3.1.10 Finger Exercise: Asteroid accuracy

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Finger Exercises 1 due Aug 3, 2023 05:00 IST Completed

MO2.6

WARNING: This problem is definitely harder than a typical finger exercise. But of course, you only have the fate of humanity resting on this analysis... don't sweat it!

HINT: consider using the relationship that the error for an order p accurate method is $C\Delta t^p$ as $\Delta t \to 0$ where C depends on the method and the problem being solved.

An asteroid has been detected that will make a very close pass to the Earth. Two **convergent** numerical methods (Method A and Method B) are being used to solve an Initial Value Problem to simulate the trajectory of the asteroid and estimate the nearest distance the asteroid will be to the Earth. The table below shows the predicted distance using both Method A and B for a range of timesteps from 0.01 seconds to 0.16 seconds. Based upon this table, answer the questions below.

Timestep	Distance Method A	Distance Method B
0.01 sec	193.21 km	192.96 km
0.02 sec	193.28 km	192.72 km
0.04 sec	193.84 km	192.24 km
0.08 sec	198.32 km	191.28 km
0.16 sec	234.16 km	189.36 km

Problem: Estimate exact answer for the nearest distance

0/1 point (graded)

Based upon these results, what do you think the exact solution of the Initial Value Problem is for the nearest distance the asteroid will be to the Earth. Enter the distance (in km) with four significant digits of accuracy (i.e. the answer will be of the form XYZ.W) Note: do not include km in your answer; just enter the numerical answer.

193.0 ✖ Answer: 193.2

Submit

Answers are displayed within the problem

Problem: Order of accuracy for Method A

0/1 point (graded)

What is the order of accuracy (p) of Method A?

- ○ $p = 1$
- ◉ $p = 2$
- ○ $p = 3$

$p = 4$

$p = 5$

Submit

Answers are displayed within the problem

Problem: Order of accuracy for Method B

0/1 point (graded)

What is the order of accuracy (p) of Method B?

$p = 1$

$p = 2$

$p = 3$

$p = 4$

$p = 5$

Submit

Answers are displayed within the problem

SOLUTION: The solution will be available shortly after the due date in Section 3.2.10.

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