

```
> Eqn1:=diff(u(t),t$2)+(1/8)*diff(u(t),t)+4*u(t)=Ft;
```

$$Eqn1 := \frac{d^2}{dt^2} u(t) + \frac{1}{8} \frac{d}{dt} u(t) + 4 u(t) = Ft \quad (1)$$

```
> DE21:=subs(Ft=3*cos(t/4),Eqn1);
```

$$DE21 := \frac{d^2}{dt^2} u(t) + \frac{1}{8} \frac{d}{dt} u(t) + 4 u(t) = 3 \cos\left(\frac{1}{4} t\right) \quad (2)$$

```
> DE22:=subs(Ft=3*cos(2*t),Eqn1);
```

$$DE22 := \frac{d^2}{dt^2} u(t) + \frac{1}{8} \frac{d}{dt} u(t) + 4 u(t) = 3 \cos(2 t) \quad (3)$$

```
> DE23:=subs(Ft=3*cos(6*t),Eqn1);
```

$$DE23 := \frac{d^2}{dt^2} u(t) + \frac{1}{8} \frac{d}{dt} u(t) + 4 u(t) = 3 \cos(6 t) \quad (4)$$

```
> #Exercise 21:
```

```
> U21:=rhs(dsolve({DE21,u(0)=2,D(u)(0)=0},u(t)));
```

$$U21 := \frac{19274}{16242171} e^{-\frac{1}{16} t} \sin\left(\frac{1}{16} \sqrt{1023} t\right) \sqrt{1023} \quad (5)$$

$$+ \frac{19658}{15877} e^{-\frac{1}{16} t} \cos\left(\frac{1}{16} \sqrt{1023} t\right) + \frac{96}{15877} \sin\left(\frac{1}{4} t\right) + \frac{12096}{15877} \cos\left(\frac{1}{4} t\right)$$

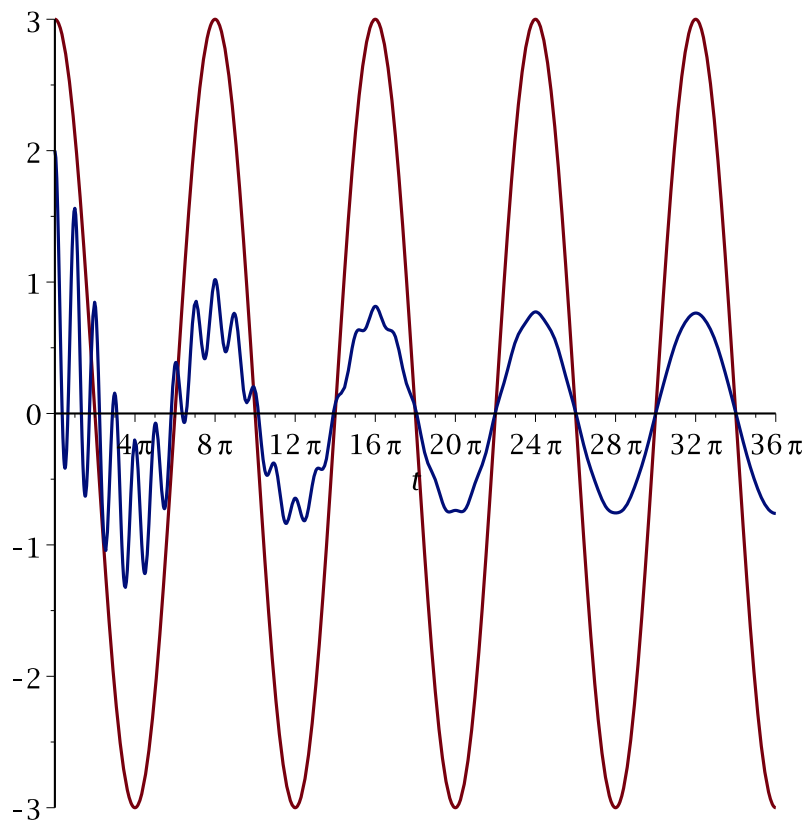
```
> dU21:=diff(U21,t);
```

$$dU21 := -\frac{1258088}{16242171} e^{-\frac{1}{16} t} \sin\left(\frac{1}{16} \sqrt{1023} t\right) \sqrt{1023} \quad (6)$$

