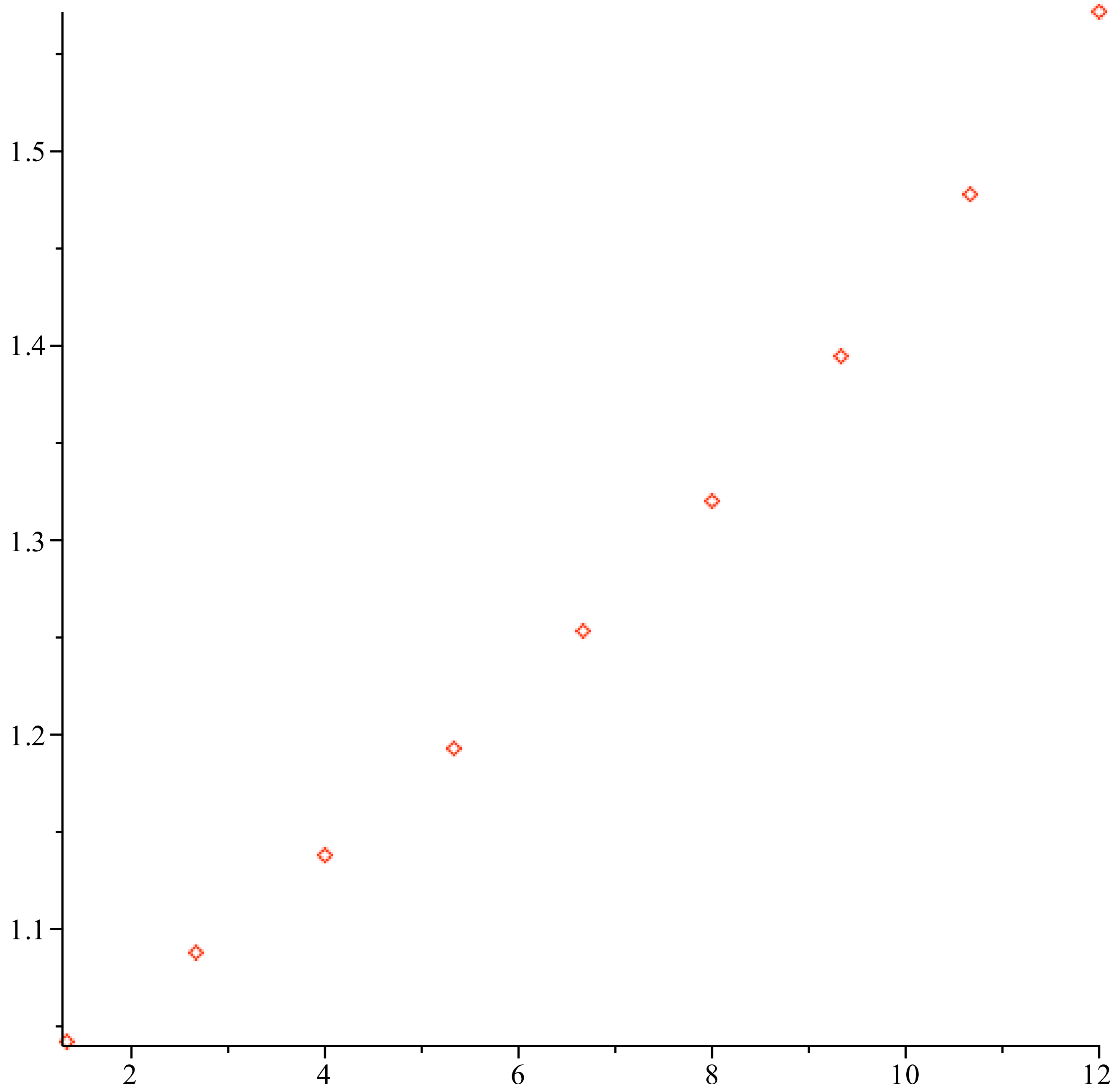
> $nump := 9 : xx := \left[\frac{6 \cdot j}{nump} \$ j = 1 ..nump \right] : col := seq(red, J = 1 ..nump) :$

$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(\frac{subs(\mathrm{mu\_} = 0, \mathrm{rci\_} = 0, \mathrm{R\_} = \mathrm{x}, \mathrm{alpha} = 0, Inr\_)}{subs(\mathrm{mu\_} = 0, \mathrm{rci\_} = \mathrm{R\_} / 7, \mathrm{R\_} = \mathrm{x}, \mathrm{alpha} = 0, Inr\_)}\right)\right], x = xx\right)\right], color = [col]\right);$

>



100
80
60
40
20
2
4
6
8
10
12


1.5
1.4
1.3
1.2
1.1
2
4
6
8
10
12

Old calculation with functions defined for different cans.

> Calculate the intensity ratio of a sample in 6mm container 9/7 double wall, etc with attenuation μ to the same 6mm sample but without absorption. rci is (sample radius)/(FWHM of radial collimator), e.g. (6/2)/7 for RC2

```
Inr6:=subs(mu_=mu,rci_=R_/7,R_=3,Inr_);
Inr9_7dw:=subs(mu_=mu,rci_=R_/7,r1=(7/2)/R_,R_=9/2,Inrdw_);
Inr10_8dw:=subs(mu_=mu,rci_=R_/7,r1=(8/2)/R_,R_=10/2,Inrdw_);
Inr10_9dw:=subs(mu_=mu,rci_=R_/7,r1=(9/2)/R_,R_=10/2,Inrdw_);
Inr10_8dw_rc1:=subs(mu_=mu,rci_=R_/14,r1=(8/2)/R_,R_=10/2,Inrdw_);
```

$$Inr6 := 9 \int_0^1 \int_0^{2\pi} r\, e^{-1.200000000 \sqrt{1 - r^2 \sin(\alpha+\phi)^2} - 1.200000000\, r \cos(\alpha+\phi) - 1.200000000 \sqrt{1 - r^2 \sin(-\phi+\alpha)^2} + 1.200000000\, r \cos(-\phi+\alpha)} \max\left(0, -\frac{3\,|r \sin(-\phi+\alpha)|}{7} + 1\right) d\phi\, dr$$

$$Inr9\_7dw := \frac{1}{4}\left(81 \int_{\frac{7}{9}}^{1} \int_0^{2\pi} r\, e^{-0.4000000000 \sqrt{1 - r^2 \sin(\alpha+\phi)^2} - 0.4000000000\, r \cos(\alpha+\phi) - 0.4000000000 \sqrt{1 - r^2 \sin(-\phi+\alpha)^2} + 0.4000000000\, r \cos(-\phi+\alpha)} \max\left(0, -\frac{9\,|r \sin(-\phi+\alpha)|}{14} + 1\right) d\phi\, dr\right)$$

$$Inr10\_8dw := 25 \int_{\frac{4}{5}}^{1} \int_0^{2\pi} r\, e^{-0.4000000000 \sqrt{1 - r^2 \sin(\alpha+\phi)^2} - 0.4000000000\, r \cos(\alpha+\phi) - 0.4000000000 \sqrt{1 - r^2 \sin(-\phi+\alpha)^2} + 0.4000000000\, r \cos(-\phi+\alpha)} \max\Big(0,$$

$$-\frac{5\,|r\sin(-\phi+\alpha)|}{7}+1\Big)\,\mathrm{d}\phi\,\mathrm{d}r$$

$$Inr10\_9dw := 25\int_{\frac{9}{10}}^{1}$$

$$\int_0^{2\pi} r\,\mathrm{e}^{-0.2000000000\sqrt{1-r^2\sin(\alpha+\phi)^2}-0.2000000000\,r\cos(\alpha+\phi)-0.2000000000\sqrt{1-r^2\sin(-\phi+\alpha)^2}+0.2000000000\,r\cos(-\phi+\alpha)}\max\Big(0,$$

