In[ ]:=
```
Remove[a, x, y, lambda]
```

In[ ]:=
```
k = 7
TraditionalForm[equation1 = {y'[t] + y[t] * k == 0}]
TraditionalForm[charaEq1 = {x + k == 0}]
TraditionalForm[Solve[charaEq1, x]]
TraditionalForm[DSolve[equation1, y, t]]
TraditionalForm[init1 = {y[0] == 3}]
TraditionalForm[DSolve[{equation1, init1}, y, t]]
```

Out[ ]=

7

Out[ ]//TraditionalForm=

$\{y'(t) + 7\,y(t) = 0\}$

Out[ ]//TraditionalForm=

$\{x + 7 = 0\}$

Out[ ]//TraditionalForm=

$\{\{x \to -7\}\}$

Out[ ]//TraditionalForm=

$\left\{\left\{y \to \left(\{t\} \longmapsto c_1\, e^{-7\,t}\right)\right\}\right\}$

Out[ ]//TraditionalForm=

$\{y(0) = 3\}$

Out[ ]//TraditionalForm=

$\left\{\left\{y \to \left(\{t\} \longmapsto 3\, e^{-7\,t}\right)\right\}\right\}$

In[ ]:=
```
TraditionalForm[equation2 = {y''[t] + (k + 1) * y'[t] + k * y[t] == 0}]
TraditionalForm[charaEq2 = {x^2 + (k + 1) * x + k == 0}]
TraditionalForm[Solve[charaEq2]]
TraditionalForm[DSolve[equation2, y, t]]
TraditionalForm[init2 = {y[0] == 4, y'[0] == -1}]
TraditionalForm[DSolve[{equation2, init2}, y, t]]
```

Out[ ]//TraditionalForm=

$\{y''(t) + 8\,y'(t) + 7\,y(t) = 0\}$

Out[ ]//TraditionalForm=

$\left\{x^2 + 8\,x + 7 = 0\right\}$

Out[ ]//TraditionalForm=

$\{\{x \to -7\}, \{x \to -1\}\}$

Out[ ]//TraditionalForm=

$\left\{\left\{y \to \left(\{t\} \longmapsto c_1\, e^{-7\,t} + c_2\, e^{-t}\right)\right\}\right\}$

Out[ ]//TraditionalForm=

$\{y(0) = 4,\ y'(0) = -1\}$

Out[ ]//TraditionalForm=

$$\left\{\left\{y \to \left(\{t\} \longmapsto \frac{1}{2}\, e^{-7\,t}\left(9\, e^{6\,t} - 1\right)\right)\right\}\right\}$$

In[∘]:=
```
TraditionalForm[equation3 = {y''[t] + k^2 * y[t] == 0}]
TraditionalForm[charaEq3 = {x^2 + k^2 == 0}]
TraditionalForm[Solve[charaEq3, x]]
TraditionalForm[DSolve[equation3, y, t]]
TraditionalForm[init3 = {y[0] == 0, y'[0] == k}]
TraditionalForm[DSolve[{equation3, init3}, y, t]]
```

Out[∘]//TraditionalForm=

$\{y''(t) + 49\, y(t) = 0\}$

Out[∘]//TraditionalForm=

$\{x^2 + 49 = 0\}$

Out[∘]//TraditionalForm=

$\{\{x \to -7\, i\}, \{x \to 7\, i\}\}$

Out[∘]//TraditionalForm=

$\{\{y \to (\{t\} \longmapsto c_1 \cos(7\, t) + c_2 \sin(7\, t))\}\}$

Out[∘]//TraditionalForm=

$\{y(0) = 0,\ y'(0) = 7\}$

Out[∘]//TraditionalForm=

$\{\{y \to (\{t\} \longmapsto \sin(7\, t))\}\}$

In[∘]:=
```
TraditionalForm[equation4 = {y''[t] + 4 * y'[t] + 13 * y[t] == 0}]
TraditionalForm[charaEq4 = {x^2 + 4 * x + 13 == 0}]
TraditionalForm[Solve[charaEq4, x]]
TraditionalForm[DSolve[equation4, y, t]]
TraditionalForm[init4 = {y[0] == 2 * k, y'[0] == -k}]
TraditionalForm[DSolve[{equation4, init4}, y, t]]
```

Out[∘]//TraditionalForm=

$\{y''(t) + 4\, y'(t) + 13\, y(t) = 0\}$

Out[∘]//TraditionalForm=

$\{x^2 + 4\, x + 13 = 0\}$

Out[∘]//TraditionalForm=

$\{\{x \to -2 - 3\, i\}, \{x \to -2 + 3\, i\}\}$

Out[∘]//TraditionalForm=

$\{\{y \to (\{t\} \longmapsto c_2\, e^{-2\, t} \cos(3\, t) + c_1\, e^{-2\, t} \sin(3\, t))\}\}$

