

Department of Applied Mathematics
 Preliminary Examination in Numerical Analysis
 August 17, 2016, 10 am – 1 pm.

Submit solutions to four (and no more) of the following six problems. Show all your work, and justify all your answers. No calculators allowed.

1. Root finding / Nonlinear equations

Consider the scalar equation $f(x) = 0$. Assume L is a root of the equation.

- a. Give the recursion for the Newton method for approximating a root.
- b. Give conditions on $f(x)$ near L that guarantee convergence for

$s(x)$ that satisfies the data

x	1	0	1	2
y	2	3	4	1

- c. If, at the nodes $x = h, 0, h$, one has function values $y = y_h, 0, y_h$

6. Numerical PDE

Consider the parabolic equation

$$\frac{\partial u}{\partial t} = a \frac{\partial^2 u}{\partial x^2} + f(x, t)$$

where a is a constant.

- a. Give the formula for the following finite difference approximations.
- (i) Forward Euler: Centered differences