

In[1]:= **General ODE solutions for RM1 and RM2s and RM2;**

Cases from Table A3 (Appendix D)

alpha = p;

beta = q;

RM1

Case 1 : $x' = 0$, var y, a

Case 2 : $y' = 0$, var x, a

Case 3 : var x, y, a


In[2]:= **RM1c1 = Solve[{z^(1/q) - y*a^d == 0, -x*a^c - y*a^d == 0}, {y, a}]**


Out[2]= $\left\{ \left\{ y \rightarrow e^{\frac{-i d \pi q + d q \operatorname{Log}[x] + c \operatorname{Log}[z] - d \operatorname{Log}[z]}{c q}}, a \rightarrow e^{\frac{i \pi q - q \operatorname{Log}[x] + \operatorname{Log}[z]}{c q}} \right\} \right\}$

In[4]:= **RM1c2 = Solve[{z^(1/p) - x*a^d == 0, -x*a^c - y*a^d == 0}, {x, a}]**

Out[4]= $\left\{ \left\{ x \rightarrow e^{\frac{-i d p \pi - d p \operatorname{Log}[y] + c \operatorname{Log}[z] - d \operatorname{Log}[z]}{(c-2 d) p}}, a \rightarrow e^{\frac{i p \pi + p \operatorname{Log}[y] - \operatorname{Log}[z]}{(c-2 d) p}} \right\} \right\}$

In[6]:= **RM1c3 = Solve[
{z^(1/p) - x*a^d == 0, z^(1/q) - y*a^d == 0, -x*a^c - y*a^d == 0}, {x, y, a}]**

 **Solve:** Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

 **Solve:** Equations may not give solutions for all "solve" variables.

Out[6]= $\left\{ \left\{ x \rightarrow e^{\frac{i d \pi q + c q \operatorname{Log}[y] - c \operatorname{Log}[z] + d \operatorname{Log}[z]}{d q}}, a \rightarrow e^{\frac{-q \operatorname{Log}[y] + \operatorname{Log}[z]}{d q}} \right\} \right\}$

RM2s

Case 4 : $x' = y' = 0$, var a, bCase 5 : $x' = a' = 0$, var y, bCase 6 : $x' = b' = 0$, var y, aCase 7 : $y' = a' = 0$, var x, bCase 8 : $y' = b' = 0$, var x, aCase 9 : $a' = b' = 0$, var x, yCase 10 : $x' = 0$, var y, a, bCase 11 : $y' = 0$, var x, a, bCase 12 : $a' = 0$, var x, y, bCase 13 : $b' = 0$, var x, y, a

Case 14 : var x, y, a, b

In[8]:= RM2sc4 = Solve[{-x * a^f - y * b * a^g == 0, x * a^f - y * b * a^g == 0}, {a, b}]

Out[8]= {}

In[9]:= RM2sc5 = Solve[{z^(1/q) - y * b * a^g == 0, x * a^f - y * b * a^g == 0}, {y, b}]

Out[9]= {}

In[10]:= RM2sc6 = Solve[{z^(1/q) - y * b * a^g == 0, -x * a^f - y * b * a^g == 0}, {y, a}]

Out[10]= $\left\{ \left\{ y \rightarrow e^{\frac{-i g \pi q - f q \log[b] + g q \log[x] + f \log[z] - g \log[z]}{f q}}, a \rightarrow e^{\frac{i \pi q - q \log[x] + \log[z]}{f q}} \right\} \right\}$

In[11]:= RM2sc7 = Solve[{z^(1/p) - x * a^f == 0, x * a^f - y * b * a^g == 0}, {x, b}]

Out[11]= $\left\{ \left\{ x \rightarrow a^{-f} z^{\frac{1}{p}}, b \rightarrow \frac{a^{-g} z^{\frac{1}{p}}}{y} \right\} \right\}$

In[12]:= RM2sc8 = Solve[{z^(1/p) - x * a^f == 0, -x * a^f - y * b * a^g == 0}, {x, a}]

