

```

> with(plots)
[animate, animate3d, animatecurve, arrow, changecoords, complexplot,      (1)
 complexplot3d, conformal, conformal3d, contourplot, contourplot3d,
 coordplot, coordplot3d, densityplot, display, dualaxisplot, fieldplot,
 fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal,
 interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d,
 listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple,
 odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot,
 polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot,
 rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween,
 spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot]

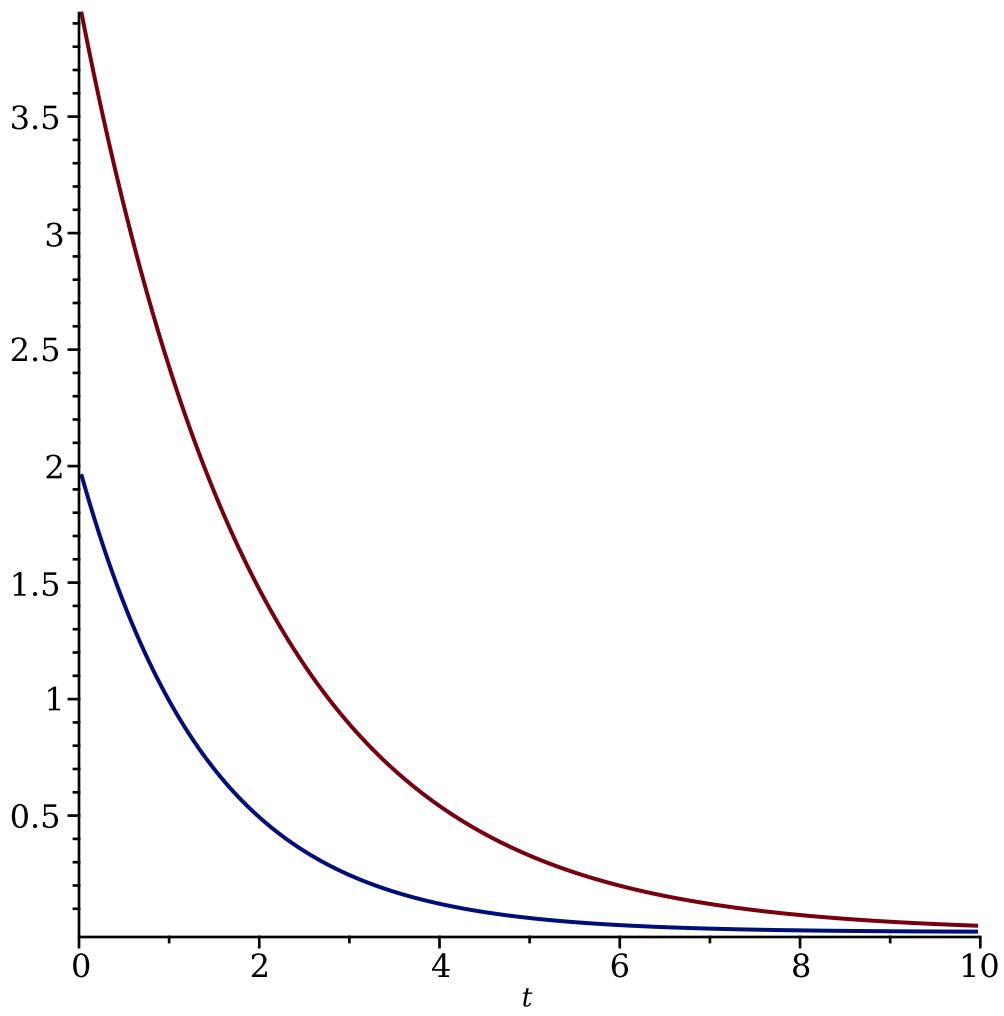
> ec1:=diff(x(t),t)=-k*x(t)
ec1 :=  $\frac{d}{dt} x(t) = -k x(t)$  (2)

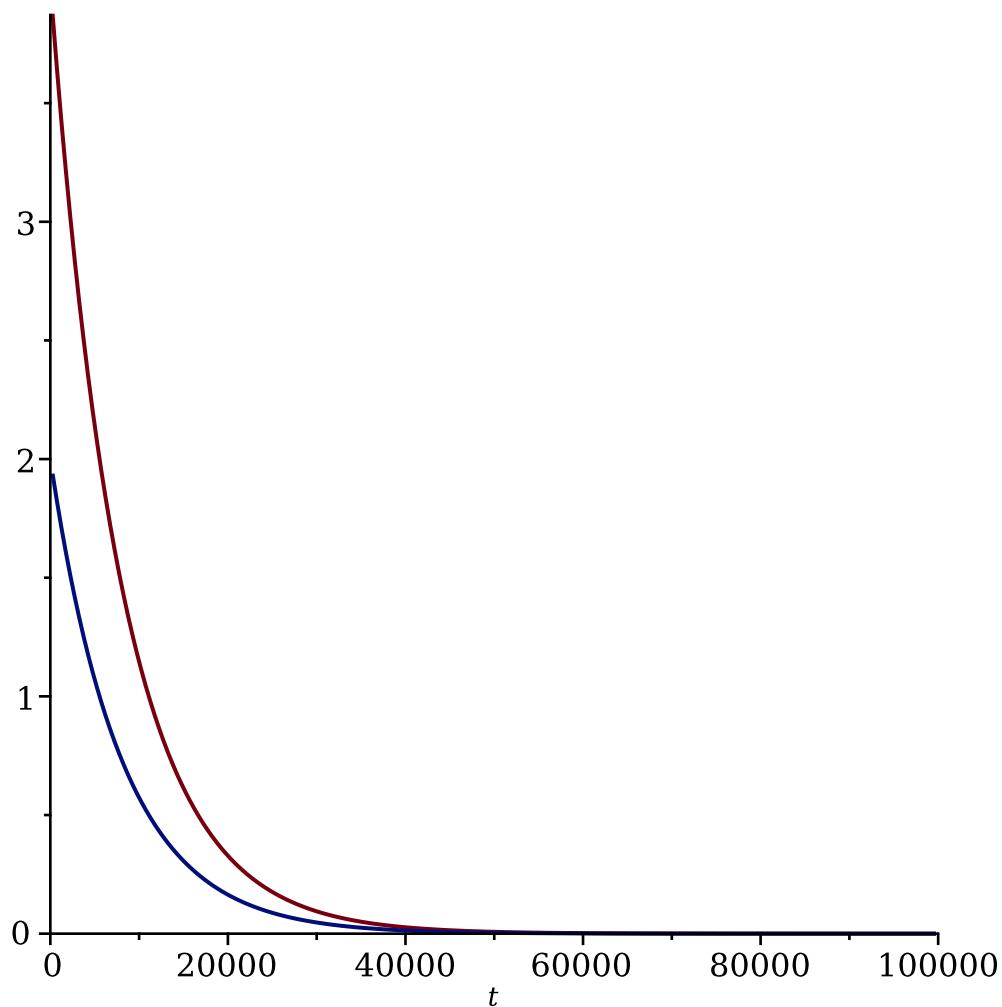
