

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no books, calculators, cellphones, communication with others, scratchpaper, etc.

Name _____

Student number _____

1a. (5) Give an important advantage of Runge-Kutta methods over PECE Adams methods.

Two possible answers: They are “self-starting,” avoiding the start-up procedure from PECE. It is easier to change order and stepsize since they have no “history”.

1b. (5) Give an important advantage of PECE Adams methods over Runge-Kutta methods.

A possible answer: They reuse old function values, so they take less work per step.

2. (10) Suppose we have measured 10 data points (t, y) as $(i * .1, y_i)$, $i = 1, \dots, 10$. Suppose that we believe the data is well modeled by the function

$$y(x) \approx x_1 \cos t + x_2 t^2 .$$

If we do a least squares fit to determine x_1 and x_2 , we solve

$$\min_x \|Ax - b\|_2$$

Give the matrix A and the vector b that we would use.

Answer:

$$A = \begin{bmatrix} \cos(.1) & (.1)^2 \\ \cos(.2) & (.2)^2 \\ \dots & \dots \\ \cos(1) & (1)^2 \end{bmatrix}, \quad b = \begin{bmatrix} y_1 \\ y_2 \\ \dots \\ y_{10} \end{bmatrix}$$