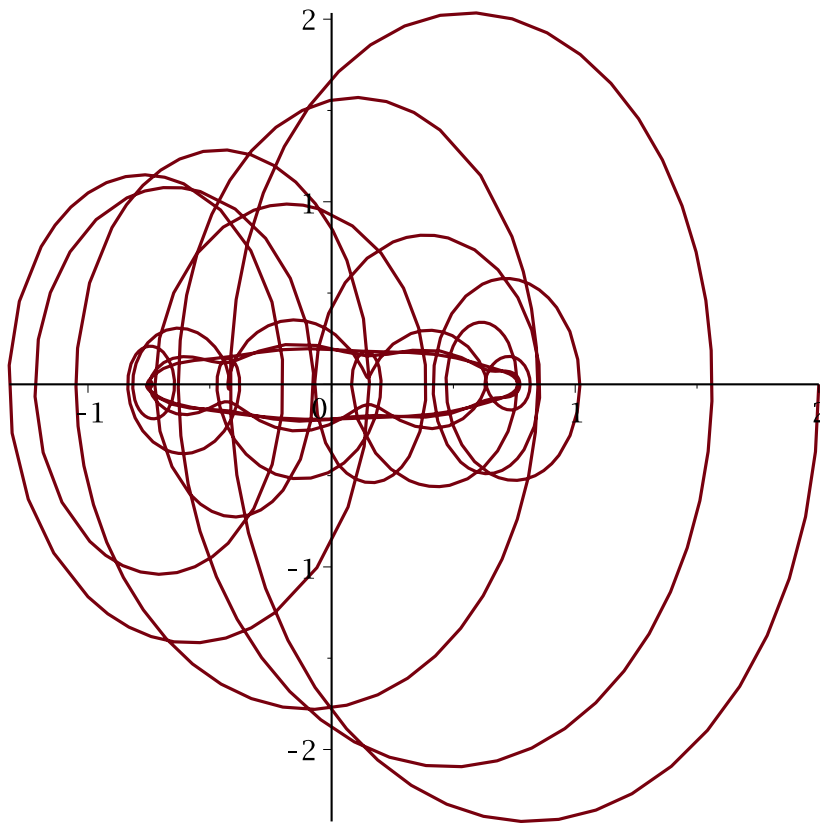
$$- \frac{24}{15877} e^{-\frac{1}{16} t} \cos\left(\frac{1}{16} \sqrt{1023} t\right) + \frac{24}{15877} \cos\left(\frac{1}{4} t\right) - \frac{3024}{15877} \sin\left(\frac{1}{4} t\right)$$

```
> #Part (a): Plot the forcing and the solution together:
```

```
> plot({3*cos(t/4),U21},t=0..36*Pi);
```



```
> #Part (b): Plot (x(t)=u(t),y(t)=u'(t))- This is a parametric
plot.
> plot([U21,dU21,t=0..36*Pi]);
```



