In [1]:
```
%display latex
E=48;f=50;L=10*10^(-3);C=150*10^(-6)
```

In [2]:
```
R=50;omega=2*n(pi)*f;round(omega,3)
L,C,omega
```

Out[2]: $\left(\frac{1}{100}, \frac{3}{20000}, 314.159265358979\right)$

Calcul de XL (reactancia inductiva) i XC (reactancia capacitiva), [Ohm] Calcul de X (reactancia), [Ohm] RECORDA:

- X positiva -> Circuit inductiu (predomina la bobina).
- X negativa -> Circuit capacitiu (predomina el condensador).
- X cero -----> Circuit ressonant, si hi ha bobina i condensador.

In [3]:
```
XL=omega*L;XL
```

Out[3]: $3.14159265358979$

In [4]:
```
if C<> 0:
    XC=1/(omega*C)
else:
    XC=0
XC
```

Out[4]: $21.2206590789194$

In [5]:
```
X=XL-XC;X
```

Out[5]: $-18.0790664253296$

Calcul de Z (impedancia total), [Ohm] L'angle s'obte en radians (per a les sinusoidals). Per veure'l millor es dona tambe en graus sexagesimals. RECORDA:

- Angle positiu -> Circuit inductiu (predomina la bobina).
- Angle negatiu -> Circuit capacitiu (predomina el condensador).
- Angle cero ----> Circuit ressonant, si hi ha bobina i condensador.

In [6]:
```
Z=sqrt(R^2+X^2);Z
```

Out[6]: $53.1681544047890$

In [7]:
```
if R==0:
    if X>0:
        PHI=pi/2
    else:
        if X<0:
            PHI=pi/2
        else:
            PHI=0
else:
    PHI=atan(X/R)
PHI
```

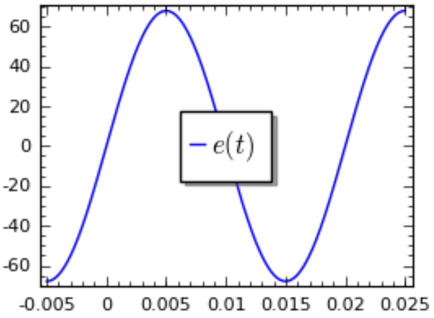
Out[7]: $-0.346954775821805$

In [8]:
```
fi=PHI*180/n(pi);fi
```
Out[8]: $-19.8790443364971$

*Calcul de Emax (f.e.m. maxima d'alimentacio), [V]*

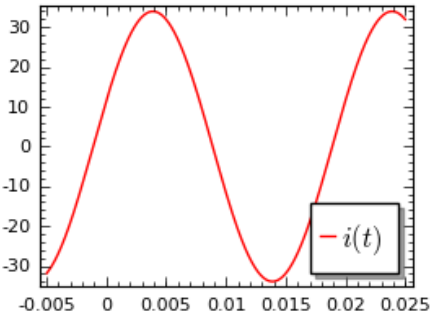
In [9]:
```
Emax=E*sqrt(2);round(Emax,2)
```
Out[9]: $67.88$

*Sinusoidal de la f.e.m. d'alimentacio, [V]*

In [10]:
```
e(t)=Emax*sin(omega*t)
te=plot(e(t),t,-0.25/f,1.25/f,color="blue",legend_label="$e(t)$");
show(te,figsize=3,frame=True,fontsize=8,axes=False)
```



*Sinusoidal de la intensitat del circuit, [A]*

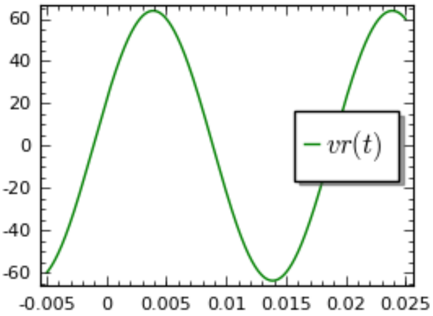
In [11]:
```
Imax=Emax/Z;round(Imax,2)
```
Out[11]: $1.28$

