

```
(%i1) kill(all);
(%o0) done
```

1 Cartesian coordinates

```
(%i1) grad(psi) := [diff(psi,x), diff(psi,y), diff(psi,z)];
(%o1) grad( $\Psi$ ):= [  $\frac{d}{d x} \Psi$ ,  $\frac{d}{d y} \Psi$ ,  $\frac{d}{d z} \Psi$  ]
```

```
(%i2) div(a) := diff(a[1],x) + diff(a[2],y) + diff(a[3],z);
(%o2) div(a):=  $\frac{d}{d x} a_1 + \frac{d}{d y} a_2 + \frac{d}{d z} a_3$ 
```

```
(%i3) curl(a) := [diff(a[3],y) - diff(a[2],z),
                  diff(a[1],z) - diff(a[3],x),
                  diff(a[2],x) - diff(a[1],y)];
(%o3) curl(a):= [  $\frac{d}{d y} a_3 - \frac{d}{d z} a_2$ ,  $\frac{d}{d z} a_1 - \frac{d}{d x} a_3$ ,  $\frac{d}{d x} a_2 - \frac{d}{d y} a_1$  ]
```

```
(%i4) Delta(psi) := diff(psi,x,2) + diff(psi,y,2) + diff(psi,z,2);
(%o4)  $\Delta(\Psi):= \frac{d^2}{d x^2} \Psi + \frac{d^2}{d y^2} \Psi + \frac{d^2}{d z^2} \Psi$ 
```

2 Delta function calculations

```
(%i5) r: sqrt(x^2+y^2+z^2);
(%o5)  $\sqrt{z^2+y^2+x^2}$ 
```

```
(%i6) f: 1/r;
(%o6)  $\frac{1}{\sqrt{z^2+y^2+x^2}}$ 
```

```
(%i14) grad(f);
(%o14) [  $-\frac{x}{(z^2+y^2+x^2)^{3/2}}$ ,  $-\frac{y}{(z^2+y^2+x^2)^{3/2}}$ ,  $-\frac{z}{(z^2+y^2+x^2)^{3/2}}$  ]
```

```
(%i16) d2f: Delta(f);
(%o16)  $-\frac{3}{(z^2+y^2+x^2)^{3/2}} + \frac{3 z^2}{(z^2+y^2+x^2)^{5/2}} + \frac{3 y^2}{(z^2+y^2+x^2)^{5/2}} + \frac{3 x^2}{(z^2+y^2+x^2)^{5/2}}$ 
```

```
(%i17) ratsimp(d2f);
(%o17) 0
```