

```
> # Neutron diffusion in Cartesian coordinates
```

```
# Initial condition
```

```
f := (x, y) → (1 - (x / L)) * (1 - (y / L)) * x * y / (L / 4)^2;
```

```
# Constants
```

```
L0 := 15.7;
```

```
L := L0;
```

```
A := 1;
```

```
xi := 100;
```

$$f := (x, y) \mapsto \frac{16 \cdot \left(1 - \frac{x}{L}\right) \cdot \left(1 - \frac{y}{L}\right) \cdot x \cdot y}{L^2}$$

$L0 := 15.7$

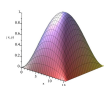
$L := 15.7$

$A := 1$

$\xi := 100$

(1)

```
> plot3d(f(x, y), x = 0 .. L, y = 0 .. L, title = "Neutron diffusion, n = f(x, y), t = 0", axes = normal,  
labels = ["x", "y", "n(t = 0, x, y)"], orientation = [ -48, 69, 1 ]);
```



Neutron diffusion, n = f(x, y), t = 0

```
> unassign(L);
```

Error, cannot unassign `15.7' (argument must be assignable)

```
> eqn3 := (4 / L^2) * Int(Int(f(x, y) * sin(p * Pi * x / L) * sin(q * Pi * y / L), x = 0 .. L), y = 0 .. L) =  
  (4 / L^2) * int(int(f(x, y) * sin(p * Pi * x / L) * sin(q * Pi * y / L), x = 0 .. L), y = 0 .. L)  
  assuming p, integer, q, integer;
```

$$\text{eqn3} := 0.01622783886 \left(\int_0^{15.7} \int_0^{15.7} 0.06491135542 (1 - 0.06369426752 x) (1 - 0.06369426752 y) x y \sin(1.200608658 x) \sin(1.200608658 y) dx dy \right) = 2.974797646 \times 10^{-17} \quad (2)$$

```
> unassign(p, q);
```

Error, cannot unassign `6' (argument must be assignable)

```
> N := 5;  
L := L0;  
lambda := 100;  
mu := 2.3446e5;  
eta := 1.8958e8;
```

$$\begin{aligned} N &:= 5 \\ L &:= 15.7 \\ \lambda &:= 100 \\ \mu &:= 234460. \\ \eta &:= 1.8958 \times 10^8 \end{aligned}$$

(3)

```
> aa := Array(1..N, 1..N);  
for p from 1 to N do  
  for q from 1 to N do  
    aa[p, q] := evalf(rhs(eqn3)); # Compute a[p, q]  
    # print(p, q, aa[p, q]); # Optional: for debugging purposes  
  end do;  
end do;
```

$$aa := \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(4)

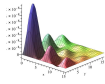
```
> n := (x, y, t) → add(add(  
  aa[i, j] * exp(eta * t - mu * ((i * Pi / L)^2 + (j * Pi / L)^2) * t) *  
  sin(i * Pi * x / L) * sin(j * Pi * y / L),  
  i = 1 .. N), j = 1 .. N) :
```

Warning, (in n) `j` is implicitly declared local

Warning, (in n) `i` is implicitly declared local

```
> plot3d(n(x, y, 1e-7), x=0 .. L, y=0 .. L, axes=framed,
  title="Neutron diffusion, L = 15.7 cm, N = 5, t = 1e-7",
  labels=["x", "y", "n(t = 1e-7, x, y)"], orientation=[-48, 69, 1]);
```

Neutron diffusion, L = 15.7 cm, N = 5, t = 1e-7



```
=
> plot3d(n(x, y, 0) - f(x, y), x=0 .. L, y=0 .. L, axes=framed,
  title="Neutron diffusion error, L = 15.7 cm, N = 5, t = 0",
  labels=["x", "y", "error(0, x, y)"], orientation=[-48, 69, 1]);
```

Neutron diffusion error, $L = 15.7$ cm, $N = 5$, $t = 0$

