Spring 2020

MATH7016 Ungraded Concept MCQ V

General Instructions: Read carefully. Open Book. Circle the one correct answer.

Name:

For questions 1-3 suppose that we are using the Classical Fourth Order Runge-Kutta Method:

$$y_{i+1} = y_i + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4) \cdot h \tag{1}$$

where

$$\begin{aligned} k_1 &= F(x_i, y_i) \\ k_2 &= F\left(x_i + h/2, y_i + \frac{1}{2}k_1 h\right) \\ k_3 &= F\left(x_i + h/2, y_i + \frac{1}{2}k_2 h\right) \\ k_4 &= F(x_i + h, y_i + k_3 h) \end{aligned}$$

to solve the initial value problem:

$$\frac{dy}{dx} = F(x, y); \quad y(x_0) = y_0.$$

1. What are the k_i?
   - A. Values of y at different points
   - B. Estimates of the value of y at different points
   - C. The slope of y at different points
   - D. Estimates of the slope of y at different points

2. If we multiply out $\frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$ we get

   $$\frac{1}{6}k_1 + \frac{1}{3}k_2 + \frac{1}{3}k_3 + \frac{1}{6}k_4.$$

   Consider these numbers $1/6, 1/3, 1/3, 1/6$. What do they represent?
   - A. Estimates of the slope at y at different points
   - B. They are used to produce a weighted average slope
   - C. Estimates of the value of y at different points
   - D. None of the above

3. For which of the following is the fourth order Runge-Kutta errors zero:
   - A. $F(x, y) = \cos x$
   - B. $F(x, y) = e^x$
   - C. $F(x, y) = x^{10} + 2x^5 + 3$
   - D. $F(x, y) = x^2 + 2x + 3$

4. What best describes the *Linear* Shooting Method *as presented in class*

   A. we keep guessing values of the initial value $y(x_0)$, and run a numerical method until we get $y_n = y(x_n)$

   B. we take two estimates of the initial value $y(x_0)$, say y_a and y_b, run a numerical method twice, and take a weighted average of y_a and y_b to find the exact $y(x_0)$

   C. we keep guessing values of the initial slope $v(x_0)$ and running a numerical method until we get $y_n = y(x_n)$

   D. we take two estimates of the initial slope $v(x_0)$, say v_a and v_b, run a numerical method twice, and take a weighted average of v_a and v_b to find the exact $v(x_0)$

5. Which is *not* a boundary value problem:

   A. finding the equilibrium temperature distribution, $T(x)$, of an uninsulated rod, whose temperature is kept fixed at both ends

   B. finding the temperature, $T(t)$, of a cup of tea in a room t seconds after being freshly made

   C. finding the bending moment, $M(x)$, on a loaded simply supported beam (so that $M(0) = M(L) = 0$)

   D. $\frac{d^2y}{dx^2} = x + \left(\frac{dy}{dx}\right)^2; \qquad x(0) = -1,\ x(1) = 1$

6. Why do we use a Shooting Method *as presented in class*:

   A. because it is faster and more accurate than using Euler's Method

   B. because we do not know the initial y value

   C. because we do not know the initial slope

   D. because we know the second derivative but not the first derivative