# MA2501 Numerical methods

**Assignment 7**

## Exercise 1

Given $f(x) = e^{-x^2}$ at the points 0.0, 0.2, 0.4, 0.6 og 0.8.

a) Find an approcimation to the integral

$$\int_{0.0}^{0.8} f(x)dx$$

by using

i) Trapezoidal rule.

ii) Simpson's formula.

iii) Romberg integration.

b) By using Romberg integration and all the given values, the answer will have an error less than $0.5 \cdot 10^{-5}$.
How many intervals are needed by the trapezoidal rule (assuming uniform spacing), to ensure a result of at least the same accuracy?

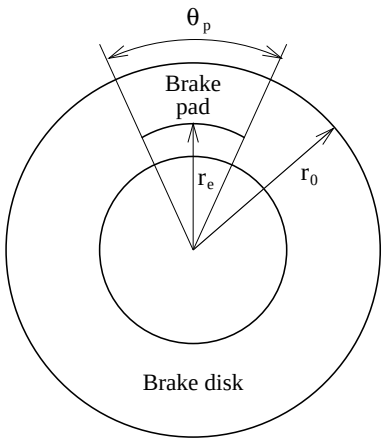
## Oppgave 2

To simulate the termal characteristics of disk brakes an approximation to the "area averaged lining temperature" $T$, of the brake pad is needed. $T$ is given by

$$T = \frac{\int_{r_e}^{r_0} T(r) r \theta_p dr}{\int_{r_e}^{r_0} r \theta_p dr}$$

Let $r_e = 9.38\,\text{cm}$ $r_0 = 14.58\,\text{cm}$ and $\theta_p = 0.7051$ radians. The temperature at each point of the pad, $T(r)$ is obtained numerically from analyzing the heat equation, and its values at some points are given in the following table:

| $r$ (cm) | T(r) (°C) |
|---|---|
| 9.38 | 338 |
| 9.90 | 423 |
| 10.42 | 474 |
| 10.94 | 506 |
| 11.46 | 557 |
| 11.98 | 573 |
| 12.50 | 601 |
| 13.02 | 622 |
| 13.54 | 651 |
| 14.06 | 661 |
| 14.58 | 671 |




Use this to find an approximation for $T$.

## Oppgave 3

Given the integrals

$$\text{i)} \qquad \int_0^{\pi} \sin(x)dx \qquad (2)$$

$$\text{ii)} \qquad \int_0^{1} \frac{4}{1+x^2}dx \qquad (\pi)$$

$$\text{iii)} \qquad \int_0^{1} \sqrt{1-x}dx \qquad (2/3)$$

The exact values are given in the parenthesis.

In the following, use `format long` to be able to observe the values with more significant digits.

a) Compute approximations to the integrals by use of `simpson.m`. Set `tol = 1.e-6`. Note the partitioning of the interval.

b) Compute the integrals by use of `romberg.m`. Note how the error improves along the diagonal of the table.

c) Explain why none of the methods work well for the third integral.

d) What is MATLABs own routines for integration. Use **search** in **Helpdesk** or `lookfor` in the command window.