

212 Lab #5 Key

My comments are in blue. You will need to select initial conditions, or choose an arbitrary value of the unknown constants to obtain an example graph. For these problem, an arbitrary example is fine.

syms x y t c

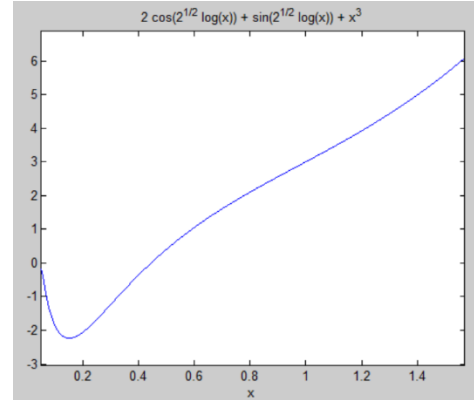
1a.

>> q=dsolve('x^3*D3y-6*y=0','x')

q =

C70*x^3 + C72*cos(2^(1/2)*log(x)) + C71*sin(2^(1/2)*log(x))

>> ezplot(x^3 + 2*cos(2^(1/2)*log(x)) + sin(2^(1/2)*log(x)),[pi/60,pi/2])

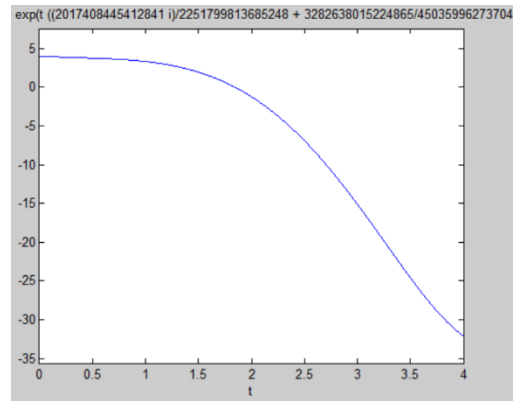


1b.

>> r=dsolve('D4y+D3y+3*y=t','t')

r =

t/3 + C74*exp(t*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2)/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6)) + ((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2))/2 - 36*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2) - 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2) - (9*6^(1/2)*(3^(1/2)*741^(1/2)*i + 9)^(1/2))/8)^(1/2)/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/4) - 1/4)) + C75*exp(-t*(1/4 + ((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2))/2 - 36*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2) - 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2) - (9*6^(1/2)*(3^(1/2)*741^(1/2)*i + 9)^(1/2))/8)^(1/2)/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/4) - ((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2))/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6))) + C76*exp(-t*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2))/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6)) - ((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2))/2 - 36*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2) - 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3))*((9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(1/3))/4 + 9*((3^(1/2)*741^(1/2)*i)/6 + 3/2)^(2/3) + 36)^(1/2) - (9*6^(1/2)*(3^(1/2)*741^(1/2)*i + 9)^(1/2))/8)^(1/2)/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6)) + (9*6^(1/2)*(3^(1/2)*741^(1/2)*i + 9)^(1/2))/8)^(1/2)/(6*(3^(1/2)*741^(1/2)*(i/6) + 3/2)^(1/6))