$$-\frac{5\,|r\sin(-\phi+\alpha)|}{7}+1\Big)\,\mathrm{d}\phi\,\mathrm{d}r$$

$$Inr10\_8dw\_rc1 := 25\int_{\frac{4}{5}}^{1} \qquad (1.4.6.1$$

$$\int_0^{2\pi} r\,\mathrm{e}^{-0.4000000000\sqrt{1-r^2\sin(\alpha+\phi)^2}-0.4000000000\,r\cos(\alpha+\phi)-0.4000000000\sqrt{1-r^2\sin(-\phi+\alpha)^2}+0.4000000000\,r\cos(-\phi+\alpha)}\max\Big(0,$$

$$-\frac{5\,|r\sin(-\phi+\alpha)|}{14}+1\Big)\,\mathrm{d}\phi\,\mathrm{d}r$$

```
> (subs(alpha=0,Inr6));
  evalf(%);
  (subs(alpha=0,Inr10_8dw));
  evalf(%);
  (subs(alpha=0,Inr10_9dw));
  evalf(%);
  (subs(alpha=0,Inr9_7dw));
  evalf(%);
  (subs(alpha=0,Inr10_8dw_rc1));
  evalf(%);
```

$$9 \int_{0}^{1}\int_{0}^{2\pi} r\, e^{-1.200000000 \sqrt{1 - r^2 \sin(\phi)^2} - 1.200000000\, r \cos(\phi) - 1.200000000 \sqrt{1 - r^2 \sin(-\phi)^2} + 1.200000000\, r \cos(-\phi)} \max\left(0, -\frac{3\,|r \sin(-\phi)|}{7} + 1\right) \mathrm{d}\phi\, \mathrm{d}r$$

$$3.132811459$$

$$25 \int_{\frac{4}{5}}^{1}\int_{0}^{2\pi} r\, e^{-0.4000000000 \sqrt{1 - r^2 \sin(\phi)^2} - 0.4000000000\, r \cos(\phi) - 0.4000000000 \sqrt{1 - r^2 \sin(-\phi)^2} + 0.4000000000\, r \cos(-\phi)} \max\left(0, -\frac{5\,|r \sin(-\phi)|}{7} + 1\right) \mathrm{d}\phi\, \mathrm{d}r$$

$$8.856365800$$

$$25 \int_{\frac{9}{10}}^{1}\int_{0}^{2\pi} r\, e^{-0.2000000000 \sqrt{1 - r^2 \sin(\phi)^2} - 0.2000000000\, r \cos(\phi) - 0.2000000000 \sqrt{1 - r^2 \sin(-\phi)^2} + 0.2000000000\, r \cos(-\phi)} \max\left(0, -\frac{5\,|r \sin(-\phi)|}{7} + 1\right) \mathrm{d}\phi\, \mathrm{d}r$$

$$6.218736688$$

$$\frac{1}{4}\left(81 \int_{\frac{7}{9}}^{1}\int_{0}^{2\pi} r\, e^{-0.4000000000 \sqrt{1 - r^2 \sin(\phi)^2} - 0.4000000000\, r \cos(\phi) - 0.4000000000 \sqrt{1 - r^2 \sin(-\phi)^2} + 0.4000000000\, r \cos(-\phi)} \max\left(0, -\frac{9\,|r \sin(-\phi)|}{14} + 1\right) \mathrm{d}\phi\, \mathrm{d}r\right)$$

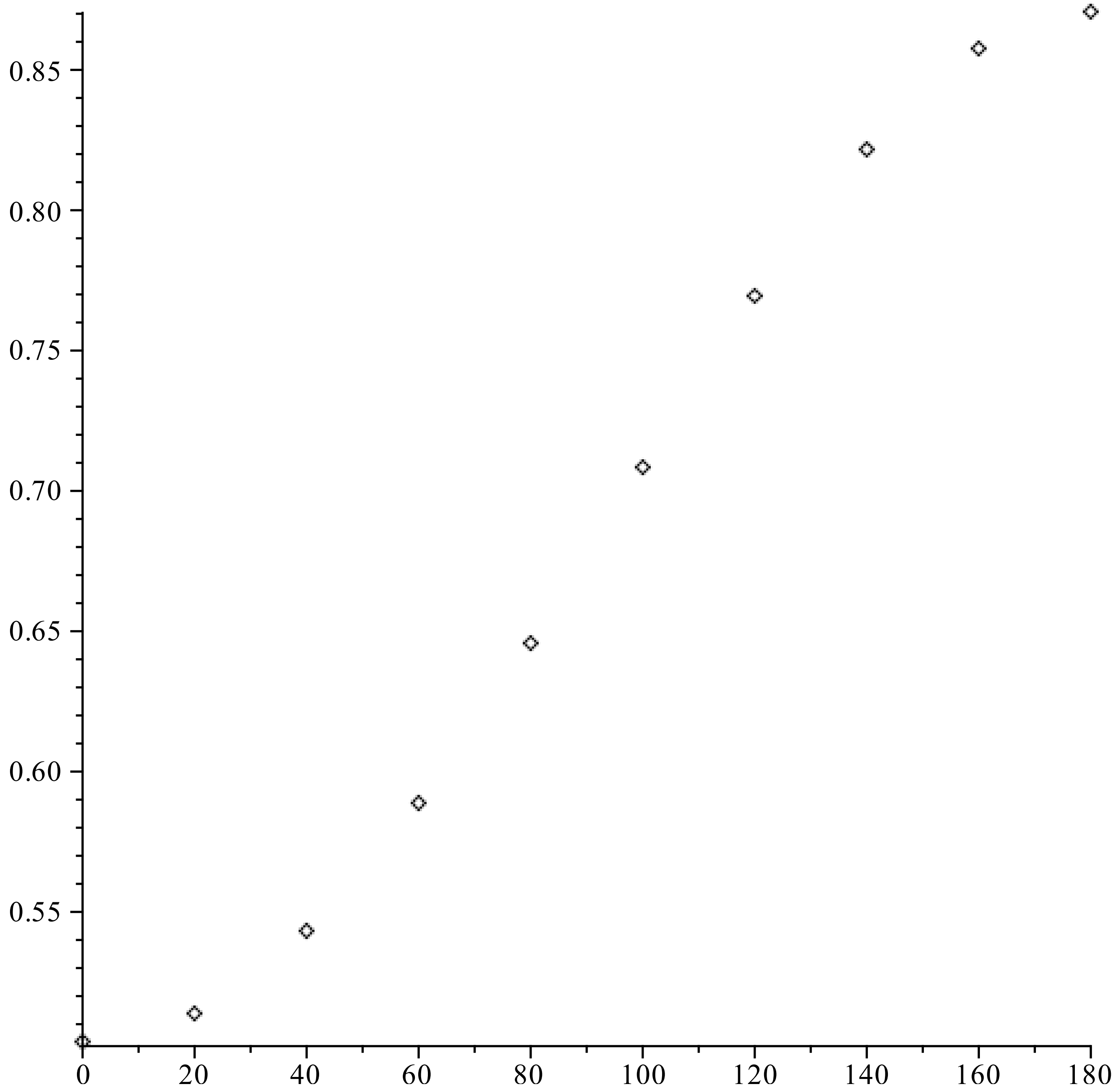
$$8.516481013$$

$$25 \int_{\frac{4}{5}}^{1}\int_{0}^{2\pi} r\, e^{-0.4000000000 \sqrt{1 - r^2 \sin(\phi)^2} - 0.4000000000\, r \cos(\phi) - 0.4000000000 \sqrt{1 - r^2 \sin(-\phi)^2} + 0.4000000000\, r \cos(-\phi)} \max\left(0, -\frac{5\,|r \sin(-\phi)|}{14}\right.$$

$+ 1 \Big) \, d\phi \, dr$

$$12.39056727 \quad (1.4.6.2$$

```
> maxi := 10:
  for i from 1 by 1 to maxi
  do x := (i-1)*90/(maxi-1): t[i]:=2*x: y[i]:=evalf(subs(alpha=x*Pi/180,Inr6/Inr10_9dw));
  end do:

> pointplot({seq([t[i],(y[i])],i=1..maxi)});
```