> cond:=x(0)=x0
cond := x(0) = x0 (3)

> xs:=unapply(rhs(dsolve({ec1,cond},x(t))),t,x0,k)
xs := (t, x0, k)  $\mapsto$   $x_0 \cdot e^{-kt}$  (4)

> plot([xs(t,4,0.5),xs(t,2,0.7)],t=0..10)

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>  $ec2 := xs(5730, x0, k) = 1/2 * x0$

$$ec2 := x0 e^{-5730 k} = \frac{x0}{2} \quad (5)$$

>  $kc14 := solve(ec2, k)$

$$kc14 := \frac{\ln(2)}{5730} \quad (6)$$

>  $ec3 := xs(t, x0, kc14) = x0/5$

$$ec3 := x0 e^{-\frac{\ln(2) t}{5730}} = \frac{x0}{5} \quad (7)$$

>  $t20 := solve(ec3, t)$

$$t20 := \frac{5730 \ln(5)}{\ln(2)} \quad (8)$$

>  $ec4 := xs(t, x0, kc14) = x0 * 91.57 / 100$

$$ec4 := x0 e^{-\frac{\ln(2) t}{5730}} = 0.9157000000 x0 \quad (9)$$

>  $tstudii := solve(ec4, t)$

$$tstudii := 728.0141045 \quad (10)$$

>  $giulgiu\_minim := 1988 - tstudii$

