mma学习记录

有人问了我个积分，然后想使用mma，遇到了一些问题。

题目如下

In[106]:=

```
DSolve[x y'[x] - y[x] - Sqrt[y[x]^2 - x^2] == 0, y[x], x]
```

求解微分方程 平方根

Out[106]=

$$\left\{\left\{y[x] \to \frac{x\left(1+\text{Tanh}\left[\frac{1}{2}\left(c_1+\text{Log}[x]\right)\right]^2\right)}{-1+\text{Tanh}\left[\frac{1}{2}\left(c_1+\text{Log}[x]\right)\right]^2}\right\}\right\}$$

看上去是做出来了，实际上答案分x正负的情况做了讨论，显然x<0也可以，但是log只能接受大于0的变量，不过实验一下

In[107]:=

```
Log[-1]
```

对数

Out[107]=

$i\pi$

然后容易想到这是mma机制，基本上都是复数函数，复数变量，如果要得到实数结果需要

In[113]:=

```
DSolve[x y'[x] - y[x] - Sqrt[y[x]^2 - x^2] == 0, y[x], x, Assumptions → {x ∈ Reals}]
```

求解微分方程 平方根 假设 实数域

Out[113]=

$$\left\{\left\{y[x] \to \frac{x\left(1+\text{Tanh}\left[\frac{1}{2}\left(c_1+\text{Log}[x]\right)\right]^2\right)}{-1+\text{Tanh}\left[\frac{1}{2}\left(c_1+\text{Log}[x]\right)\right]^2}\right\}\right\}$$

但是仔细看一下还是log没有分段，直接手动处理一下

In[114]:=

```
DSolve[x y'[x] - y[x] - Sqrt[y[x]^2 - x^2] == 0, y[x], x, Assumptions → {x < 0}]
```

求解微分方程 平方根 假设

Out[114]=

$$\left\{\left\{y[x] \to \frac{x\left(1+\text{Tanh}\left[\frac{1}{2}\left(i\pi+c_1+\text{Log}[-x]\right)\right]^2\right)}{-1+\text{Tanh}\left[\frac{1}{2}\left(i\pi+c_1+\text{Log}[-x]\right)\right]^2}\right\}\right\}$$

In[115]:=

```
y[x] /. %
```

Out[115]=

$$\left\{\frac{x\left(1+\text{Tanh}\left[\frac{1}{2}\left(i\pi+c_1+\text{Log}[-x]\right)\right]^2\right)}{-1+\text{Tanh}\left[\frac{1}{2}\left(i\pi+c_1+\text{Log}[-x]\right)\right]^2}\right\}$$

In[117]:=

```
Simplify[⛓115]
化简
```

Out[117]=

$\{x \operatorname{Cosh}[c_1 + \operatorname{Log}[-x]]\}$

In[118]:=

```
TrigToExp[⛓117]
三角函数转换为指数
```

Out[118]=

$$\left\{-\frac{e^{-c_1}}{2} - \frac{e^{c_1} x^2}{2}\right\}$$

In[119]:=

```
DSolve[x y'[x] - y[x] - Sqrt[y[x]^2 - x^2] == 0, y[x], x, Assumptions → {x > 0}]
求解微分方程              平方根                                  假设
```

Out[119]=

$$\left\{\left\{y[x] \to \frac{x\left(1 + \operatorname{Tanh}\left[\frac{1}{2}(c_1 + \operatorname{Log}[x])\right]^2\right)}{-1 + \operatorname{Tanh}\left[\frac{1}{2}(c_1 + \operatorname{Log}[x])\right]^2}\right\}\right\}$$

In[120]:=

```
y[x] /. %
```

Out[120]=

$$\left\{\frac{x\left(1 + \operatorname{Tanh}\left[\frac{1}{2}(c_1 + \operatorname{Log}[x])\right]^2\right)}{-1 + \operatorname{Tanh}\left[\frac{1}{2}(c_1 + \operatorname{Log}[x])\right]^2}\right\}$$

In[121]:=

```
Simplify[%]
化简
```

Out[121]=

$\{-x \operatorname{Cosh}[c_1 + \operatorname{Log}[x]]\}$

In[122]:=

```
TrigToExp[%]
三角函数转换为指数
```

Out[122]=

$$\left\{-\frac{e^{-c_1}}{2} - \frac{e^{c_1} x^2}{2}\right\}$$