1. (10%) Line shapes in spectroscopy are often described by the Lorentz function $g(\omega)=\frac{1}{\pi}\frac{T}{1+T^2(\omega-\omega_0)^2}$. Evaluate the integral for $\int_{\omega_0}^{\infty} g(\omega)\,d\omega$

2. (10%) Evaluate the integral for the Gaussian curve $\int_{\omega_0}^{\infty}(\omega-\omega_0)^2\,g(\omega)\,d\omega$ where $g(\omega)=\sqrt{\frac{2}{\pi}}T\exp\left[-\frac{1}{2}T^2(\omega-\omega_0)^2\right]$

3. (20%) Evaluate the following integrals:

   (a) $\int_0^{\infty} x\,e^{-x^2}dx$　　(b) $\int_0^{1} x\,e^{x}\,dx$

4. (20%) The Lennard-Jones potential for the interaction of two molecules separated by distance R is $U(R)=\frac{A}{R^{12}}-\frac{B}{R^6}$ where A and B are constants. The equilibrium separated Re is that value of R at which $U(R)$ is a minimum and the binding energy $De = -U(Re)$. (a) Express A and B in terms of Re and De. (b) Express $U(R)$ in terms of R, Re and De.

5. (20%) Transform to polar coordinates and evaluate: $\int_0^{\infty}\int_0^{\infty} e^{-(x^2+y^2)}x^2\,dxdy$

6. (20%) Find the MacLaurin expansions for the following terms:

   (a) $sin\ x$　　(b) $ln(1+x)$