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| MAT 3130 | Quiz 4 | NAME:__________________ |
| FALL '13 | Form *Last* | EMAIL ID:__________________ |

Work quickly and carefully, following directions closely. Answer all questions completely.

FOR ALL PROBLEMS: Define $P$, $Q$, $R$, and $S$ to be the four digits in your given number.

$$P = \underline{\quad\quad}, \qquad Q = \underline{\quad\quad}, \qquad R = \underline{\quad\quad}, \qquad S = \underline{\quad\quad}.$$

§I. TRUE and/or FALSE. Circle your answer. There are 2 questions at 2 points each.

1. TRUE or FALSE: Euler's method is a 'predictor-corrector' numerical method.

2. TRUE or FALSE: The Runge-Kutta method is based on $\begin{cases} \text{Simpson's Rule of integration} & (P \text{ is even}) \\ \text{the Trapezoid Rule of integration} & (P \text{ is odd}) \end{cases}$.

§II. MULTIPLE CHOICE. Circle your answer. There are 2 question at 5 points each.

1. The order of the Runge-Kutta numerical method we studied is

   (a) $\mathcal{O}(h)$ (b) $\mathcal{O}(h^2)$ (c) $\mathcal{O}(h^3)$ (c) $\mathcal{O}(h^4)$

2. For Heun's method, the new $y$ value is $y + \Delta y$ where $\Delta y$ is given by:

   (a) $\Delta y = f(t,y) \cdot h$ (b) $\Delta y = \frac{1}{2}(m_L + m_R)\,h$ (c) $\Delta y = \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)\,h$

   (d) none of the above (e) all of the above

§III. PROBLEMS. *You must show your work to receive credit.* There are 3 problems at 10 points each.

1. Suppose that the overall error in using Heun's method on $y' = f(t,y)$ is $\varepsilon \leq 10^{-3}$ for a given stepsize $h$. What stepsize $h$ do we need to use to achieve an error of $\varepsilon \leq 10^{-6}$ ?

FOR ALL PROBLEMS: Define $P$, $Q$, $R$, and $S$ to be the four digits in your given number.

$$P = \_\_\_\_, \qquad Q = \_\_\_\_, \qquad R = \_\_\_\_, \qquad S = \_\_\_\_.$$

2. Consider the initial value problem $y'' - Py' + Qy = 0$ with $y(0) = R$ and $y'(0) = S$. Do one step of Euler's method to find $y_1 \approx y(0.1)$ using a stepsize $h = 0.1$.

3. Why would an applied mathematician use a numerical method instead of just solving an initial value problem symbolically to get an exact solution?

☐ What is like *kryptonite* to moms?