0.85
0.80
0.75
0.70
0.65
0.60
0.55
0
20
40
60
80
100
120
140
160
180

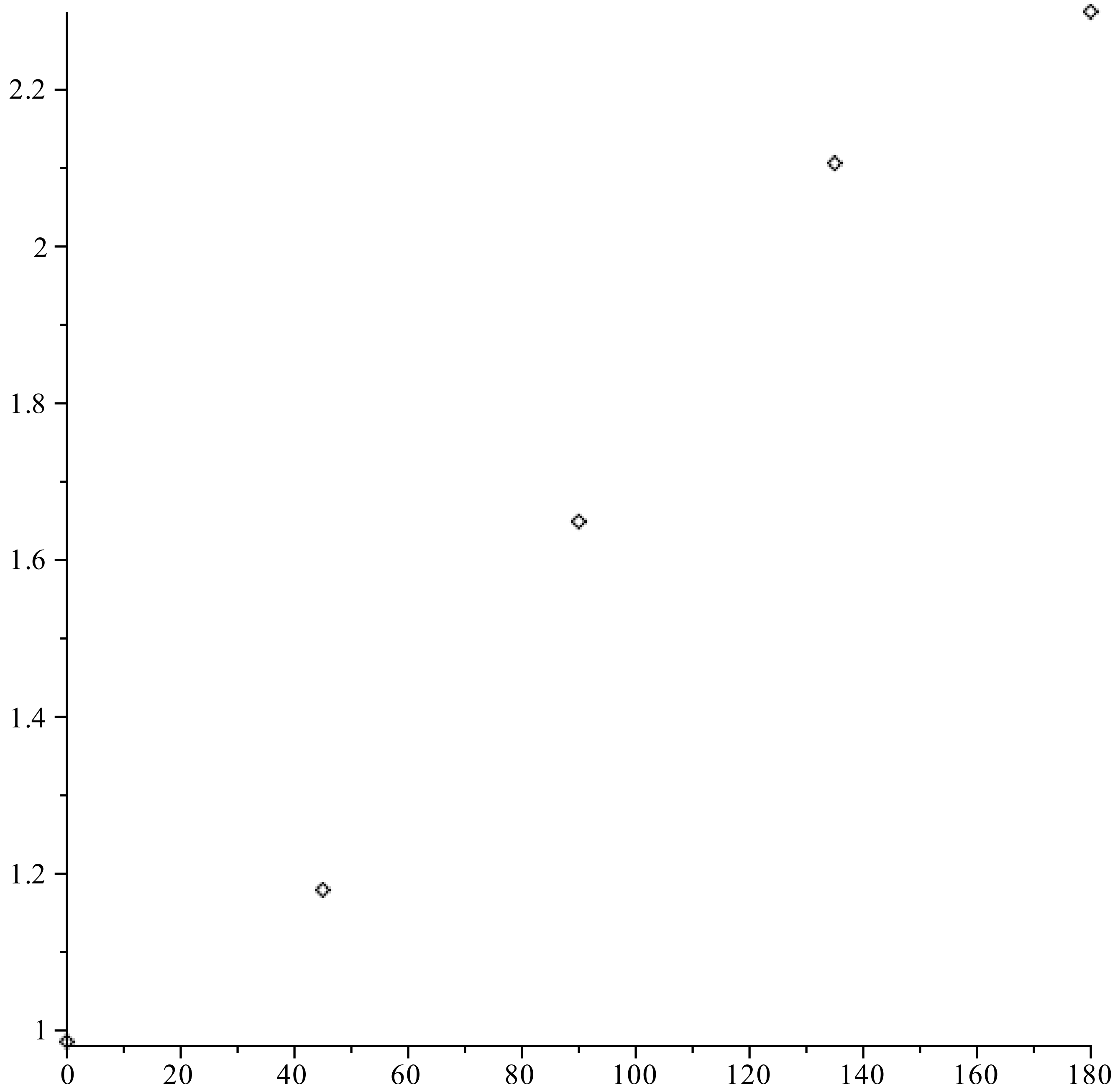
>

Various calculations using subs on the original integrals...

```
> iofmu := seq([(subs(rci_ = R_/7, R_ = 3, alpha = x*Pi/180, Inr_))], x = xx) :
```

```
> xx := [j·90/4 $(j = 0..4)];
pointplot({seq([2· x, evalf(subs(mu_ = 0.5, rci_ = R_/7, R_ = 3, alpha = x*Pi/180, mu_· Inr_))], x = xx)});
    # to make the sample volume smaller in case of dilution by NACl we multiply by μ
```

$$xx := \left[0, \frac{45}{2}, 45, \frac{135}{2}, 90\right]$$



2.2
2
1.8
1.6
1.4
1.2
1
0
20
40
60
80
100
120
140
160
180

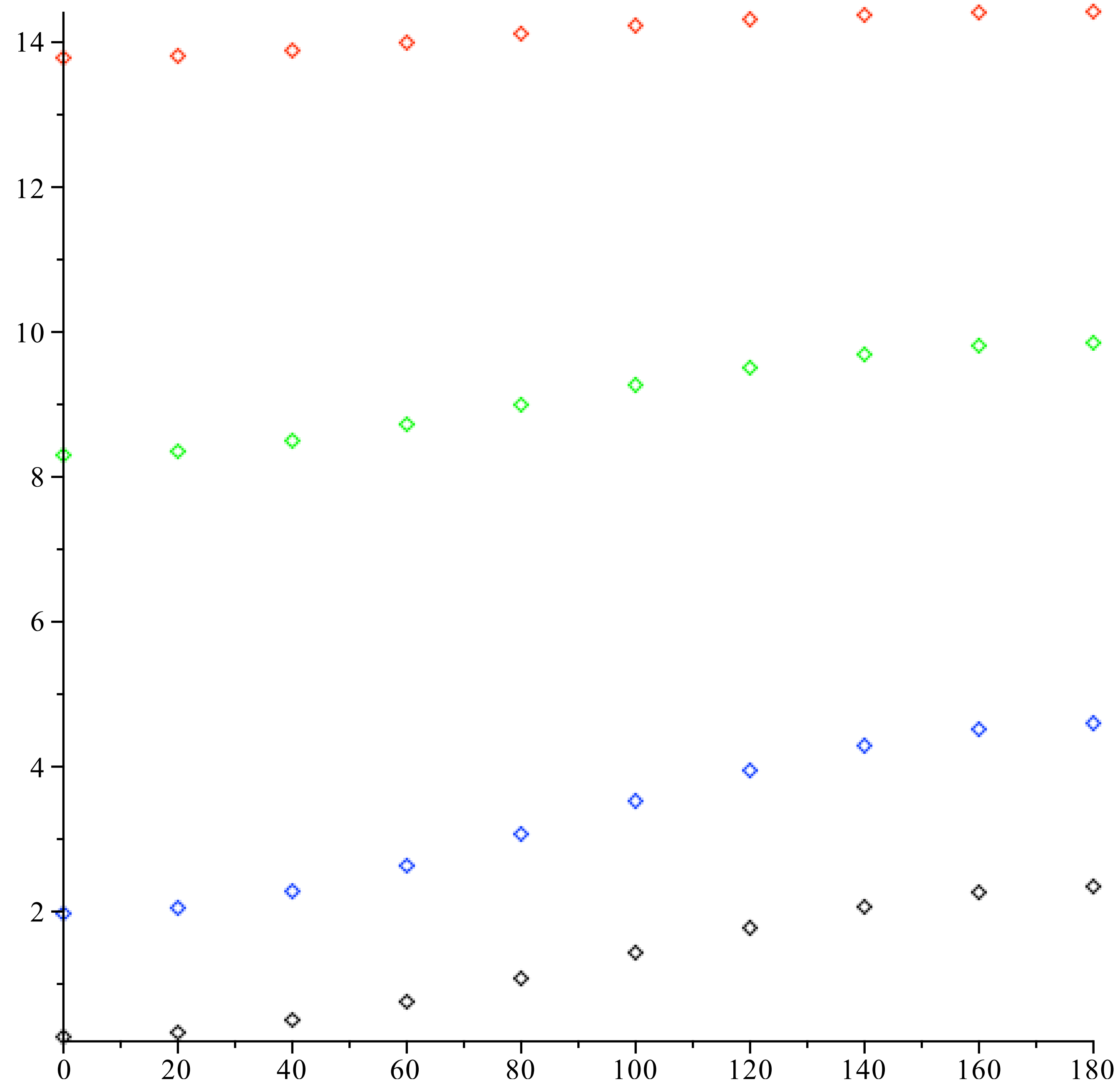
>

Different mu in 6mm can

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 ..nump)\right]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J = 0 ..nump), seq(black, J = 0 ..nump) :$