$$\begin{aligned} & 3/2)^{(1/6)} * ((9 * (3^{(1/2)} * 741^{(1/2)} * i/6) + 3/2)^{(1/3)})/4 + 9 * (3^{(1/2)} * 741^{(1/2)} * i/6 + 3/2)^{(2/3)} + \\ & 36)^{(1/4)} + 1/4) + C77 * \exp(-t * (((9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(1/3)})/4 + \\ & 9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(2/3)} + 36)^{(1/2)}) / (6 * (3^{(1/2)} * 741^{(1/2)} * i/6 + 3/2)^{(1/6)} + \\ & ((9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(1/3)} * ((9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(1/3)})/4 + \\ & 9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(2/3)} + 36)^{(1/2)})/2 - 36 * ((9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(1/3)})/4 \\ & + 9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(2/3)} + 36)^{(1/2)} - 9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + \\ & 3/2)^{(2/3)} * ((9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(1/3)})/4 + 9 * ((3^{(1/2)} * 741^{(1/2)} * i)/6 + 3/2)^{(2/3)} + \\ & 36)^{(1/2)} + (9 * 6^{(1/2)} * (3^{(1/2)} * 741^{(1/2)} * i + 9)^{(1/2)})/8)^{(1/2)} / (6 * (3^{(1/2)} * 741^{(1/2)} * i/6 + \\ & 3/2)^{(1/6)} * ((9 * (3^{(1/2)} * 741^{(1/2)} * i/6) + 3/2)^{(1/3)})/4 + 9 * (3^{(1/2)} * 741^{(1/2)} * i/6 + 3/2)^{(2/3)} + \\ & 36)^{(1/4)} + 1/4) \end{aligned}$$

```
>> ezplot(t/3 + exp(t * (((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6)) + ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / 2 - 36 * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - (9 * 6^(1/2) * (3^(1/2) * 741^(1/2) * i + 9)^(1/2)) / 8)^(1/2) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6) * ((9 * (3^(1/2) * 741^(1/2) * i/6) + 3/2)^(1/3)) / 4 + 9 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(2/3) + 36)^(1/4)) - 1/4) + exp(-t * (1/4 + ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / 2 - 36 * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - (9 * 6^(1/2) * (3^(1/2) * 741^(1/2) * i + 9)^(1/2)) / 8)^(1/2) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6) * ((9 * (3^(1/2) * 741^(1/2) * i/6) + 3/2)^(1/3)) / 4 + 9 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(2/3) + 36)^(1/4)) - 1/4) + exp(-t * (((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6)) - ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / 2 - 36 * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - (9 * 6^(1/2) * (3^(1/2) * 741^(1/2) * i + 9)^(1/2)) / 8)^(1/2) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6) * ((9 * (3^(1/2) * 741^(1/2) * i/6) + 3/2)^(1/3)) / 4 + 9 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(2/3) + 36)^(1/4)) + 1/4) + exp(-t * (((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6)) + ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) / 2 - 36 * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) * ((9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(1/3))/4 + 9 * ((3^(1/2) * 741^(1/2) * i)/6 + 3/2)^(2/3) + 36)^(1/2)) - (9 * 6^(1/2) * (3^(1/2) * 741^(1/2) * i + 9)^(1/2)) / 8)^(1/2) / (6 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(1/6) * ((9 * (3^(1/2) * 741^(1/2) * i/6) + 3/2)^(1/3)) / 4 + 9 * (3^(1/2) * 741^(1/2) * i/6 + 3/2)^(2/3) + 36)^(1/4)) + 1/4)), [0,4])
```

Maybe not a problem I'd want to solve by hand!

1c.

```
>> s=dsolve('D4y+y=0','t')
```

s =

$$C79 * \exp((2^{1/2} * t) / 2) * \cos((2^{1/2} * t) / 2) + C81 * \exp(- (2^{1/2} * t) / 2) * \cos((2^{1/2} * t) / 2) + C80 * \exp((2^{1/2} * t) / 2) * \sin((2^{1/2} * t) / 2) + C82 * \exp(- (2^{1/2} * t) / 2) * \sin((2^{1/2} * t) / 2)$$

```
>> ezplot(exp((2^(1/2)*t)/2)*cos((2^(1/2)*t)/2) + exp(- (2^(1/2)*t)/2)*cos((2^(1/2)*t)/2) + exp((2^(1/2)*t)/2)*sin((2^(1/2)*t)/2) + 2*exp(- (2^(1/2)*t)/2)*sin((2^(1/2)*t)/2),[-pi,pi])
```

1d.

```
>> u=dsolve('D4y-y=0','t')
```

u =

$$C84 * \cos(t) + C87 * \exp(t) + C85 * \sin(t) + C86 * \exp(-t)$$

```
>> ezplot(4*cos(t) + 7*exp(t) + 5*sin(t) + 6*exp(-t),[-2,2])
```

1e.

```
>> v=dsolve('D4y-y=sin(t)','t')
```

v =

$$\sin(3*t) / 16 - (3 * \sin(t)) / 16 + \cos(t) * (t / 4 - \sin(2*t) / 8) + C89 * \cos(t) + C92 * \exp(t) + C90 * \sin(t) + C91 * \exp(-t)$$

```
>> ezplot(sin(3*t)/16 - (3*sin(t))/16 + cos(t)*(t/4 - sin(2*t)/8) + 9*cos(t) + 2*exp(t) + sin(t) + exp(-t),[-2,2])
```