In [12]:
```
i(t)=Imax*sin((omega*t)-PHI)
ti=plot(Z/2*i(t),t,-0.25/f,1.25/f,color="red",legend_label="$i(t)$")
show(ti,figsize=3,frame=True,fontsize=8,axes=False)
```



*Sinusoidals de les caigudes de tensio a R, L i C, [V]*

In [13]:
```
Vrmax=Imax*R;round(Vrmax,2)
```
Out[13]: $63.84$

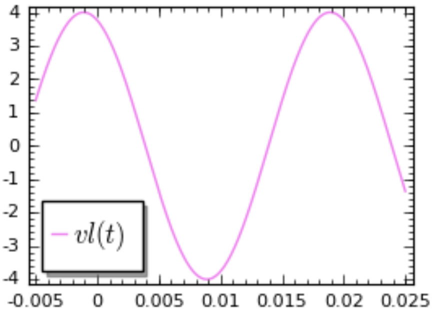
In [14]:
```
vr(t)=Vrmax*sin((omega*t)-PHI)
rv=plot(vr(t),t,-0.25/f,1.25/f,color="green",legend_label="$vr(t)$")
show(rv,figsize=3,frame=True,fontsize=8,axes=False)
```




In [15]:
```
Vlmax=Imax*XL;round(Vlmax,2)
```

Out[15]: 4.01

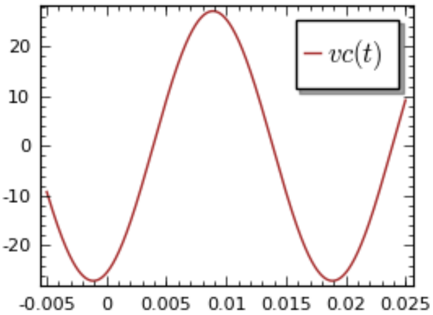
In [16]:
```
vl(t)=Vlmax*sin((omega*t)-PHI+(pi/2))
lv=plot(vl(t),t,-0.25/f,1.25/f,color="violet",legend_label="$vl(t)$")
show(lv,figsize=3,frame=True,fontsize=8,axes=False)
```



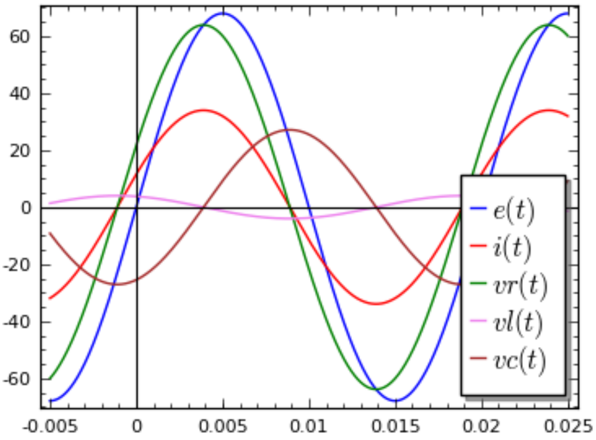

In [17]:
```
Vcmax=Imax*XC;round(Vcmax,2)
```

Out[17]: 27.09

In [18]:
```
vc(t)=Vcmax*sin(-pi/2-PHI+omega*t)
cv=plot(vc(t),t,-0.25/f,1.25/f,color="brown",legend_label="$vc(t)$")
show(cv,figsize=3,frame=True,fontsize=8,axes=False)
```



In [19]:
```
show(te+ti+rv+lv+cv,figsize=4,frame=True,fontsize=8)
```

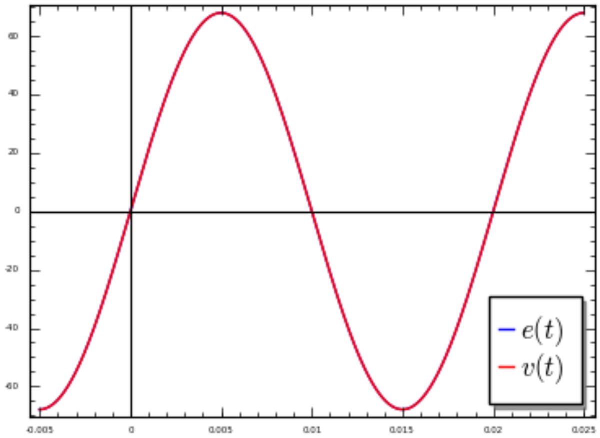



Representacio grafica de les sinusoidals. La intensitat es dibuixa sempre amb una amplitud la meitat de la de la tensio.