$pointplot([seq([2 \cdot x, evalf(subs(\mathrm{mu\_} = 0.1, \mathrm{rci\_} = \mathrm{R\_}/7, \mathrm{R\_} = 3, \mathrm{alpha} = \mathrm{x} * \mathrm{Pi}/180, Inr\_))], x = xx),$
$seq([2 \cdot x, evalf(subs(\mathrm{mu\_} = 0.2, \mathrm{rci\_} = \mathrm{R\_}/7, \mathrm{R\_} = 3, \mathrm{alpha} = \mathrm{x} * \mathrm{Pi}/180, Inr\_))], x = xx),$
$seq([2 \cdot x, evalf(subs(\mathrm{mu\_} = 0.5, \mathrm{rci\_} = \mathrm{R\_}/7, \mathrm{R\_} = 3, \mathrm{alpha} = \mathrm{x} * \mathrm{Pi}/180, Inr\_))], x = xx),$
$seq([2 \cdot x, evalf(subs(\mathrm{mu\_} = 1, \mathrm{rci\_} = \mathrm{R\_}/7, \mathrm{R\_} = 3, \mathrm{alpha} = \mathrm{x} * \mathrm{Pi}/180, Inr\_))], x = xx)], color = [col]);$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



14
12
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180

No rc, full hight, different volumes.

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0..nump)\right]; col := seq(red, J = 0..nump), seq(green, J = 0..nump), seq(blue, J = 0..nump), seq(black, J = 0..nump) :$

$\mu_1 := 0.5 :$

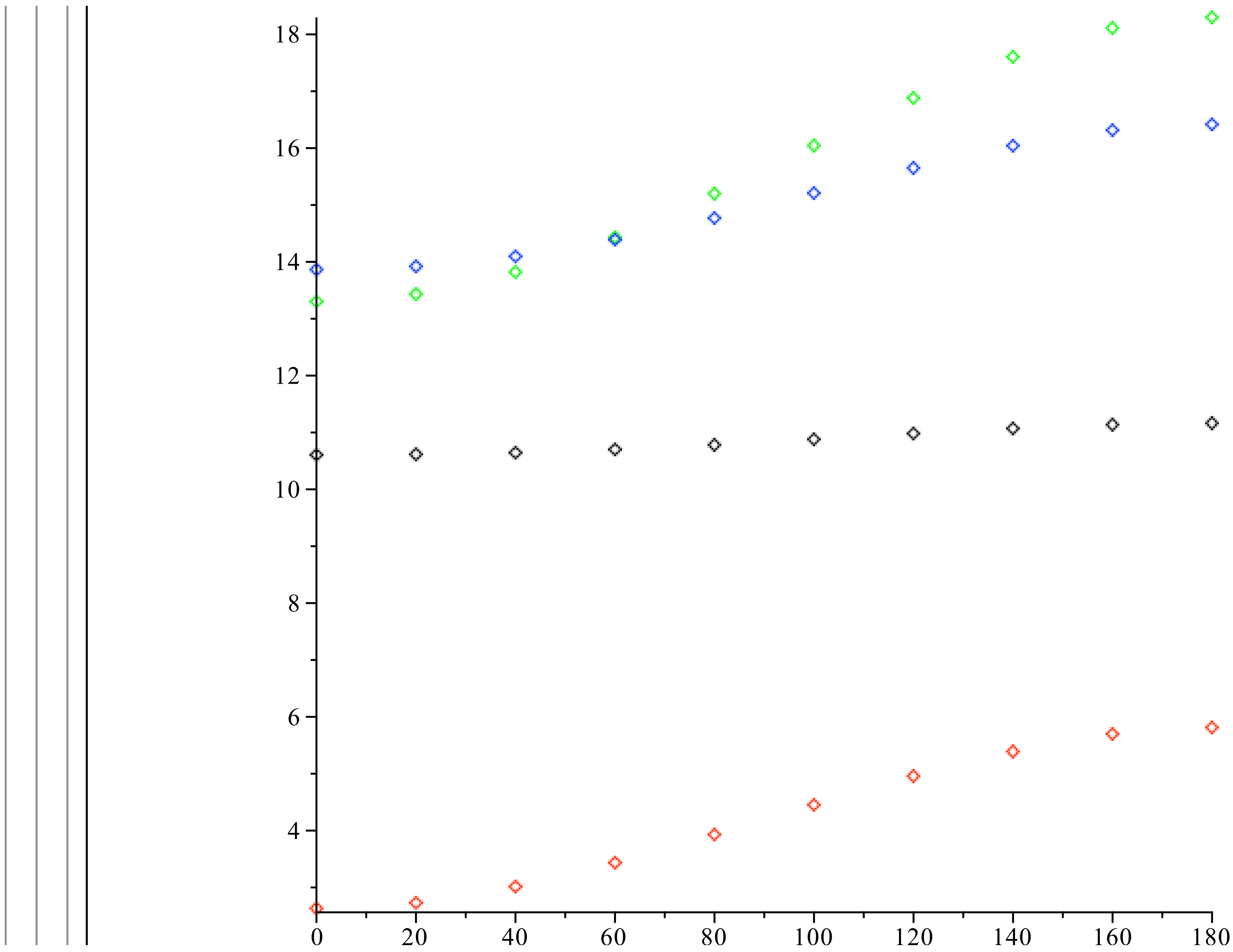
$$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = 0, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inr\_\right)\right)\right], x = xx\right),\right.$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\right);$$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