Out[∘]//TraditionalForm=

$\{y(0) = 14,\ y'(0) = -7\}$

Out[∘]//TraditionalForm=

$\{\{y \to (\{t\} \longmapsto 7\, e^{-2\, t} (\sin(3\, t) + 2 \cos(3\, t)))\}\}$

In[∘]:=
```
TraditionalForm[Solve[lambda^2 + a * lambda + k == 0, lambda]]
TraditionalForm[Solve[lambda^2 + a * lambda + k == 0, a]]
ComplexPlot3D[(-p^2 - 8) / p, {p, -10 - 10 * Sqrt[2] I, 10 + 10 I}, PlotLegends → Automatic]
TraditionalForm[Solve[-(lambda^2 + 8) == 0]]
TraditionalForm[DSolve[y''[t] + a * y'[t] + k * y[t] == 0, y, t]]
TraditionalForm[DSolve[y''[t] + k * y[t] == 0, y, t]]
a = Sqrt[28]
TraditionalForm[DSolve[{y''[t] + a * y'[t] + k * y[t] == 0, y[0] == 1, y'[0] == 0}, y, t]]
a = Sqrt[20]
TraditionalForm[DSolve[{y''[t] + a * y'[t] + k * y[t] == 0, y[0] == 1, y'[0] == 0}, y, t]]
a = Sqrt[36]
TraditionalForm[DSolve[{y''[t] + a * y'[t] + k * y[t] == 0, y[0] == 1, y'[0] == 0}, y, t]]
```

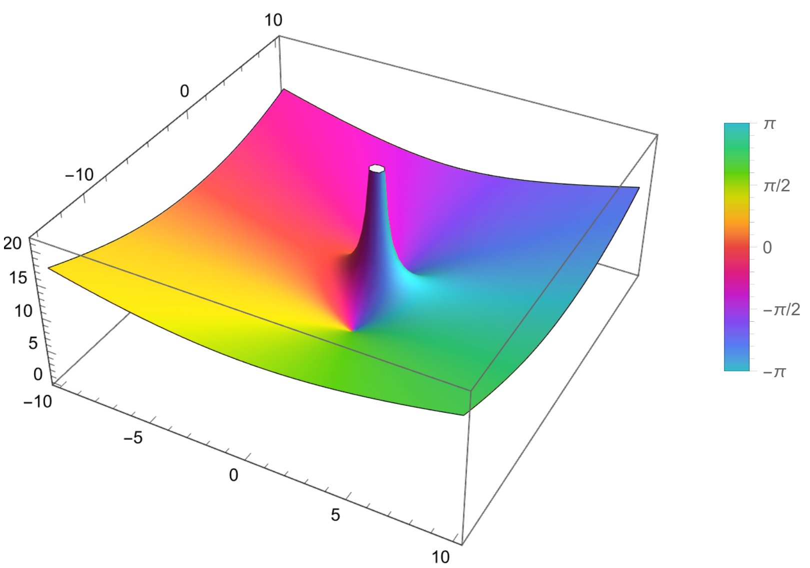
Out[∘]//TraditionalForm=

$$\left\{\left\{\text{lambda} \to \frac{1}{2}\left(-\sqrt{a^2-28}-a\right)\right\}, \left\{\text{lambda} \to \frac{1}{2}\left(\sqrt{a^2-28}-a\right)\right\}\right\}$$

Out[∘]//TraditionalForm=

$$\left\{\left\{a \to \frac{-\text{lambda}^2-7}{\text{lambda}}\right\}\right\}$$

Out[∘]=



Out[∘]//TraditionalForm=

$$\left\{\left\{\text{lambda} \to -2\, i\, \sqrt{2}\right\}, \left\{\text{lambda} \to 2\, i\, \sqrt{2}\right\}\right\}$$

Out[∘]//TraditionalForm=

$$\left\{\left\{y \to \left(\{t\} \mapsto c_1\, e^{\frac{1}{2}\left(-\sqrt{a^2-28}-a\right)t} + c_2\, e^{\frac{1}{2}\left(\sqrt{a^2-28}-a\right)t}\right)\right\}\right\}$$

Out[∘]//TraditionalForm=

$$\left\{\left\{y \to \left(\{t\} \mapsto c_1 \cos\left(\sqrt{7}\, t\right) + c_2 \sin\left(\sqrt{7}\, t\right)\right)\right\}\right\}$$

Out[∘]=

$$2\sqrt{7}$$

Out[∘]//TraditionalForm=

$$\left\{\left\{y \to \left(\{t\} \mapsto e^{-\sqrt{7}\, t}\left(\sqrt{7}\, t + 1\right)\right)\right\}\right\}$$

Out[ ]=

$$2\ \sqrt{5}$$

Out[ ]//TraditionalForm=

$$\left\{\left\{y \to \left(\{t\} \longmapsto \frac{1}{2}\ e^{-\sqrt{5}\ t}\left(\sqrt{10}\ \sin\left(\sqrt{2}\ t\right) + 2\cos\left(\sqrt{2}\ t\right)\right)\right)\right\}\right\}$$

Out[ ]=

$$6$$

Out[ ]//TraditionalForm=

$$\left\{\left\{y \to \left(\{t\} \longmapsto \frac{1}{4}\left(2\ e^{\left(-3-\sqrt{2}\right)t} - 3\ \sqrt{2}\ e^{\left(-3-\sqrt{2}\right)t} + 2\ e^{\left(\sqrt{2}-3\right)t} + 3\ \sqrt{2}\ e^{\left(\sqrt{2}-3\right)t}\right)\right)\right\}\right\}$$