$$giulgiu\_minim := 1259.985896 \quad (11)$$

$$> ec4:=xs(t,x0,kc14)=x0*93.021/100 \\ ec4 := x0 e^{-\frac{\ln(2) t}{5730}} = 0.9302100000 x0 \quad (12)$$

$$> tstudii:=solve(ec4,t) \\ tstudii := 598.0495293 \quad (13)$$

$$> giulgiu_maxim:=1988-tstudii \\ giulgiu_maxim := 1389.950471 \quad (14)$$

> restart  
 > with(plots)

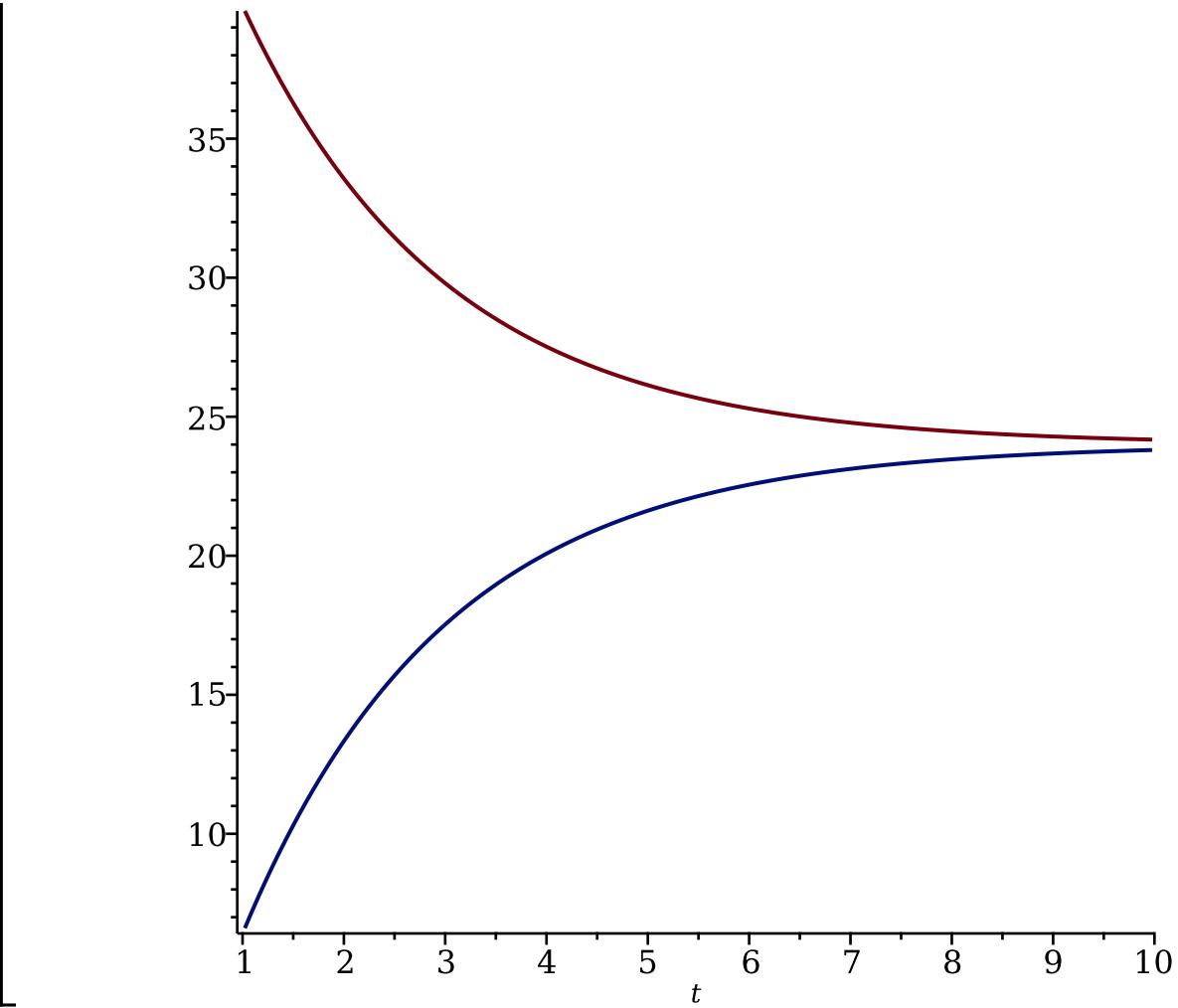
[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra\_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot]

$$> ec1:=diff(T(t),t)=-k*(T(t)-Tm) \\ ec1 := \frac{d}{dt} T(t) = -k (T(t) - Tm) \quad (16)$$

$$> cond:=T(0)=T0 \\ cond := T(0) = T0 \quad (17)$$

$$> Ts:=unapply(rhs(dsolve({ec1,cond},T(t))),t,T0,k,Tm) \\ Ts := (t, T0, k, Tm) \mapsto Tm + e^{-kt} \cdot (T0 - Tm) \quad (18)$$

$$> plot([Ts(t,50,0.5,24), Ts(t,-5,0.5,24)],t=1..10)$$