18
16
14
12
10
8
6
4
0
20
40
60
80
100
120
140
160
180

No rc, constant volume, check of integral

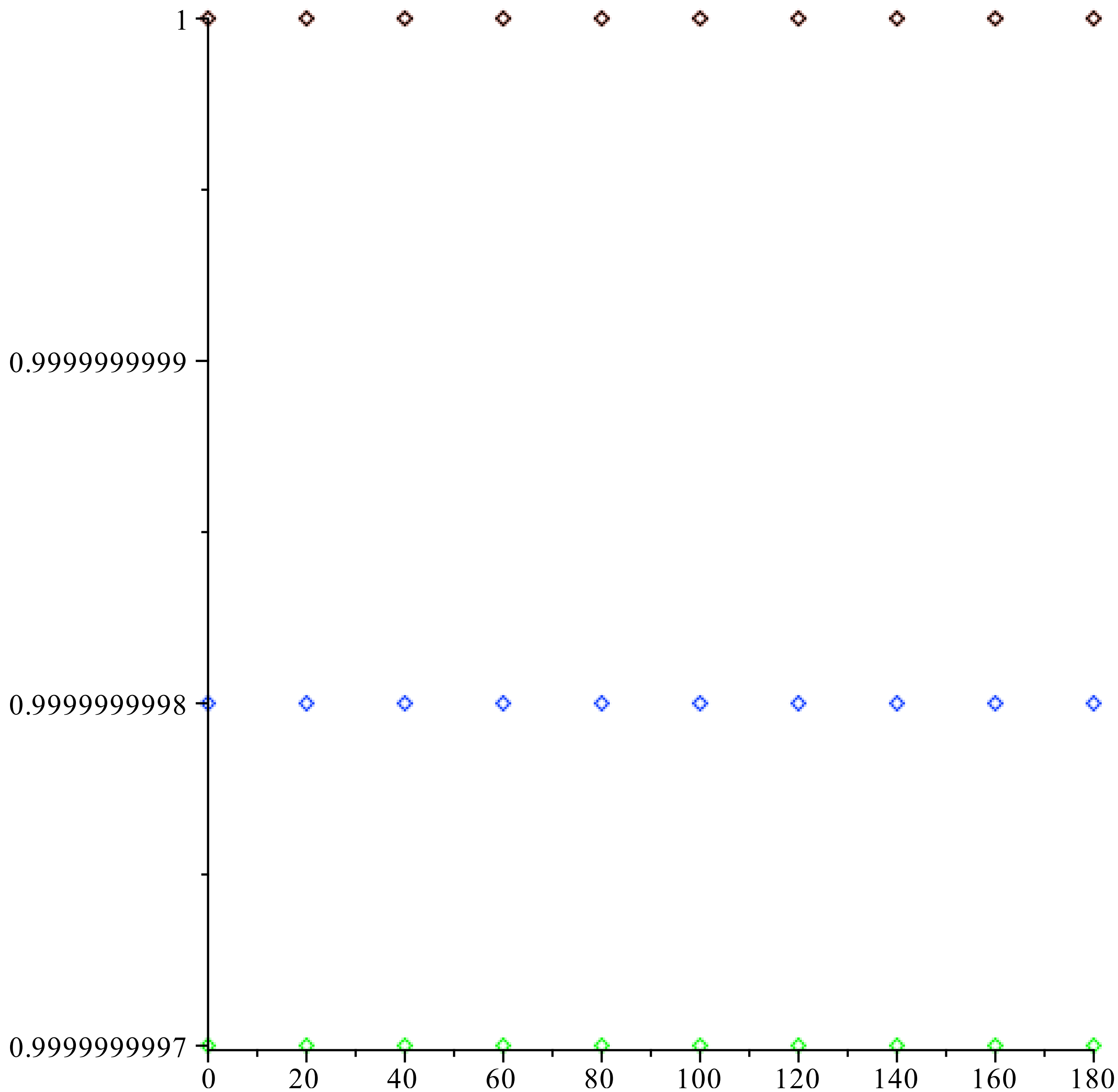
> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump)\right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 0.0 :$

$$pointplot\Big(\Big[seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = 0, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrV\_\Big)\Big)\Big], x = xx\Big),$$
$$seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrdwV\_\Big)\Big)\Big], x = xx\Big),$$
$$seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrdwV\_\Big)\Big)\Big], x = xx\Big),$$
$$seq\Big(\Big[2 \cdot x, evalf\Big(subs\Big(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrdwV\_\Big)\Big)\Big], x = xx\Big)\Big], color = [col]\Big);$$

>

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



1
0.9999999999
0.9999999998
0.9999999997
0
20
40
60
80
100
120
140
160
180

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$(j = 0 .. nump) \right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 1 :$

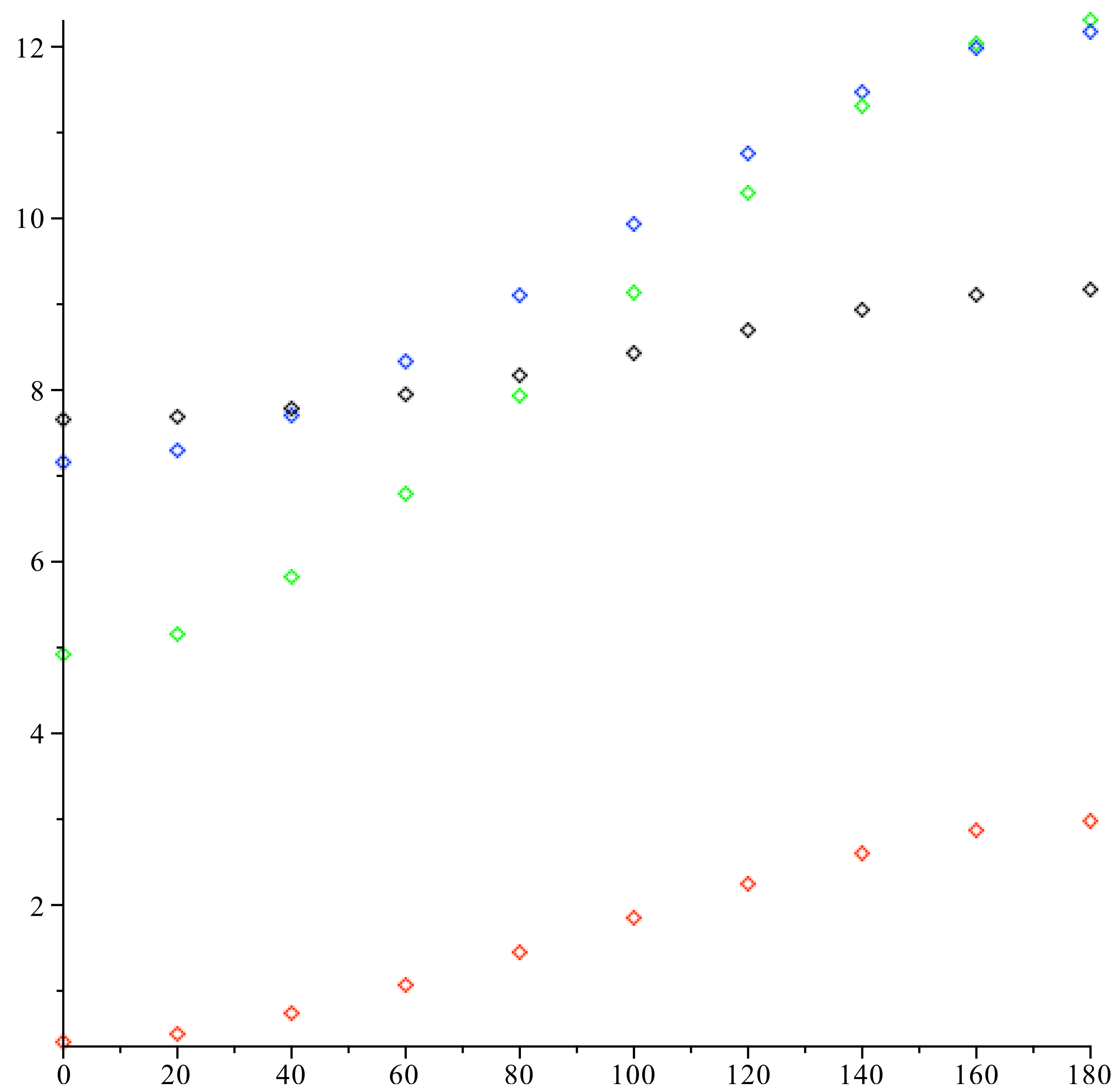
$$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = 0, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inr\_\right)\right)\right], x = xx\right),\right.$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right),$$