Out[12]= $\left\{ \left\{ x \rightarrow e^{\frac{i f p \pi + f p \log[b] - f p \log[y] - f \log[z] + g \log[z]}{g p}}, a \rightarrow e^{\frac{-i p \pi - p \log[b] - p \log[y] + \log[z]}{g p}} \right\} \right\}$

In[14]:= RM2sc9 = Solve[{z^(1/p) - x * a^f == 0, z^(1/q) - y * b * a^g == 0}, {x, y}]

Out[14]= $\left\{ \left\{ x \rightarrow a^{-f} z^{\frac{1}{p}}, y \rightarrow \frac{a^{-g} z^{\frac{1}{q}}}{b} \right\} \right\}$ In[16]:= RM2sc10 = Solve[{z^(1/q) - y * b * a^g == 0,
-x * a^f - y * b * a^g == 0, x * a^f - y * b * a^g == 0}, {y, a, b}]

Out[16]= {}

In[17]:= RM2sc11 = Solve[{z^(1/p) - x * a^f == 0,
-x * a^f - y * b * a^g == 0, x * a^f - y * b * a^g == 0}, {x, a, b}]

Out[17]= {}

```
In[18]:= RM2sc12 = Solve[
  {z^(1/p) - x*a^f == 0, z^(1/q) - y*b*a^g == 0, x*a^f - y*b*a^g == 0}, {x, y, b}]
```

```
Out[18]= {}
```

```
In[19]:= RM2sc13 = Solve[{z^(1/p) - x*a^f == 0,
  z^(1/q) - y*b*a^g == 0, -x*a^f - y*b*a^g == 0}, {x, y, a}]
```

... Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

... Solve: Equations may not give solutions for all "solve" variables.

```
Out[19]= {{x -> e^((i g π q + f q Log[b] + f q Log[y] - f Log[z] + g Log[z]) / (g q)), a -> e^((-q Log[b] - q Log[y] + Log[z]) / (g q))}}
```

```
In[20]:= RM2sc14 = Solve[{z^(1/p) - x*a^f == 0, z^(1/q) - y*b*a^g == 0,
  -x*a^f - y*b*a^g == 0, x*a^f - y*b*a^g == 0}, {x, y, a, b}]
```

```
Out[20]= {}
```

RM2

Case 15 : $x' = y' = 0$, var a, b

Case 16 : $x' = a' = 0$, var y, b

Case 17 : $x' = b' = 0$, var y, a

Case 18 : $y' = a' = 0$, var x, b

Case 19 : $y' = b' = 0$, var x, a

Case 20 : $a' = b' = 0$, var x, y

Case 21 : $x' = 0$, var y, a, b

Case 22 : $y' = 0$, var x, a, b

Case 23 : $a' = 0$, var x, y, b

Case 24 : $b' = 0$, var x, y, a

Case 25 : var x, y, a, b

```
In[21]:= RM2c15 = Solve[{-x*a^f - y*b*a^g - y*a^d == 0, x*a^f - y*b*a^g == 0}, {a, b}]
```

... Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

... Solve: Equations may not give solutions for all "solve" variables.

```
Out[21]= {{a -> e^((Log[b] - Log[x] + Log[y]) / (f - g))}}
```

```
In[22]:= RM2c16 = Solve[{z^(1/q) - y*b*a^g - y*a^d == 0, x*a^f - y*b*a^g == 0}, {y, b}]
```

```
Out[22]= {{y -> a^-d (-a^f x + z^(1/q)), b -> -a^(d+f-g) x / (a^f x - z^(1/q))}}
```

In[23]:= RM2c17 =

Solve[{ $z^{(1/q)} - y * b * a^g - y * a^d == 0$, $-x * a^f - y * b * a^g - y * a^d == 0$ }, {y, a}]

... **Solve**: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

$$\text{Out[23]} = \left\{ \left\{ y \rightarrow \frac{z^{\frac{1}{q}}}{\left(\left(-\frac{z^{\frac{1}{q}}}{x} \right)^{\frac{1}{f}} + b \left(\left(-\frac{z^{\frac{1}{q}}}{x} \right)^{\frac{1}{f}} \right)^g}, a \rightarrow \left(-\frac{z^{\frac{1}{q}}}{x} \right)^{\frac{1}{f}} \right\} \right\}$$