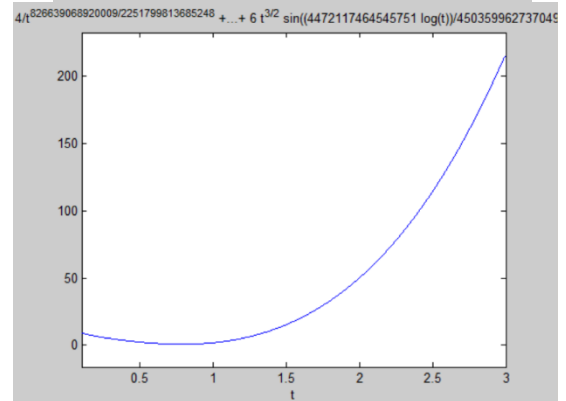
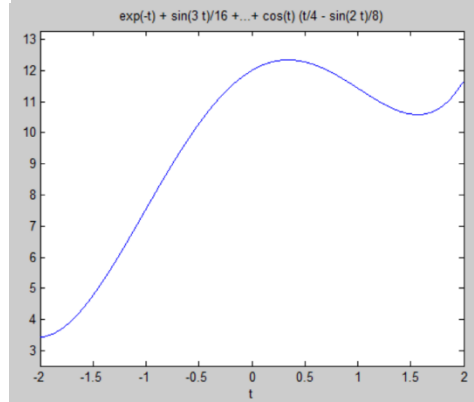
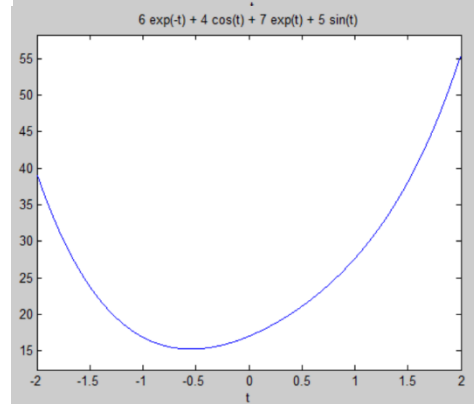
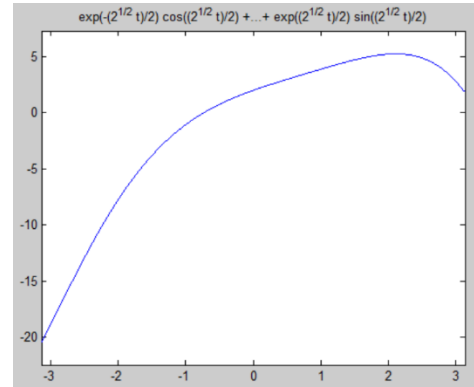
1f.

```
>> w=dsolve('t^4*D4y-4*y','t')
```

w =

$$C94 * t^{3/2 - (4 * 5^{1/2} + 5)^{1/2} / 2} + C95 * t^{((4 * 5^{1/2} + 5)^{1/2} / 2 + 3/2)} + C97 * t^{3/2} * \cos((\log(t) * (4 * 5^{1/2} - 5)^{1/2}) / 2) + C96 * t^{3/2} * \sin((\log(t) * (4 * 5^{1/2} - 5)^{1/2}) / 2)$$

```
>> ezplot(4*t^(3/2 - (4*5^(1/2) + 5)^(1/2)/2) + 5*t^((4*5^(1/2) + 5)^(1/2)/2 + 3/2) - 7*t^(3/2)*cos((log(t)*(4*5^(1/2) - 5)^(1/2))/2) + 6*t^(3/2)*sin((log(t)*(4*5^(1/2) - 5)^(1/2))/2),[0.1,3])
```

