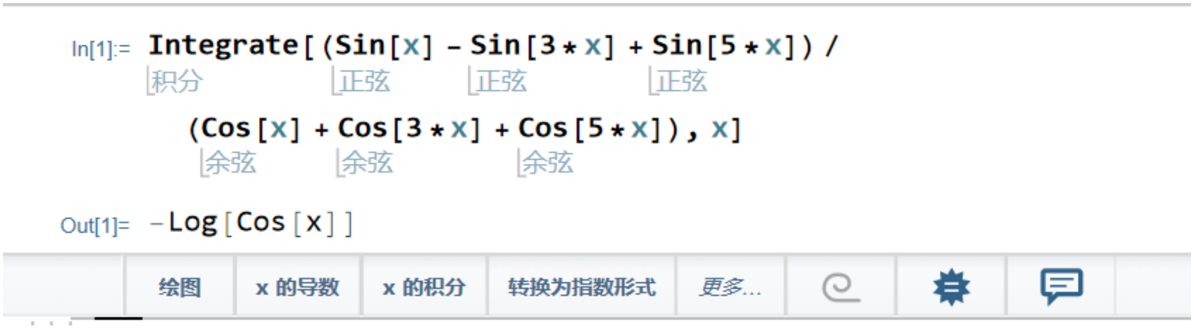
PART 2

Q1.

详见`part2_q1.ipynb`

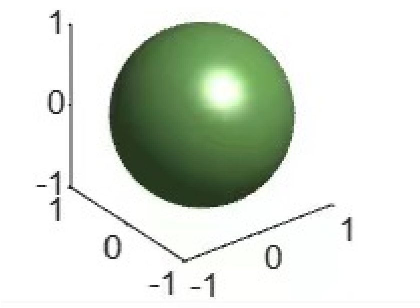
Q2.

Input:
`Integrate[(Sin[x] - Sin[3*x] + Sin[5*x])/(Cos[x] + Cos[3*x] + Cos[5*x]),x]`
Output:
`-Log(Cos[x])`

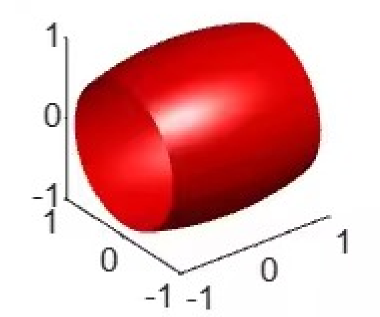


Q3.

```
[x,y,z]=meshgrid(-1:0.1:1); isosurface(x,y,z,x.^2+y.^2+z.^2-1,0); axis equal;
colormap summer
```




```
[x,y,z] = meshgrid(-1:0.1:1,-1:0.1:1,-1:0.1:1); a = 2; b = 1; V = (x.^2/a^2 +
y.^2/b^2 + z.^2/b^2); isosurface(x,y,z,V,1); axis equal; colormap([1 0 0])
```



Q4.

Lorenz Attractor

The Lorenz attractor is an attractor that arises in a simplified system of equations describing the two-dimensional flow of fluid. In the early 1960s, Lorenz accidentally discovered the chaotic behavior of this system when he found that, for a simplified system, periodic solutions of the form

$$\psi = \psi_0 \sin\left(\frac{\pi a x}{H}\right) \sin\left(\frac{\pi z}{H}\right)$$

$$\theta = \theta_0 \cos\left(\frac{\pi a x}{H}\right) \sin\left(\frac{\pi z}{H}\right)$$

grew for Rayleigh numbers larger than the critical value, $Ra > Ra_c$. Furthermore, vastly different results were obtained for very small changes in the initial values, representing one of the earliest discoveries of the so-called butterfly effect.

Lorenz obtained the simplified equations

$$\dot{X} = \sigma(Y - X)$$

$$\dot{Y} = X(\rho - Z) - Y$$

$$\dot{Z} = XY - \beta Z$$

now known as the Lorenz equations.