> **#Exercise 22:**

> **U22:=rhs(dsolve({DE22,u(0)=2,D(u)(0)=0},u(t)));**

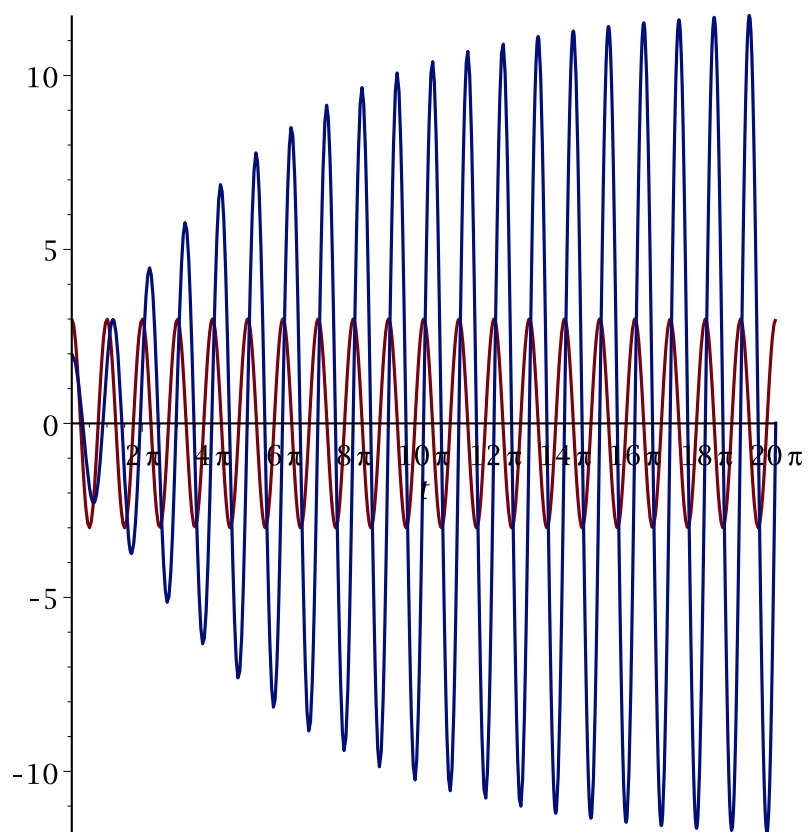
$$U22 := -\frac{382}{1023} e^{-\frac{1}{16}t} \sin\left(\frac{1}{16} \sqrt{1023} t\right) \sqrt{1023} + 2 e^{-\frac{1}{16}t} \cos\left(\frac{1}{16} \sqrt{1023} t\right) + 12 \sin(2t) \quad (7)$$

> **dU22:=diff(U22,t);**

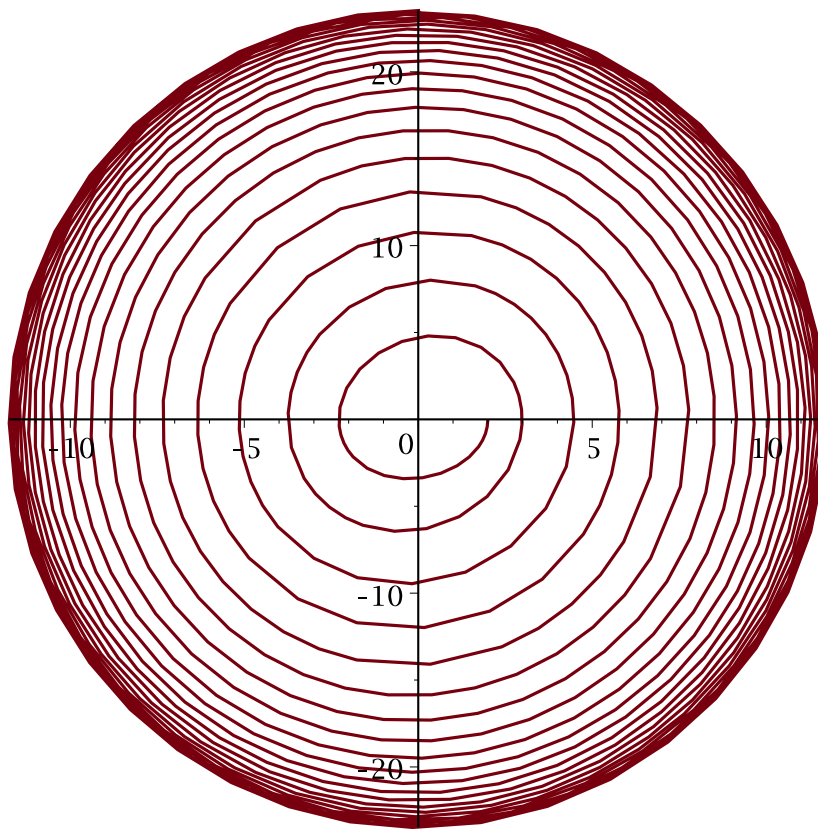
$$dU22 := -\frac{104}{1023} e^{-\frac{1}{16}t} \sin\left(\frac{1}{16} \sqrt{1023} t\right) \sqrt{1023} - 24 e^{-\frac{1}{16}t} \cos\left(\frac{1}{16} \sqrt{1023} t\right) + 24 \cos(2t) \quad (8)$$