```
> ec2:=Ts(t,36,k,21)=34.22
ec2 :=  $21 + 15 e^{-kt} = 34.22$  (19)
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```
> ec3:=Ts(t+1,36,k,21)=34.11
ec3 :=  $21 + 15 e^{-k(t+1)} = 34.11$  (20)
```

```
> sist:=ec2,ec3
sist :=  $21 + 15 e^{-kt} = 34.22, 21 + 15 e^{-k(t+1)} = 34.11$  (21)
```

```
> solve({sist},{t,k})
{k = 0.008355536648, t = 15.11804352} (22)
```

```
> timp_deces:=11.5-15.11804352+24
timp_deces := 20.38195648 (23)
```

```
> restart
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fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal,
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(24)

*interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra\_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot]*

```
> ec1:=diff(x(t),t)=r*x(t)
      
$$ec1 := \frac{d}{dt} x(t) = rx(t)$$
 (25)

> cond1:=x(0)=x0
      
$$cond1 := x(0) = x0$$
 (26)

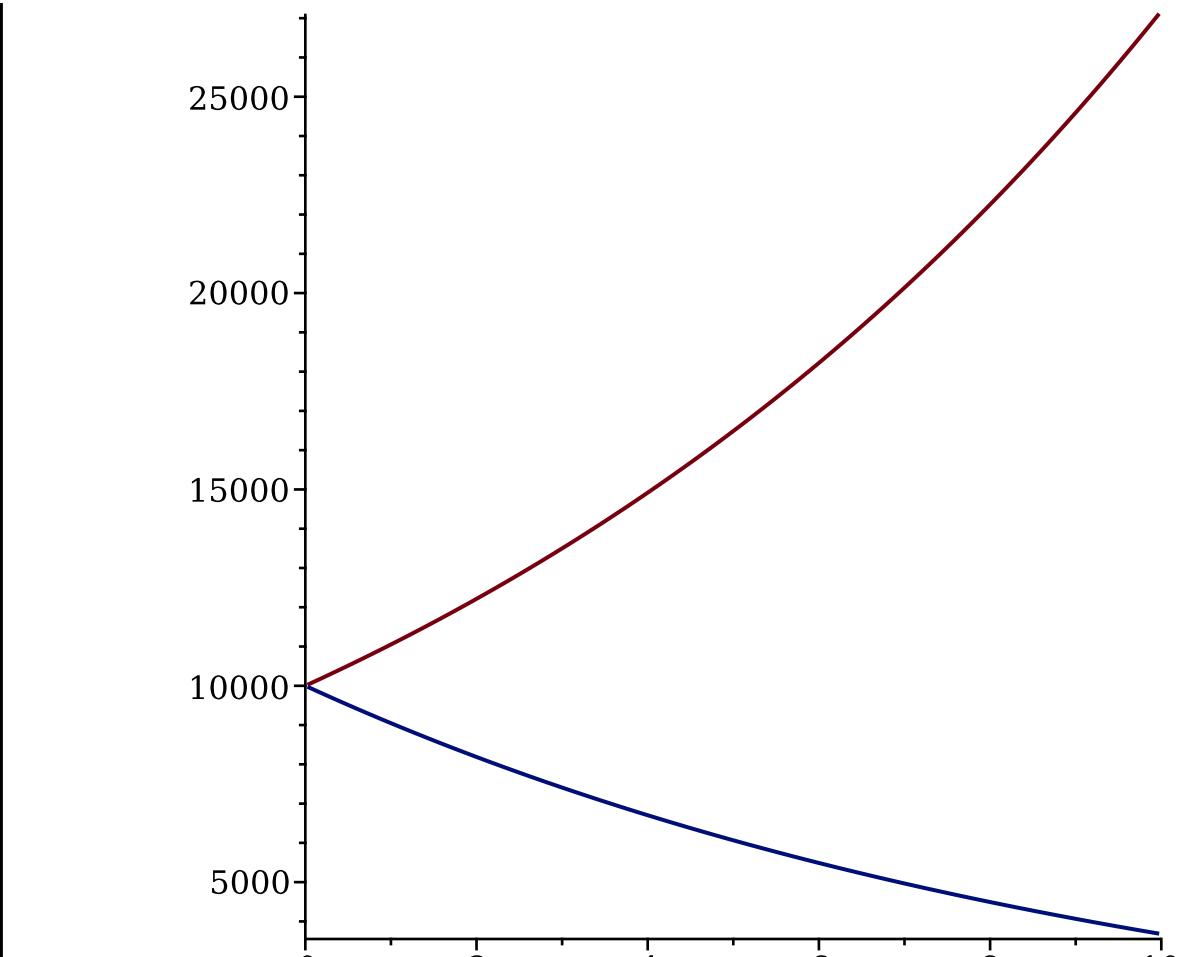
> ec2:=diff(x(t),t)=r0*x(t)*(1-x(t)/k)
      
$$ec2 := \frac{d}{dt} x(t) = r0 x(t) \left(1 - \frac{x(t)}{k}\right)$$
 (27)

> cond2:=x(0)=x0
      
$$cond2 := x(0) = x0$$
 (28)

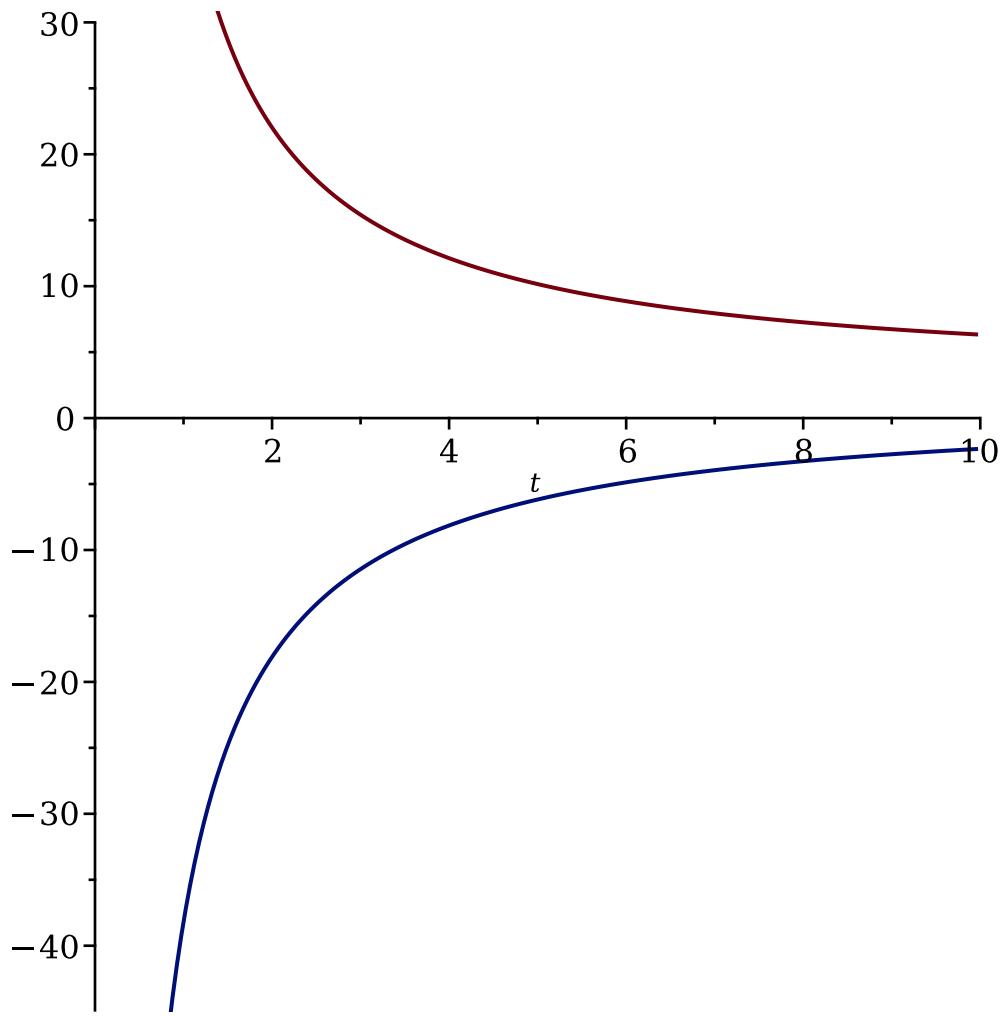
> xms:=unapply(rhs(dsolve({ec1,cond1},x(t))),t,x0,r)
      
$$xms := (t, x0, r) \mapsto x0 \cdot e^{rt}$$
 (29)

> xvs:=unapply(rhs(dsolve({ec2,cond2},x(t))),t,x0,k,r0)
      
$$xvs := (t, x0, k, r0) \mapsto \frac{k \cdot x0}{(k - x0) \cdot e^{-r0 \cdot t} + x0}$$
 (30)

> plot([xms(t,10000,0.1),xms(t,10000,-0.1)],t=0..10)
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```
> plot([xvs(t,10000,4,0.1),xvs(t,10000,4,-0.1)],t=0..10)
```



