PHYS 404
HANDOUT 8 – *Applications of Bessel Functions in Physics*

1. Given that $J_0(x) = \frac{1}{2\pi}\int_0^{2\pi} e^{ix\cos\theta}\, d\theta$, estimate the integral which appears in the study of Fraunhofer diffraction through a circular aperture of radius *a*. The parameter *b* is given by $b = \left(2\pi/\lambda\right)\sin\phi$, where ϕ is the angle defined by a point on a screen below the circular aperture relative to the normal through the center point.

$$\Phi \approx \int_0^a \int_0^{2\pi} e^{ibr\cos\theta} d\theta r dr \,.$$

(Arf. p. 580)

2. Find the energy spectrum of a quantum mechanical particle which is inside a sphere of radius *a*. Show what happens in the Bessel equation when $x=k\rho$.

(Arf. p. 629)

3. A circular plate has a radius equal to 1 and its plane surfaces thermally isolated from the environment. If the initial temperature is $F(\rho)$ and the circumference is kept at zero temperature, calculate the temperature of a point of the plate as a function of time.

(Sch. p. 114)

4. A hollow tube has an internal radius equal to *a* and an external one equal to *b*. If the initial temperature is $F(\rho)$ and both the internal and external surfaces are kept at zero temperature, calculate the temperature of a point of the cylinder as a function of time.

(Sch. p. 120)