Assignment 5

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1 Question 2

The given integrals are:

$$I = \int_{-1}^{1} \sqrt{1 - x^2}\, dx$$

and,

$$I = \int_{-1}^{1} sin^2\theta\, d\theta$$

The exact value $= \Pi/2 = 0.157079632679E + 01$

2 Question 3: Plank's black body radiation

2.1 part a: Gauss-Laguerre

The given integral is :

$$I = \int_{0}^{\infty} \frac{x^3}{e^x - 1}\, dx$$

Comparing to the standard format for generalized Gauss-Laguerre quadrature:

$$I = \int_{0}^{\infty} e^{-x} x^{\alpha}\, f(x)\, dx$$

we get: $\alpha = 3$ and

$$f(x) = \frac{1}{1 - e^{-x}}$$

2.2 part b: Gauss-Legendre

$x = \tan \frac{pi*y}{2}$
Then, I calculated the value of f(y) for the integral of the form:

$$I = \int_{0}^{1} f(y)\, dy$$

3 Question 4

$$I = \int_{1}^{1000} \frac{sin(x)}{x}\, dx$$

We have to solve numerically the integral:

$$I = \int_{1}^{100} \frac{sin(40x)}{x}\, dx$$

So, I substituted $y = 40x$, then, I got the integral:

$$I = \int_{40}^{4000} \frac{sin(y)}{y}\, dy$$

The exact solution is : $Si(4000) - Si(40)$
Where Sine integral 'Si' is an entire function defined as:

$$Si(z) = \int_{0}^{z} \frac{sin(t)}{t}\, dt$$