>  $rs := \text{solve}(xms(2, 25*10^3, r) = 30*10^3, r)$

$$rs := \frac{\ln\left(\frac{6}{5}\right)}{2} \quad (31)$$

>  $\text{marime\_dupa\_5\_ani\_malthus} := xms(5, 25*10^3, rs)$

$$\text{marime\_dupa\_5\_ani\_malthus} := 7200\sqrt{30} \quad (32)$$

>  $ec3 := xvs(2, 20*10^3, k, r0) = 40*10^3$

$$ec3 := \frac{20000 k}{(k - 20000) e^{-2 r0} + 20000} = 40000 \quad (33)$$

>  $ec4 := xvs(3, 20*10^3, k, r0) = 50*10^3$

$$ec4 := \frac{20000 k}{(k - 20000) e^{-3 r0} + 20000} = 50000 \quad (34)$$

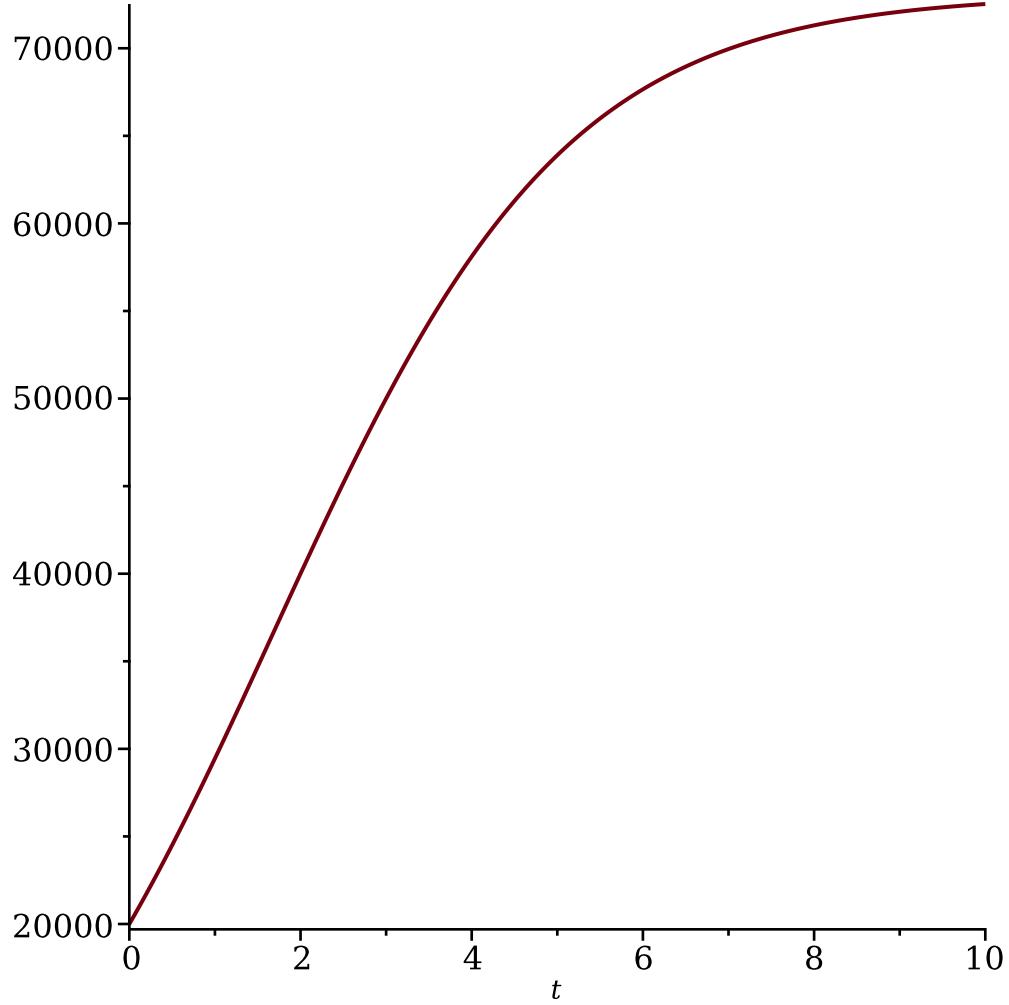
>  $sist := ec3, ec4$

$$sist := \frac{20000 k}{(k - 20000) e^{-2 r0} + 20000} = 40000, \frac{20000 k}{(k - 20000) e^{-3 r0} + 20000} = 50000 \quad (35)$$

>  $\text{sol} := \text{solve}(\{sist\}, \{k, r0\})$

$$sol := \left\{ k = \frac{200000 \operatorname{RootOf}(5 Z^2 - Z - 1)}{7} + \frac{400000}{7}, r0 = -\ln(\operatorname{RootOf}(5 Z^2 - Z - 1)) \right\} \quad (36)$$

```
> plot([xvs(t, 20*10^3, rhs(sol[1]), rhs(sol[2]))], t=0..10)
```



```
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 polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot,
 rootlocus, semilogplot, setcolors, setoptions, setoptions3d,
 shadebetween, spacecurve, sparsematrixplot, surfdata, textplot,]      (37)
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textplot3d, tubeplot]