In[24]:= RM2c18 = **Solve**[{ $z^{(1/p)} - x * a^f == 0$, $x * a^f - y * b * a^g == 0$ }, {x, b}]

$$\text{Out[24]} = \left\{ \left\{ x \rightarrow a^{-f} z^{\frac{1}{p}}, b \rightarrow \frac{a^{-g} z^{\frac{1}{p}}}{y} \right\} \right\}$$

In[25]:= RM2c19 = **NSolve**[{ $z^{(1/p)} - x * a^f == 0$, $-x * a^f - y * b * a^g - y * a^d == 0$ }, {x, a}]

... **NSolve**: Inverse functions are being used by NSolve, so some solutions may not be found; use Reduce for complete solution information.

... **NSolve**: Equations may not give solutions for all "solve" variables.

$$\text{Out[25]} = \left\{ \left\{ x \rightarrow 2.71828^{\frac{-1. f p \text{Log}[a] + 1. \text{Log}[z]}{p}} \right\} \right\}$$

In[26]:= RM2c20 = **Solve**[{ $z^{(1/p)} - x * a^f == 0$, $z^{(1/q)} - y * b * a^g - y * a^d == 0$ }, {x, y}]

$$\text{Out[26]} = \left\{ \left\{ x \rightarrow a^{-f} z^{\frac{1}{p}}, y \rightarrow \frac{z^{\frac{1}{q}}}{a^d + a^g b} \right\} \right\}$$

In[27]:= RM2c22 = **Solve**[{ $z^{(1/p)} - x * a^f == 0$,
 $-x * a^f - y * b * a^g - y * a^d == 0$, $x * a^f - y * b * a^g == 0$ }, {x, a, b}]

... **Solve**: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

... **Solve**: Equations may not give solutions for all "solve" variables.

$$\text{Out[27]} = \left\{ \left\{ a \rightarrow e^{\frac{-p \text{Log}[x] - \text{Log}[z]}{f p}}, b \rightarrow e^{\frac{g p \text{Log}[x] - f p \text{Log}[y] + f \text{Log}[z] - g \text{Log}[z]}{f p}} \right\} \right\}$$

In[28]:= RM2c23 = **Solve**[{ $z^{(1/p)} - x * a^f == 0$,
 $z^{(1/q)} - y * b * a^g - y * a^d == 0$, $x * a^f - y * b * a^g == 0$ }, {x, y, b}]

$$\text{Out[28]} = \left\{ \left\{ x \rightarrow a^{-f} z^{\frac{1}{p}}, y \rightarrow -a^{-d} \left(z^{\frac{1}{p}} - z^{\frac{1}{q}} \right), b \rightarrow -\frac{a^{d-g} z^{\frac{1}{p}}}{z^{\frac{1}{p}} - z^{\frac{1}{q}}} \right\} \right\}$$

In[29]:= RM2c24 = **Solve**[{ $z^{(1/p)} - x * a^f == 0$,
 $z^{(1/q)} - y * b * a^g - y * a^d == 0$, $-x * a^f - y * b * a^g - y * a^d == 0$ }, {x, y, a}]

Out[29]= {}

In[30]:= RM2c25 = **Solve**[{ $z^{(1/p)} - x * a^f == 0$, $z^{(1/q)} - y * b * a^g - y * a^d == 0$,
 $-x * a^f - y * b * a^g - y * a^d == 0$, $x * a^f - y * b * a^g == 0$ }, {x, y, a, b}]

Out[30]= {}

```
In[31]:= RM2c21 = Solve[{z^(1/q) - y*b*a^g - y*a^d == 0,
      -x*a^f - y*b*a^g - y*a^d == 0, x*a^f - y*b*a^g == 0}, {y, a, b}]
```

```
Out[31]= $Aborted
```