In [20]:
```
Ymax=max(Emax,Vrmax,Vlmax,Vcmax)
```

Comprovacio grafica de les tensions. Les sinusoidals e(t) i v(t) son la mateixa funcio. Nomes es veu una funcio perque l'altra queda amagada a sota.

In [21]:
```
v(t)=vr(t)+vl(t)+vc(t)
vt=plot(v(t),t,-0.25/f,1.25/f,color="red",legend_label="$v(t)$")
show(te+vt,figsize=4,frame=True,fontsize=4)
```




In [22]:
```
print"PHI en degré = ",PHI*180/n(pi)
```

```
PHI en degré =  -19.8790443364971
```

In [23]:
```
if L == 0:
    C = 0
    fr= 0
else:
    fr=1/(2*pi*(sqrt(L*C)))
print"fr = ",round(fr), " Hz","Wr =",round(1/sqrt(L*C))
```

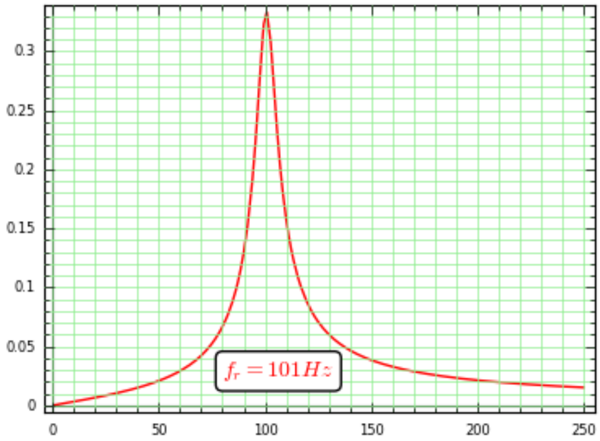
```
fr =  130  Hz Wr = 816
```

In [24]:

```
reset()
var('f l c');radians = pi/180.0;degrees = 180.0/pi
def argd(x):
    return N(arg(x) * degrees)
def plt(q,a,b,typ = abs,col = 'blue'):
     return plot(lambda x: float(typ(q(x))),(x,a,b),rgbcolor=col)
omega = 2*pi*f
zs(r,l,c,f) = r + (i*omega*l) - i/(omega*c)
```

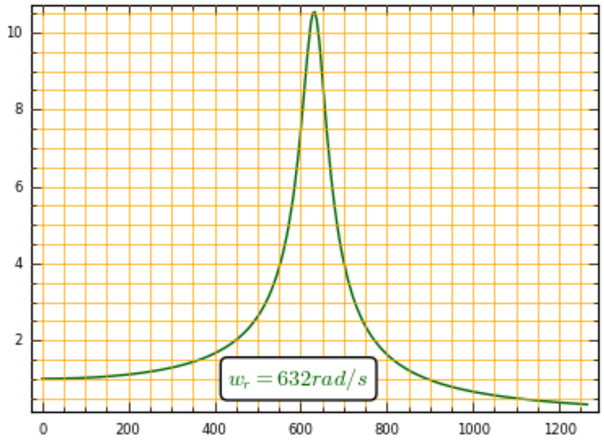
In [25]:

```
a = 1;b = 250;r = 3;l = 5E-2;c = 5E-5;
fr=n(1/(2*pi*(sqrt(l*c))))
lbl = text("$f_r = %.0f Hz$" % (fr),(80,0.04),rgbcolor="red",
           horizontal_alignment="left", fontsize=10,
           vertical_alignment="top",
        bounding_box={'boxstyle':'round', 'fc':'w'}  )
q(f) = zs(r,l,c,f);p1 = plt(1/q,a,b,abs,"red")
zs(r,l,c,f) = r + (i*omega*l) - i/(omega*c)
show(p1+lbl,figsize=(4,3),fontsize=6,
     frame=True,gridlines="minor",
     gridlinesstyle=dict(color="lightgreen",
                         linestyle="-",
                         linewidth="0.5"))
```