$$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\right);$$

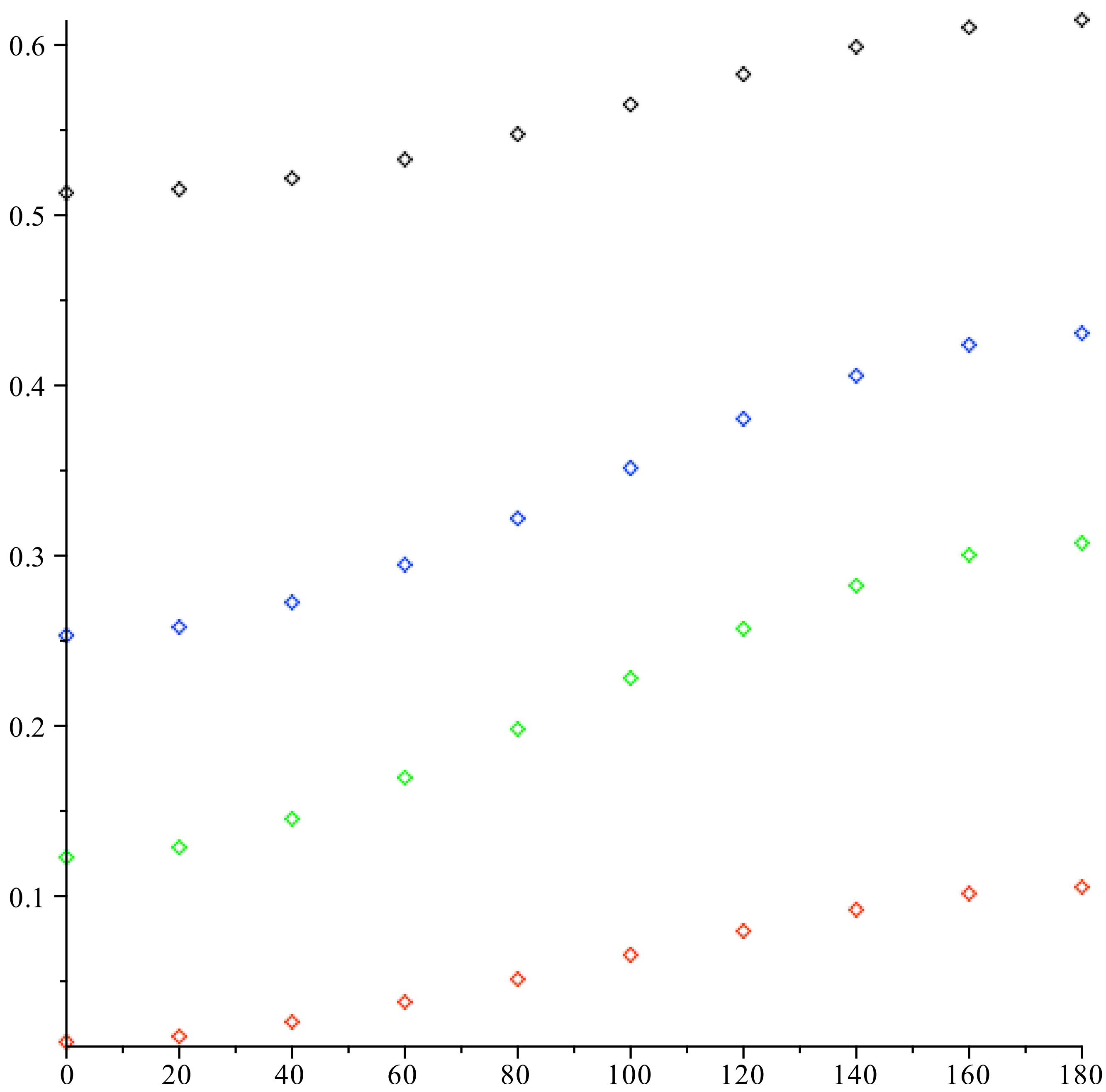
$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$


12
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180

No rc, constant volume

```
> nump := 9 : xx := [ (j·90)/nump $ (j = 0 ..nump) ]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J
      = 0 ..nump), seq(black, J = 0 ..nump) :
  μ_1 := 1. :
  pointplot([seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, R_ = 6/2, α = x * Pi / 180, InrV_))], x = xx),
            seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, r1 = (7/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx),
            seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, r1 = (8/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx),
            seq([2· x, evalf(subs(mu_ = μ_1, rci_ = 0, r1 = (9/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
      InrdwV_))], x = xx)], color = [col]);
```

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



0.6
0.5
0.4
0.3
0.2
0.1
0
20
40
60
80
100
120
140
160
180

rc2, constant volume

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump) \right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 0.25 :$

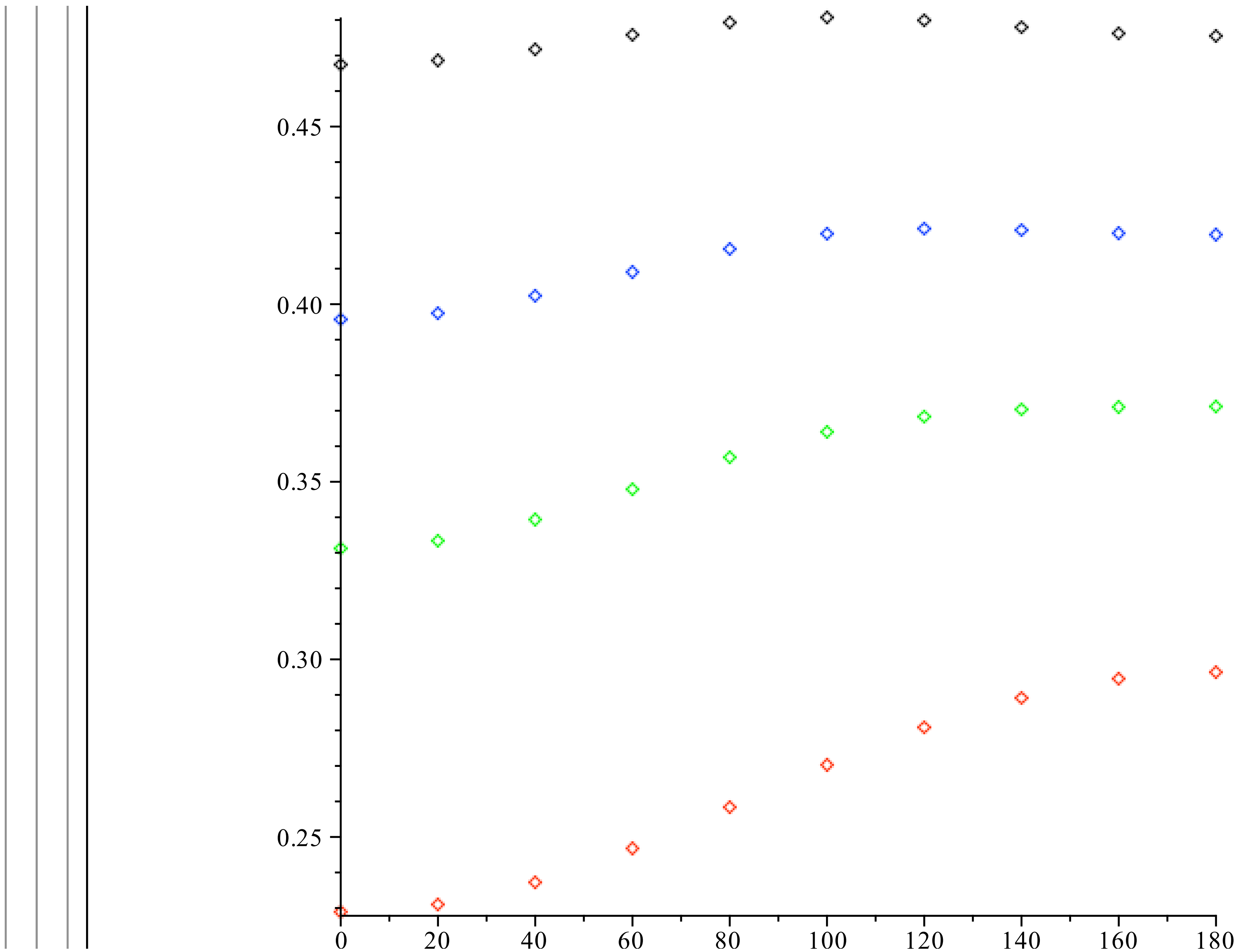
$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = \frac{\mathrm{R\_}}{7}, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrV\_\right)\right)\right], x = xx\right),\right.$

$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{7}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrdwV\_\right)\right)\right], x = xx\right),$

$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrdwV\_\right)\right)\right], x = xx\right),$

$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\mathrm{R\_}}{7}, r1 = \left(\frac{9}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180, InrdwV\_\right)\right)\right], x = xx\right)\right], color = [col]\right);$

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$


0.45
0.40
0.35
0.30
0.25
0
20
40
60
80
100
120
140
160
180

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 .. nump)\right]; col := seq(red, J = 0 .. nump), seq(green, J = 0 .. nump), seq(blue, J = 0 .. nump), seq(black, J = 0 .. nump) :$