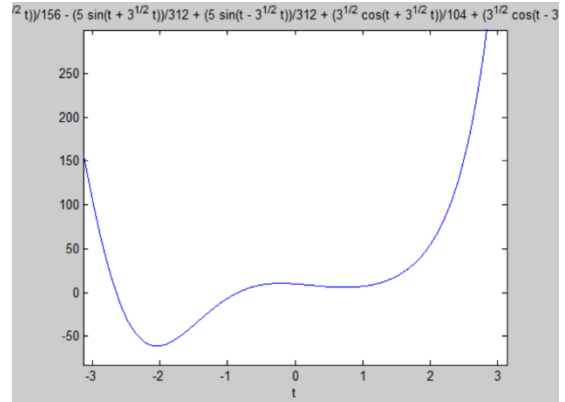


1g.

```
>> z=dsolve('D3y-8*y=sin(t)', 't')
```

z =

```
cos(3^(1/2)*t)*((5*cos(t + 3^(1/2)*t))/312 + (5*cos(t -
3^(1/2)*t))/312 - (7*sin(t + 3^(1/2)*t))/156 - (7*sin(t -
3^(1/2)*t))/156 - (3^(1/2)*cos(t + 3^(1/2)*t))/156 +
(3^(1/2)*cos(t - 3^(1/2)*t))/156 + (3^(1/2)*sin(t +
3^(1/2)*t))/104 - (3^(1/2)*sin(t - 3^(1/2)*t))/104) -
sin(t)/30 - cos(t)/60 - sin(3^(1/2)*t)*((7*cos(t -
3^(1/2)*t))/156 - (7*cos(t + 3^(1/2)*t))/156 - (5*sin(t +
3^(1/2)*t))/312 + (5*sin(t - 3^(1/2)*t))/312 + (3^(1/2)*cos(t + 3^(1/2)*t))/104 + (3^(1/2)*cos(t -
3^(1/2)*t))/104 + (3^(1/2)*sin(t + 3^(1/2)*t))/156 + (3^(1/2)*sin(t - 3^(1/2)*t))/156) + C101*exp(2*t) +
C99*exp(-t)*cos(3^(1/2)*t) + C100*exp(-t)*sin(3^(1/2)*t)
```



```
>> ezplot(cos(3^(1/2)*t)*((5*cos(t + 3^(1/2)*t))/312 + (5*cos(t -
3^(1/2)*t))/312 - (7*sin(t + 3^(1/2)*t))/156 - (7*sin(t - 3^(1/2)*t))/156 - (3^(1/2)*cos(t + 3^(1/2)*t))/156 + (3^(1/2)*cos(t -
3^(1/2)*t))/156 + (3^(1/2)*sin(t + 3^(1/2)*t))/104 - (3^(1/2)*sin(t - 3^(1/2)*t))/104) - sin(t)/30 -
cos(t)/60 - sin(3^(1/2)*t)*((7*cos(t - 3^(1/2)*t))/156 - (7*cos(t + 3^(1/2)*t))/156 - (5*sin(t +
3^(1/2)*t))/312 + (5*sin(t - 3^(1/2)*t))/312 + (3^(1/2)*cos(t + 3^(1/2)*t))/104 + (3^(1/2)*cos(t -
3^(1/2)*t))/104 + (3^(1/2)*sin(t + 3^(1/2)*t))/156 + (3^(1/2)*sin(t - 3^(1/2)*t))/156) + exp(2*t) +
9*exp(-t)*cos(3^(1/2)*t) + exp(-t)*sin(3^(1/2)*t),[-pi,pi])
```

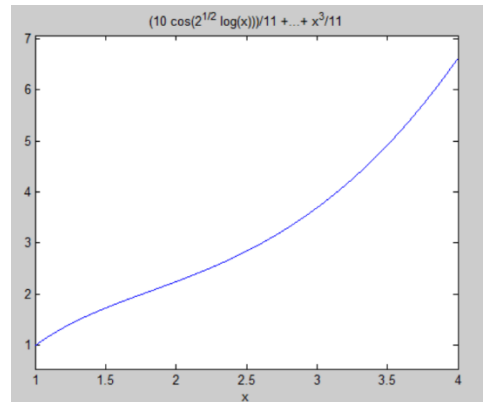
2.

```
>> q=dsolve('x^3*D3y-6*y=0','y(1)=1','Dy(1)=2','D2y(1)=-3','x')
```

q =

```
(10*cos(2^(1/2)*log(x)))/11 +
(19*2^(1/2)*sin(2^(1/2)*log(x)))/22 + x^3/11
```

```
>> ezplot(q,[1,4])
```