In [26]:

```
var("omega")
R=3;L=5E-2;C=5E-5;w=1/(sqrt(L*C));
p=plot(abs(1/(1+i*omega*R*C-omega*omega*L*C)),
       [omega,0,2*w],color="darkgreen")
f=w;r=R;c=C;l=L
lbl = text("$w_r = %.0f rad/s$" % (f),(430,1),
           rgbcolor="darkgreen",
           horizontal_alignment="left",
           fontsize=10,
           bounding_box={'boxstyle':'round', 'fc':'w'})
show(p+lbl,figsize=4,frame=True,axes=False,
     gridlines="minor",fontsize=6,
     gridlinesstyle=dict(color="orange",
                         linestyle="-",
                         linewidth="0.5"))
```




In [27]:

```
zs
```

Out[27]: $(r, l, c, f) \mapsto 2i\,\pi f l + r - \frac{i}{2\,\pi c f}$

In [28]:

```
reset()
%display latex
```

In [48]:

```
var('m,k,t,x0,v0')
assume(m>0)
assume(k>0)
assume(t>0)
x = function(('x'),(t));x
```

Out[48]: $x\left(t\right)$

In [30]:

```
de = m*diff(x,t,2)==-k*x;de
```

Out[30]: $m \frac{\partial^{2}}{(\partial t)^{2}}x\left(t\right) = -k x\left(t\right)$

In [31]:

```
sol = desolve(de, x, ivar=t);sol
```

Out[31]: $K_2 \cos\left(\frac{\sqrt{k} t}{\sqrt{m}}\right) + K_1 \sin\left(\frac{\sqrt{k} t}{\sqrt{m}}\right)$

In [32]:

```
var('k1,k2'); sol.subs(t=0)==x0
```

Out[32]: $K_2 = x_0$

In [33]:
```
sol = sol.subs(_); sol
```

Out[33]:

$$x_0 \cos\left(\frac{\sqrt{k}t}{\sqrt{m}}\right) + K_1 \sin\left(\frac{\sqrt{k}t}{\sqrt{m}}\right)$$

In [34]:
```
diff(sol, t)(t=0)==v0
```

Out[34]:

$$\frac{K_1\sqrt{k}}{\sqrt{m}} = v_0$$

In [35]:
```
sol = sol.subs(_); sol
```

Out[35]:

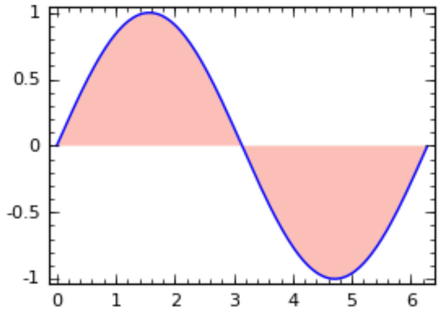
$$x_0 \cos\left(\frac{\sqrt{k}t}{\sqrt{m}}\right) + K_1 \sin\left(\frac{\sqrt{k}t}{\sqrt{m}}\right)$$

In [36]:
```
sol = desolve(de, x, ivar=t, ics=[0,x0,v0]) ;sol
```

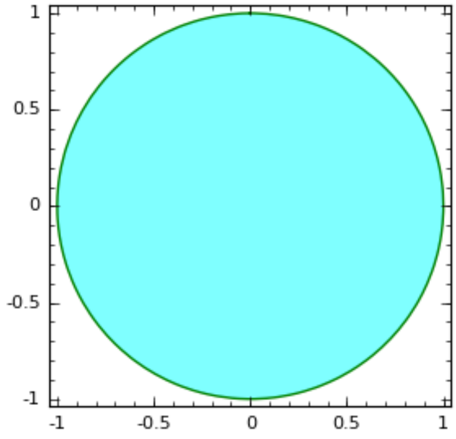
Out[36]:

$$x_0 \cos\left(\frac{\sqrt{k}t}{\sqrt{m}}\right) + \frac{\sqrt{m}v_0 \sin\left(\frac{\sqrt{k}t}{\sqrt{m}}\right)}{\sqrt{k}}$$

