Name _____

Math 2280 Numerical Methods Project
S2018

References: Edwards-Penney, Sections 2.4,2.5, 2.6. This document is located at:
`http://www.math.utah.edu/~gustafso/s2018/2280/homework/numericalDEproject/numericalDEproject-S2018.pdf`

Other related and required documents:
2280 web site: `http://www.math.utah.edu/~gustafso/s2018/2280/`
Slides: `http://www.math.utah.edu/~gustafso/s2018/2280/lectureslides/numericalDE2008.pdf`
Manuscript: `http://www.math.utah.edu/~gustafso/s2018/2280/lectureslides/numericalManuscript.pdf`
Maple code: `http://www.math.utah.edu/~gustafso/s2018/2280/homework/numericalDEproject/src/2280numerical-hints.txt`.

Symbolic Solution. (E & P Exercises 2.4-6, 2.5-6, 2.6-6 Symbolic Solution)

The symbolic solution of $y' = -2xy$, $y(0) = 2$ is $y = 2e^{-x^2}$. Display the details for the derivation of this symbolic solution, using methods from Edwards-Penney section 1.4 or 1.5. Do a full 2-panel answer check.

The answer $y = 2e^{-x^2}$ can be used to make the following table, which is used in the problems below.

x	0.00	0.10	0.20	0.25	0.30	0.40	0.50
$2e^{-x^2}$	2.000000000	1.980099667	1.921578878	1.878826126	1.827862371	1.704287578	1.557601566

Euler's Method. (E & P Exercise 2.4-6)

Consider the initial value problem $y' = -2xy$, $y(0) = 2$ with symbolic solution $y = 2e^{-x^2}$. Apply Euler's method to produce two dot tables, as shown below. The first has three pairs, $h = 0.25$. The second has six pairs, $h = 0.1$. Reproduce the summary of results below, writing 4 small digits (Geek pen required) into the blank rectangle ☐. The 4th digit can be rounded or not.

The work for $h = 0.25$ is to be entirely hand-written, with calculator assist. Answer checks and the work for $h = 0.1$ may use technology.

Table $h = 0.25$: `[0,2], [0.25,2], [0.5,1.75`☐`]`

Table $h = 0.10$: `[0,2], [0.1,2.0], [0.2,1.96], [0.3,1.88`☐`], [0.4,1.76`☐`], [0.5,1.627`☐`]`

Actual $y(.5)$	Approx $y(.5)$, $h = 0.25$	Approx $y(.5)$, $h = 0.10$
1.557601566	1.75☐	1.627☐

Heun's Method (Modified Euler). (E & P Exercise 2.5-6)

Consider the initial value problem $y' = -2xy$, $y(0) = 2$ with symbolic solution $y = 2e^{-x^2}$. Apply Heun's method (Improved Euler) to produce one dot table of six rows, $h = 0.1$. Reproduce the table below and fill in missing digits. Hand-written work is expected with computer assist. Hand-written work with calculator assist should end after the estimate for $y(0.1)$. Technology should be used for the remaining answers. Four digits are expected in ☐.

x	0.0	0.1	0.2	0.3	0.4	0.5
Actual $y(x)$	2.000000000	1.980099667	1.921578878	1.827862371	1.704287578	1.557601566
Approx $y(x)$	2.0000000	1.980☐	1.921☐	1.827☐	1.704☐	1.557☐

RK4 Method. (E & P Exercise 2.6-6)

Consider the initial value problem $y' = -2xy$, $y(0) = 2$ with symbolic solution $y = 2e^{-x^2}$. Apply the RK4 method to produce one dot table of three rows, $h = 0.25$. Reproduce the table below, filling in the missing digits. Hand-written work should complete the estimate of $y(0.25)$ to 8 digits, using calculator assist. The remaining steps should use technology, with a plan to reproduce the hand-written result. Four digits are expected in ☐.

x	0.00	0.25	0.50
Actual $y(x)$	2.000000000	1.878826126	1.557601566
Approx $y(x)$	2.000000000	1.878☐	1.557☐

Submit this printed page, with blanks filled in, as the first page of your report. Attach hand-written solutions next. Append computer results last, then staple. Assigned in Week 3.