> ec1:=v(x)*diff(v(x),x)=-g*R^2/(x+R)^2

$$ec1 := v(x) \left( \frac{d}{dx} v(x) \right) = -\frac{g R^2}{(x + R)^2} \quad (38)$$


> cond:=v(0)=v0

$$cond := v(0) = v0 \quad (39)$$


> s:=solve(lhs(dsolve({ec1,cond},v(x),implicit))=0,v(x))

$$s := \frac{\sqrt{-(x + R) (2 x g R - R v0^2 - v0^2 x)}}{x + R},$$


$$-\frac{\sqrt{-(x + R) (2 x g R - R v0^2 - v0^2 x)}}{x + R} \quad (40)$$


> vs:=unapply(s[1],x,v0,R,g)

$$vs := (x, v0, R, g) \mapsto \frac{\sqrt{-(x + R) \cdot (2 \cdot R \cdot g \cdot x - R \cdot v0^2 - v0^2 \cdot x)}}{x + R} \quad (41)$$


> b:=vs(75,50,6371000,9.81)

$$b := 32.07050550 \quad (42)$$


> c:=solve(vs(x,50,6371000,9.81)=0,x)

$$c := 127.4235475 \quad (43)$$


> sol_ve:=solve(vs(x,v0,R,g)=0,v0)

$$sol\_ve := \frac{\sqrt{2} \sqrt{(x + R) x g R}}{x + R}, -\frac{\sqrt{2} \sqrt{(x + R) x g R}}{x + R} \quad (44)$$


> ve:=unapply(sol_ve[1],x,R,g)

$$ve := (x, R, g) \mapsto \frac{\sqrt{2} \cdot \sqrt{(x + R) \cdot x \cdot g \cdot R}}{x + R} \quad (45)$$


> limit(ve(x,R,g),x=infinity)

$$\sqrt{2} \sqrt{g R} \quad (46)$$


> limit(ve(x,6378160,9.78),x=infinity)

$$11169.45878 \quad (47)$$


> limit(ve(x,6357778,9.832),x=infinity)

$$11181.20506 \quad (48)$$


> limit(ve(x,6371110,9.81),x=infinity)

$$11180.39257 \quad (49)$$


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