3.

```
>> u=dsolve('D4y-
y=0','y(0)=c','Dy(0)=0','D2y(0)=0','D3y(0)=0','t')
```

u =

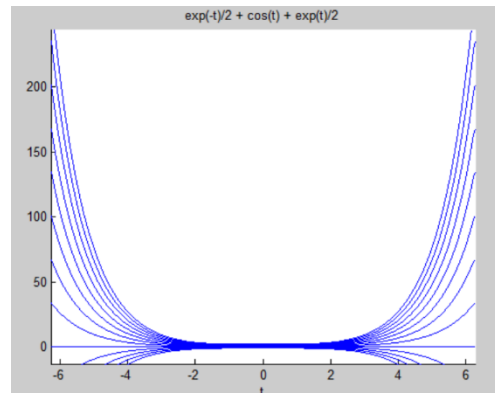
```
(c*cos(t))/2 + (c*exp(t))/4 + (c*exp(-t))/4
```

```
>> figure, hold on
```

```
>> for cval=-1:0.25:2
```

```
ezplot(subs(u,c,cval),[-2*pi,2*pi]),end
```

```
>> hold off
```



4.

```
>> u=dsolve('D4y-  
y=0','y(0)=0','Dy(0)=c','D2y(0)=0','D3y(0)=0','t')
```

u =

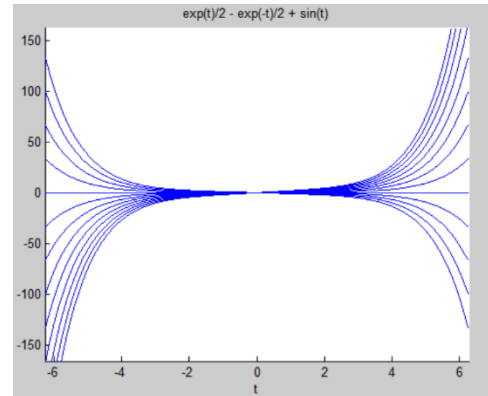
$$(c*\exp(t))/4 + (c*\sin(t))/2 - (c*\exp(-t))/4$$

```
>> figure, hold on
```

```
>> for cval=-1:0.25:2
```

```
ezplot(subs(u,c,cval),[-2*pi,2*pi]),end
```

```
>> hold off
```



5.

```
>> u=dsolve('D4y-  
y=0','y(0)=0','Dy(0)=0','D2y(0)=c','D3y(0)=0','t')
```

u =

$$(c*\exp(t))/4 - (c*\cos(t))/2 + (c*\exp(-t))/4$$

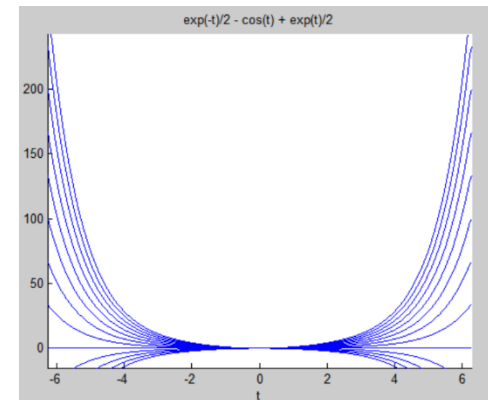
```
>> figure, hold on
```

```
>>
```

```
>> for cval=-1:0.25:2
```

```
ezplot(subs(u,c,cval),[-2*pi,2*pi]),end
```

```
>> hold off
```



6.

```
>> u=dsolve('D4y-  
y=0','y(0)=0','Dy(0)=0','D2y(0)=0','D3y(0)=c','t')
```

u =

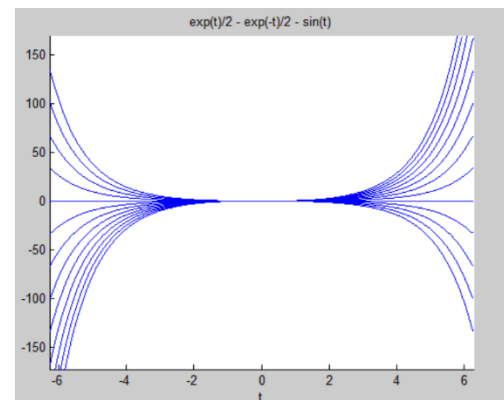
$$(c*\exp(t))/4 - (c*\sin(t))/2 - (c*\exp(-t))/4$$

```
>> figure, hold on
```

```
>> for cval=-1:0.25:2
```

```
ezplot(subs(u,c,cval),[-2*pi,2*pi]),end
```

```
>> hold off
```



7. Yes, e does, but while you can spot it in the equation, the exponential increases so quickly that the effect is not as noticeable.