$\mu_1 := 0.25 :$

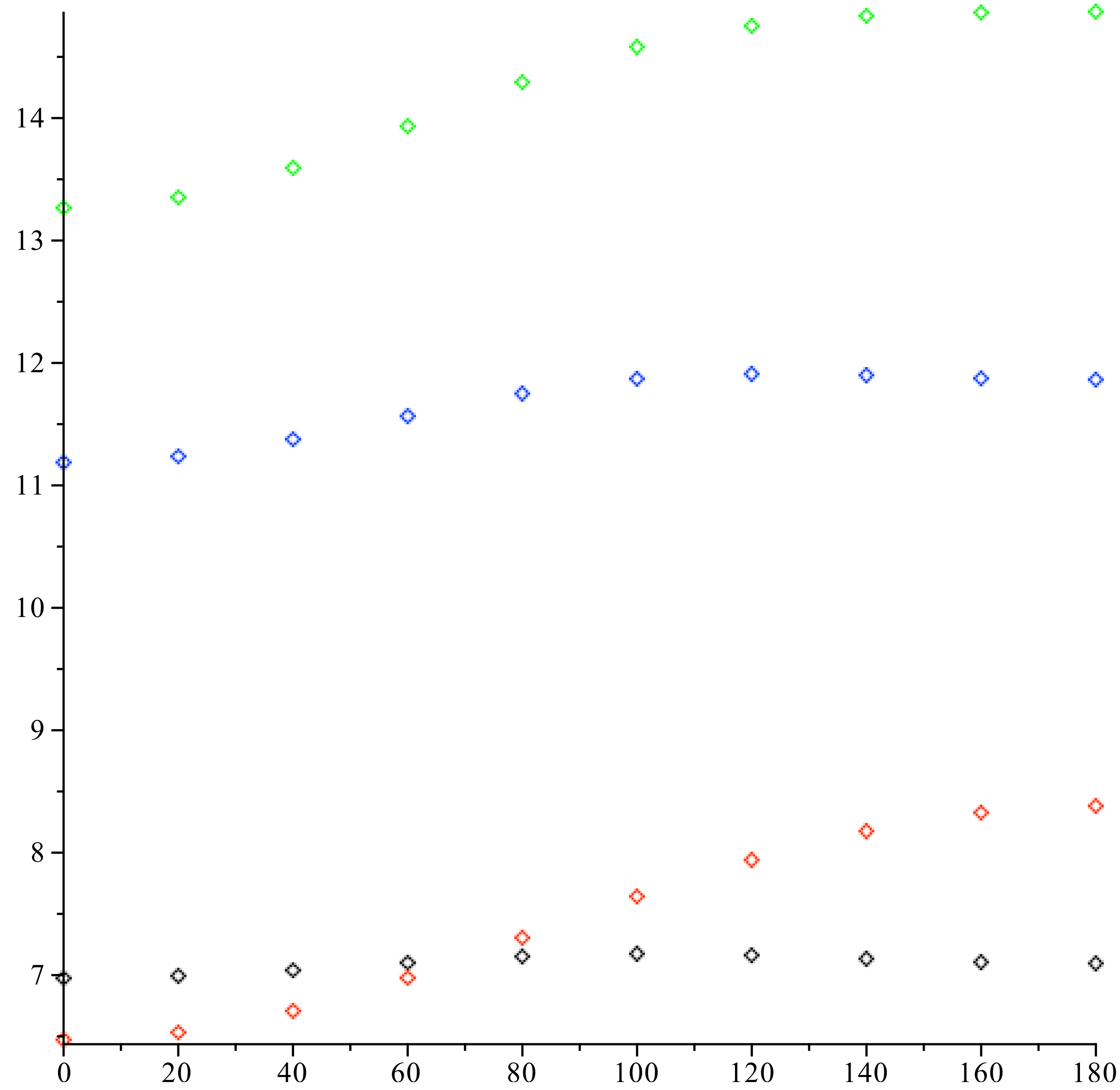
$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\text{mu\_} = \mu_1, \text{rci\_} = \frac{\text{R\_}}{7}, \text{R\_} = \frac{6}{2}, \alpha = x * Pi / 180, Inr\_\right)\right)\right], x = xx\right),\right.$

$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\text{R\_}}{7}, r1 = \left(\frac{7}{2}\right) / \text{R\_}, \text{R\_} = 10/2, \alpha = x * Pi / 180, Inrdw\_\right)\right)\right], x = xx\right),$

$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\text{R\_}}{7}, r1 = \left(\frac{8}{2}\right) / \text{R\_}, \text{R\_} = 10/2, \alpha = x * Pi / 180, Inrdw\_\right)\right)\right], x = xx\right),$

$\left.seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = \frac{\text{R\_}}{7}, r1 = \left(\frac{9}{2}\right) / \text{R\_}, \text{R\_} = 10/2, \alpha = x * Pi / 180, Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\Big);$

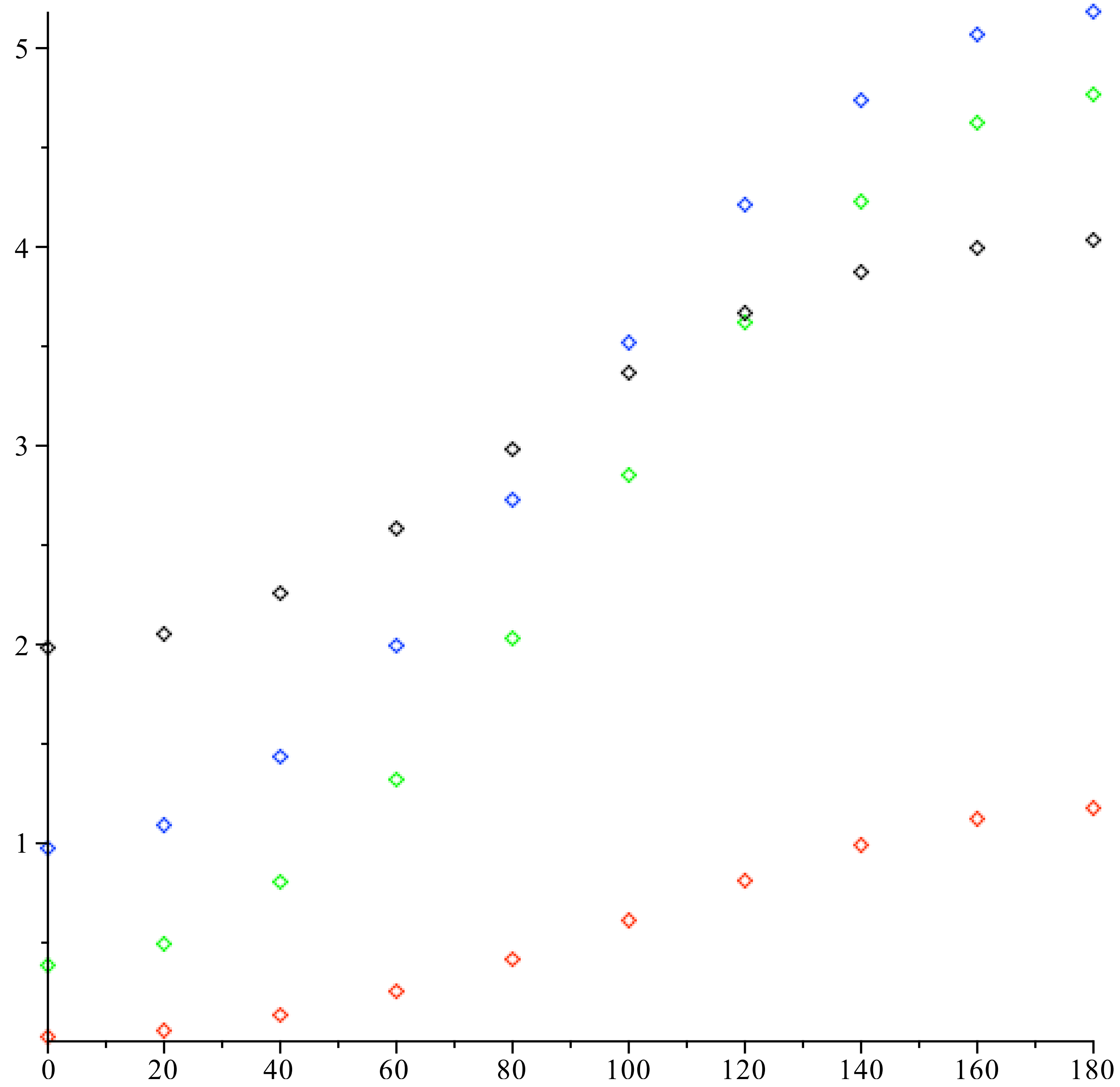
$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



