

Integration

The command **Integrate** is used to compute the exact integrals (definite or indefinite) in Mathematica. The command **NIntegrate** is used to compute approximate numerical value of a definite integral. For example,

(1) $\int \sin x dx$

```
Integrate[Sin[x], x]
```

(2) $\int_0^\pi \sin x dx$

```
Integrate[Sin[x], {x, 0, Pi}]
```

(3) $\int_0^2 \int_0^1 (x + 2y) dx dy$

```
Integrate[x + 2 y, {y, 0, 2}, {x, 0, 1}]
```

(4) $\int_0^2 \int_{y-1}^{2y} (x + 2y) dx dy$

```
Integrate[x + 2 y, {y, 0, 2}, {x, y - 1, 2 y}]
```

(5) $\iint_{[0,1] \times [0,2]} (x + 2y) dA$

```
R = ImplicitRegion[0 <= x <= 1 && 0 <= y <= 2, {x, y}]
Integrate[x + 2 y, {x, y} \[Element] R]
```

(6) Numerical approximation of $\int_0^2 \int_0^1 e^{-x^2 y^2} dx dy$

```
NIntegrate[Exp[-x^2 y^2], {x, 0, 1}, {y, 0, 2}]
```

The integrals in (3) and (5) represent the volume of the solid under the graph of $f(x, y) = x + 2y$ and above the xy -plane. One can plot that solid as follows.

```
S = ImplicitRegion[0 <= z <= x + 2 y && 0 <= x <= 1 && 0 <= y <= 2, {x, y, z}]
Region[S]
```

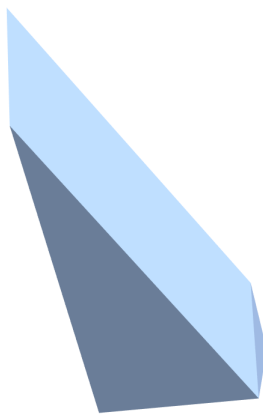


Figure 1