```
> restart:with(LinearAlgebra):
> # Guckenheimer Exercise 3.2.1 (b), (c), and (d)
> f1:=y-x*(x^2+y^2);
```

$$f1 := y - x\left(x^2 + y^2\right) \tag{1}$$

```
> f2:=-x-y*(x^2+y^2);
```

$$f2 := -x - y\left(x^2 + y^2\right) \tag{2}$$

```
> dr:= (x*dx+y*dy)/r;
```

$$dr := \frac{x\,dx + y\,dy}{r} \tag{3}$$

```
> dtheta:=(x*dy-y*dx)/r^2;
```

$$dtheta := \frac{-y\,dx + x\,dy}{r^2} \tag{4}$$

```
> dz:= dr*(cos(theta)+i*sin(theta))+r*(-sin(theta)+i*cos(theta));
```

$$dz := \frac{(x\,dx + y\,dy)\left(\cos(\theta) + i\sin(\theta)\right)}{r} + r\left(-\sin(\theta) + i\cos(\theta)\right) \tag{5}$$

```
> dr2:= simplify(subs(dx=f1,dy=f2,dr));
```

$$dr2 := -\frac{\left(x^2 + y^2\right)^2}{r} \tag{6}$$

```
> dtheta2:=simplify(subs(dx=f1,dy=f2,dtheta));
```

$$dtheta2 := \frac{-x^2 - y^2}{r^2} \tag{7}$$

```
> dr3:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dr2));
```

$$dr3 := -r^3 \tag{8}$$

```
> dtheta3:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dtheta2));
```

$$dtheta3 := -1 \tag{9}$$

```
> # Perko Page 138 Example 2
> f1e:=-y-x^3-x*y^2;
```

$$f1e := -x^3 - x\,y^2 - y \tag{10}$$

```
> f2e:=x-y^3-x^2*y;
```

$$f2e := -x^2\,y - y^3 + x \tag{11}$$

```
> dr2e:= simplify(subs(dx=f1e,dy=f2e,dr));
```

$$dr2e := -\frac{\left(x^2 + y^2\right)^2}{r} \tag{12}$$

```
> dtheta2e:=simplify(subs(dx=f1e,dy=f2e,dtheta));
```

$$dtheta2e := \frac{x^2 + y^2}{r^2} \tag{13}$$

```
> dr3e:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dr2e));
```

$$dr3e := -r^3 \tag{14}$$

```
> dtheta3e:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dtheta2e))
  ;
```

$$dtheta3e := 1 \tag{15}$$

```
> # Perko Page 142 Example 5
> f1f:= -x-y/ln(sqrt(x^2+y^2));
```

$$f1f := -x - \frac{2\,y}{\ln(x^2+y^2)} \tag{16}$$

```
> f2f:= -y+x/ln(sqrt(x^2+y^2));
```

$$f2f := -y + \frac{2\,x}{\ln(x^2+y^2)} \tag{17}$$

```
> dr2f:= simplify(subs(dx=f1f,dy=f2f,dr));
```

$$dr2f := \frac{-x^2-y^2}{r} \tag{18}$$

```
> dtheta2f:=simplify(subs(dx=f1f,dy=f2f,dtheta));
```

$$dtheta2f := \frac{2\,x^2+2\,y^2}{\ln(x^2+y^2)\,r^2} \tag{19}$$

```
> dr3f:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dr2f));
```

$$dr3f := -r \tag{20}$$

```
> dtheta3f:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dtheta2f))
  ;
```

$$dtheta3f := \frac{2}{\ln(r^2)} \tag{21}$$

 # Guckenheimer Exercise 3.1.2

```
> restart:with(LinearAlgebra):
> f1:=mu1*x-y-mu2*x*(x^2+y^2)-x*(x^2+y^2)^2;
```

$$f1 := \mu1\,x - y - \mu2\,x\,(x^2+y^2) - x\,(x^2+y^2)^2 \tag{22}$$

```
> f2:=x+mu1*y-mu2*y*(x^2+y^2)-y*(x^2+y^2)^2;
```

$$f2 := x + \mu1\,y - \mu2\,y\,(x^2+y^2) - y\,(x^2+y^2)^2 \tag{23}$$

```
> dr:= (x*dx+y*dy)/r;
```

$$dr := \frac{x\,dx + y\,dy}{r} \tag{24}$$

```
> dtheta:=(x*dy-y*dx)/r^2;
```

$$dtheta := \frac{-y\,dx + x\,dy}{r^2} \tag{25}$$

```
> dr2:= simplify(subs(dx=f1,dy=f2,dr));
```

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$$dr2 := -\frac{\left(x^4 + \left(2\,y^2 + \mu 2\right)\,x^2 + y^4 + y^2\,\mu 2 - \mu 1\right)\,\left(x^2 + y^2\right)}{r} \tag{26}$$

```
> dtheta2:= simplify(subs(dx=f1,dy=f2,dtheta));
```

$$dtheta2 := \frac{x^2 + y^2}{r^2} \tag{27}$$

```
> dr3:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dr2));
```

$$dr3 := -r\left(r^4 + \mu 2\,r^2 - \mu 1\right) \tag{28}$$

```
> dtheta3:= simplify(subs(x=r*cos(theta),y=r*sin(theta),dtheta2));
```

$$dtheta3 := 1 \tag{29}$$