In [37]:
```
a=plot(sol(m=1,k=1,x0=0,v0=1), (t,0,6.28),
        fill=True,fillcolor="salmon")
show(a,figsize=3,frame=True,fontsize=8,axes=False)
```



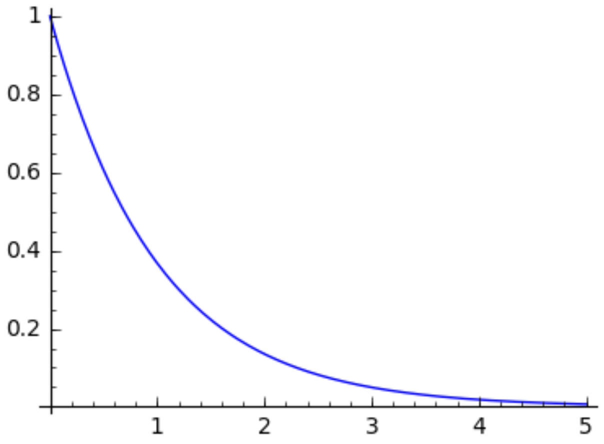

In [38]:
```
c=parametric_plot(( sol(m=1,k=1,x0=0,v0=1),
                   diff(sol,t)(m=1,k=1,x0=0,v0=1)),
                   (t,0,6.28),color="green",
                   fill=True,fillcolor="cyan")
show(c,figsize=4,frame=True,fontsize=8,axes=False)
```



In [39]:
```
var('a b c x y z')
```
Out[39]: $(a, b, c, x, y, z)$

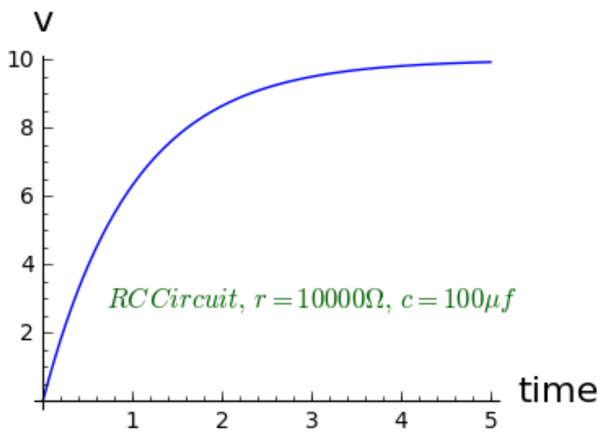
In [40]:
```
var('r c t');y = function('y',t)
de = y + r*c*diff(y,t) == 0
des = desolve(de,[y,t],[0,1]);show(des)
```
$e^{\left(-\frac{t}{cr}\right)}$

In [41]:
```
f(t,r,c) = des
plot(f(t,1,1),(t,0,5),figsize=(4,3))
```
Out[41]:




In [42]:
```
f(t,a,b,r,c) = (a-b) * des + b
```

In [43]:
```
lbl = text("$RC \, Circuit, \, r = 10000\Omega, \, c = 100\mu f $",(3,3)
,fontsize=12,rgbcolor='#006000')
p = plot(f(t,0,10,10000,100e-6),(t,0,5), figsize=(4,3),axes_labels=['tim
e','v'])
show(p+lbl)
```



In [56]:
```
var("c_t omega")
y = function(('y'),(t))
de = y + r*c_t*diff(y,t) == sin(omega * t)
des = desolve(de,[y,t]);des
```

Out[56]:

$$\left(C - \frac{\left(1000\,\omega\cos(\omega t) - \frac{\sin(\omega t)}{c_t}\right)e^{\left(\frac{t}{1000\,c_t}\right)}}{\left(1000000\,\omega^2 + \frac{1}{c_t^2}\right)c_t}\right)e^{\left(-\frac{t}{1000\,c_t}\right)}$$