```
> # Quiz 11 solutions
> # Problem 1
> de:=-diff(u(t),t,t) = diff(X(t),t,t) + 16*diff(X(t),t) + 80* X(t)
  ;
> X:=t->10*cos(3*t);
> dsolve(de,u(t));subs(_C1=0,_C2=0,%);
```

$$de := -\left(\frac{d^2}{dt^2}\,u(t)\right) = \frac{d^2}{dt^2}\,X(t) + 16\left(\frac{d}{dt}\,X(t)\right) + 80\,X(t)$$

$$X := t \to 10\cos(3\,t)$$

$$u(t) = \frac{710}{9}\cos(3\,t) - \frac{160}{3}\sin(3\,t) + \_C1\,t + \_C2$$

$$u(t) = \frac{710}{9}\cos(3\,t) - \frac{160}{3}\sin(3\,t) \qquad (1)$$

```
> # answer check problem 2(a)
> f:=3*(t+1)^2*exp(2*t)+2*exp(t)*sin(3*t);
> with(inttrans): # load laplace package
> laplace(f,t,s);
```

$$f := 3\,(t+1)^2\,e^{2\,t} + 2\,e^{t}\sin(3\,t)$$

$$\frac{3\,(s^4 - 2\,s^3 + 4\,s^2 + 4)}{(s-2)^3\,((s-1)^2 + 9)} \qquad (2)$$

```
> convert(%,parfrac,s);
```

$$\frac{6}{s^2 - 2\,s + 10} + \frac{6}{(s-2)^2} + \frac{6}{(s-2)^3} + \frac{3}{s-2} \qquad (3)$$

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> # answer check problem 2(b)
> F:=4*s/(s^2+4)+(s-1)/(s^2-2*s+5);
> invlaplace(F,s,t);
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$$F := \frac{4\,s}{s^2+4} + \frac{s-1}{s^2 - 2\,s + 5}$$

$$\cos(2\,t)\,(4 + e^{t}) \qquad (4)$$

```
> # answer check problem 2(c)
> x:='x':de:=diff(x(t),t,t)+2*diff(x(t),t)+5*x(t)=exp(t);
  ic:=x(0)=0,D(x)(0)=1;
> dsolve([de,ic],x(t));
> # answer check problem 2(c), partial fractions
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$$de := \frac{d^2}{dt^2}\,x(t) + 2\left(\frac{d}{dt}\,x(t)\right) + 5\,x(t) = e^{t}$$

$$ic := x(0) = 0,\ D(x)(0) = 1$$

$$x(t) = \frac{3}{8}\,e^{-t}\sin(2\,t) - \frac{1}{8}\,e^{-t}\cos(2\,t) + \frac{1}{8}\,e^{t} \qquad (5)$$

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> convert((s^2-s+1)/((s-1)*(s^2+2*s+5)),parfrac,s);
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$$\frac{1}{8}\,\frac{7\,s-3}{s^2+2\,s+5}+\frac{1}{8\,(s-1)} \tag{6}$$