14
13
12
11
10
9
8
7
0
20
40
60
80
100
120
140
160
180

```
> nump := 9 : xx := [ (j·90)/nump $(j = 0 ..nump) ]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump), seq(blue, J
      = 0 ..nump), seq(black, J = 0 ..nump) :
  μ_1 := 2 :
  pointplot([seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, R_ = 6/2, α = x * Pi / 180, Inr_))], x = xx),
              seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, r1 = (7/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
     Inrdw_))], x = xx),
              seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, r1 = (8/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
     Inrdw_))], x = xx),
              seq([2· x, evalf(subs(mu_ = μ_1, rci_ = R_/7, r1 = (9/2) / R_, R_ = 10 / 2, α = x * Pi / 180,
     Inrdw_))], x = xx)], color = [col]);
```

$$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$$



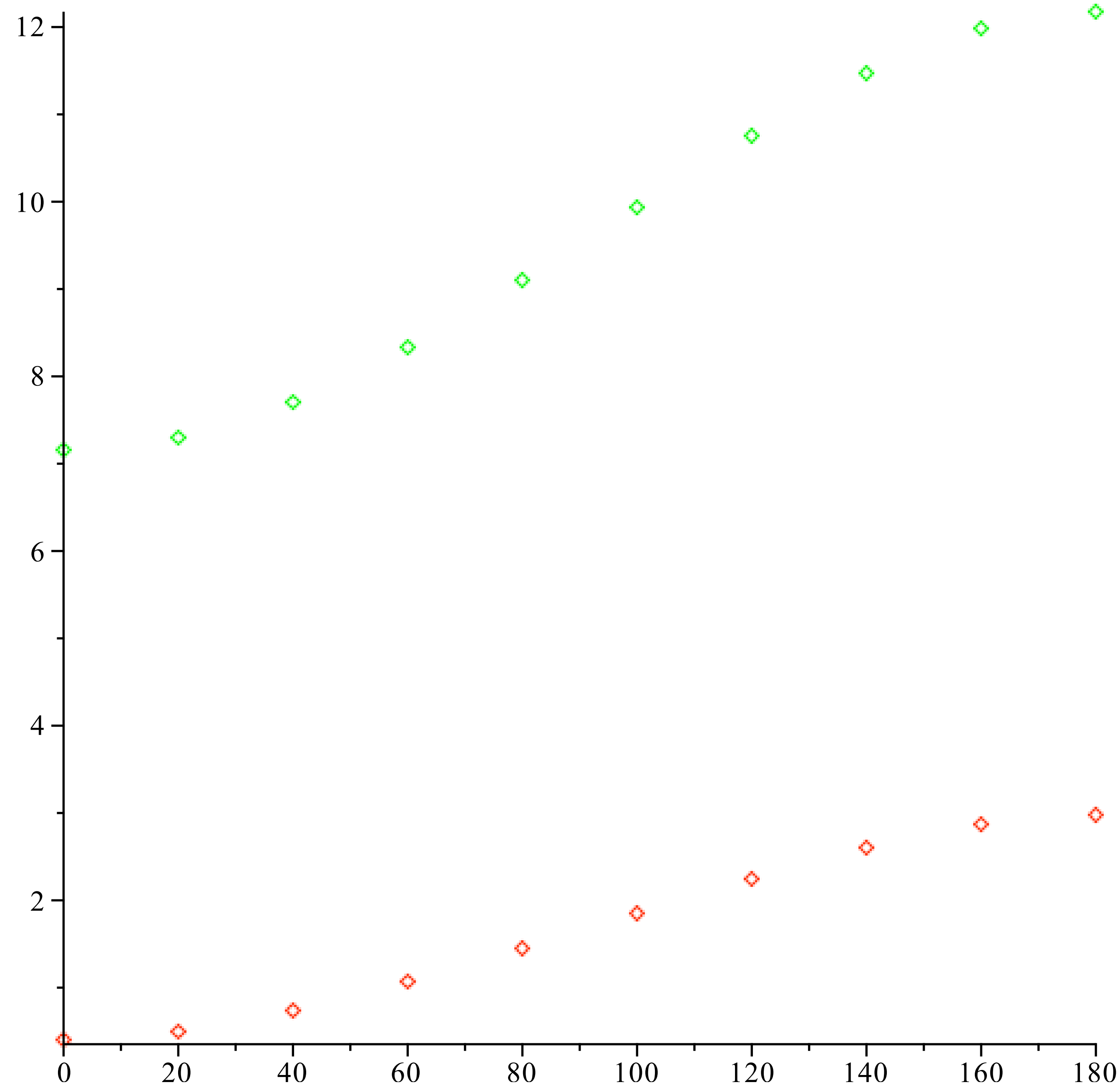
5
4
3
2
1
0
20
40
60
80
100
120
140
160
180

> $nump := 9 : xx := \left[\frac{j \cdot 90}{nump} \$ (j = 0 ..nump) \right]; col := seq(red, J = 0 ..nump), seq(green, J = 0 ..nump) :$

$\mu_1 := 1 :$

$pointplot\left(\left[seq\left(\left[2 \cdot x, evalf\left(subs\left(\mathrm{mu\_} = \mu_1, \mathrm{rci\_} = 0, \mathrm{R\_} = \frac{6}{2}, \alpha = \mathrm{x} * \mathrm{Pi} / 180, Inr\_\right)\right)\right], x = xx\right),\right.$
$seq\left(\left[2 \cdot x, evalf\left(subs\left(mu\_ = \mu_1, rci\_ = 0, r1 = \left(\frac{8}{2}\right) / \mathrm{R\_}, \mathrm{R\_} = 10/2, \alpha = \mathrm{x} * \mathrm{Pi} / 180,\right.\right.\right.\right.$
$\left.\left.\left.\left.\left. Inrdw\_\right)\right)\right], x = xx\right)\right], color = [col]\right)$

$xx := [0, 10, 20, 30, 40, 50, 60, 70, 80, 90]$


12
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180

```
> 10^2-8^2; 10^2-9^2;
```

$$36$$
$$19 \quad (1.4.7.1)$$

```
> #multiple(pointplot,{seq([x,evalf(subs(alpha=x*Pi/180,Inr6)),tt],t2=tt)});
```

```
>
```

2020

> $evalf(\exp(1))$

$$2.718281828 \quad (1.4.8.1)$$

> $muR = \frac{1}{1.5} \cdot 3;\ mu0 = \frac{1}{1.5}$

$r0 = \left(\frac{\frac{3}{5.0}}{5 \cdot \pi}\right)^{0.5}$

$$muR = 2.000000000$$
$$\mu 0 = 0.6666666667$$
$$r0 = 0.1954410048 \quad (1.4.8.2)$$

Volumes [cm^3] r is V-can radius

> $seq\left(\pi \cdot r^2 \cdot 4.5,\ r = [0.2,\ 0.3,\ 0.4]\right)$

$$0.5654866776,\ 1.272345025,\ 2.261946710 \quad (1.4.8.3)$$

Double wall volumes, outer r=0.5

> $seq\left(\pi \cdot \left(0.5^2 - r2^2\right) \cdot 4.5,\ r2 = [0.4,\ 0.45]\right)$

$$1.272345025,\ 0.671515430 \quad \textbf{(1.4.8.4}$$

>

>