```
lhs = D[ Sqrt[x[t]^2 + y[t]^2], t]
```

$$\frac{2\,x[t]\,x'[t] + 2\,y[t]\,y'[t]}{2\sqrt{x[t]^2 + y[t]^2}}$$

```
rhs = D[(r^4) / 4, r]
```

$$r^3$$

```
DSolve[ {r'[t] == - r'''[t] , r[0] == r0}, r[t], t]
```

```
{{r[t] → r0 + C[2] - C[2] Cos[t] + C[1] Sin[t]}} /.  r0 → Sqrt[xz^2 = yz^2]
```

Set::write : Tag Power in xz^2 is Protected. ≫

$$\left\{\left\{r[t] \to \sqrt{yz^2} + C[2] - C[2]\,\text{Cos}[t] + C[1]\,\text{Sin}[t]\right\}\right\}$$

```
Solve[ {r^2 == x^2 + y^2}, {x} ]
```

$$\left\{\left\{x \to -\sqrt{r^2 - y^2}\right\}, \left\{x \to \sqrt{r^2 - y^2}\right\}\right\}$$

```
DSolve[ {x'[t] ==  - x[t], y'[t] ==  - y[t], x[0] == x0, y[0] == y0 }, {x[t], y[t]}, t ]
```

$$\left\{\left\{x[t] \to e^{-t}\,x0,\ y[t] \to e^{-t}\,y0\right\}\right\}$$

```
D[ ((x^2 + y^2)^2) / 2, y]
```

$$2\,y\left(x^2 + y^2\right)$$

```
h = DSolve[ {x'[t] ==  - 2 x[t] ( x[t]^2 + y[t]^2),
   y'[t] ==  - 2 y[t] ( x[t]^2 + y[t]^2), x[0] == x0, y[0] == y0 }, {x[t], y[t]}, t ]
```

$$\left\{\left\{y[t] \to -\frac{y0}{x0\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}},\ x[t] \to -\frac{1}{\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}\right\},\right.$$

$$\left.\left\{y[t] \to \frac{y0}{x0\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}},\ x[t] \to \frac{1}{\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}\right\}\right\}$$

```
h[[1]] [[1]]
```

$$y[t] \to -\frac{y0}{x0\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}$$

```
xm = D[-1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2], t] ; ym = D[-y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]), t];
yp = D[y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]), t]; xp = D[1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2], t]
```

$$-\frac{4\,x0^2+4\,y0^2}{2\,x0^2\left(\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}\right)^{3/2}}$$

```
2 * (1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]) * (((1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2])^2 + (y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]))^2)
(2 (x0^2/(1+4 t x0^2+4 t y0^2) + y0^2/(1+4 t x0^2+4 t y0^2)))/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2] // Simplify
(2 (x0^2 + y0^2))/(x0^2 ((1+4 t (x0^2+y0^2))/x0^2)^(3/2)) - xp // Simplify
```

$$\frac{4\,(x0^2+y0^2)}{x0^2\left(\frac{1+4\,t\,(x0^2+y0^2)}{x0^2}\right)^{3/2}}$$

```
h = DSolve[{x'[t] == -2 x[t] (x[t]^2 + y[t]^2),
   y'[t] == -2 y[t] (x[t]^2 + y[t]^2), x[0] == x0, y[0] == y0}, {x[t], y[t]}, t]
```

$$\left\{\left\{y[t]\to -\frac{y0}{x0\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}},\ x[t]\to -\frac{1}{\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}\right\},\right.$$
$$\left.\left\{y[t]\to \frac{y0}{x0\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}},\ x[t]\to \frac{1}{\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}\right\}\right\}$$

```
a = D[1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2], t]
```

$$-\frac{4\,x0^2+4\,y0^2}{2\,x0^2\left(\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}\right)^{3/2}}$$

```
b = -2 * (1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]) * ((1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2])^2 + (-y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]))^2)
```

$$-\frac{2\left(\frac{x0^2}{1+4\,t\,x0^2+4\,t\,y0^2}+\frac{y0^2}{1+4\,t\,x0^2+4\,t\,y0^2}\right)}{\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}$$

```
b / a // Simplify
```

1

```
c = D[-y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]), t]
```

$$\frac{y0\,(4\,x0^2+4\,y0^2)}{2\,x0^3\left(\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}\right)^{3/2}}$$

```
d = -2 * (-y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2])) * ((1/Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2])^2 + (-y0/(x0 Sqrt[(1+4 t x0^2+4 t y0^2)/x0^2]))^2)
```

$$\frac{2\,y0\left(\frac{x0^2}{1+4\,t\,x0^2+4\,t\,y0^2}+\frac{y0^2}{1+4\,t\,x0^2+4\,t\,y0^2}\right)}{x0\sqrt{\frac{1+4\,t\,x0^2+4\,t\,y0^2}{x0^2}}}$$

```
c / d // Simplify
```

1