> **#Part (a): Plot the forcing and the solution together:**

> **plot({3*cos(2*t),U22},t=0..20*Pi);**



```
> #Part (b): Plot (x(t)=u(t),y(t)=u'(t))- This is a parametric  
plot.  
> plot([U22,dU22,t=0..20*Pi]);
```



> #Exercise 23:

> U23:=rhs(dsolve({DE23,u(0)=2,D(u)(0)=0},u(t)));

$$U23 := \frac{2806}{1524549} e^{-\frac{1}{16}t} \sin\left(\frac{1}{16} \sqrt{1023} t\right) \sqrt{1023} \quad (9)$$

$$+ \frac{34322}{16393} e^{-\frac{1}{16}t} \cos\left(\frac{1}{16} \sqrt{1023} t\right) + \frac{36}{16393} \sin(6t) - \frac{1536}{16393} \cos(6t)$$

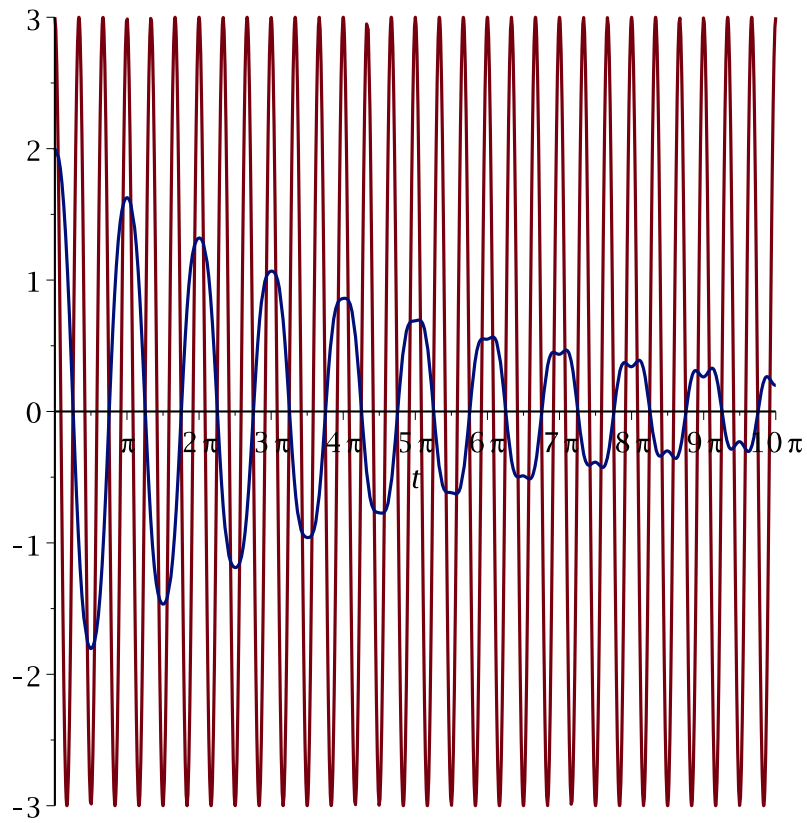
> dU23:=diff(U23,t);

$$dU23 := -\frac{199672}{1524549} e^{-\frac{1}{16}t} \sin\left(\frac{1}{16} \sqrt{1023} t\right) \sqrt{1023} \quad (10)$$

$$- \frac{216}{16393} e^{-\frac{1}{16}t} \cos\left(\frac{1}{16} \sqrt{1023} t\right) + \frac{216}{16393} \cos(6t) + \frac{9216}{16393} \sin(6t)$$

> #Part (a): Plot the forcing and the solution together:

> plot({3*cos(6*t),U23},t=0..10*Pi);



```
> #Part (b): Plot (x(t)=u(t),y(t)=u'(t))- This is a parametric
> plot([U23,dU23,t=0..36*Pi]);
```

