```
import sympy as sp
import numpy as np
import matplotlib.pylab as plt
```

```
[158] r=sp.symbols("r")
      R=sp.symbols("R")
      rho0=sp.symbols("rho0")
      L=sp.symbols("L")
      rho_=sp.symbols("rho_")
      M = 4*sp.pi*rho0*sp.integrate(r**2*sp.exp(-r/L),(r, 0, R))
      M
```

$$4\pi\rho_0 \cdot \left(2L^3 + \left(-2L^3 - 2L^2R - LR^2\right) e^{-\frac{R}{L}}\right)$$

```
def mass(R, L, rho):
  return 4*np.pi*rho*( 2*L**3 + (-2*L**3-2*L**2*R-L*R**2)*np.exp(-R/L) )

def mass_g(Rterrestre, rho_):
  return (1.75*Rterrestre)**3*4*np.pi*rho_/3

L = 6500E3
rho = 18000
rho_ = 5520
Rterrestre = 6371E3
masa_tierra = 5.972E24
mm=mass_g(Rterrestre, rho_)/masa_tierra
R=np.linspace(1, 16000E3, 1000)
F =  (mass_g(Rterrestre, rho_)-mass(R, L, rho) )/masa_tierra
```

```
[161] plt.plot(R/1E3, F)
      plt.xlabel("R(km)")
      plt.ylabel("M(masa_tierra)")
```