Boundary value problem

A cylindrical pipe (r=2 cm) carrying hot fluid (T=250 oF, constant) is covered by 6 cm thick insulation (see diagram below). The surface temperature of the insulation is 100 oF.

The insulation’s conductivity is a function of temperature, k(T) =22 - 0.08\*T, where k has units of BTU/hr-oF.

The energy balance for this system is, Q = -k(T)\*r\*dT/dr.

Calculate the rate at which the hot fluid loses energy, i.e. the heat flux, Q in BTU/hr)

1. Manually using Euler’s method
2. Using MathCad

Could the Runge-Kutta method be used to solve this problem? Explain.



Runge-Kutta problem

Solve the differential equation below for the range 0<x<20 using Euler’s method and the Runge-Kutta method using Excel for step size 1 and 0.1.

dy/dx = 1/x – y(x)/x – y(x) y(1)=0 Note: analytical solution is (1-exp(1-x)/x)

If helpful, an article with the Runge-Kutta algorithm is attached in the email.