

Midterm Exam (part 1) - Computational Physics II

NAME: _____ SCORE:

Date: Tuesday 7 November 2023 Duration: 45 minutes

Credits: 10 points (5 questions) Type of evaluation: Midterm Exam

This exam has two parts: Part 1 is in-class, individual, open-book and contains short-answer questions. Part 2 is take-home and contains long application problems.

Provide short and concise answers to the following items.

1. (2 points) **Runge-Kutta methods for ODEs**

Explain how the Runge-Kutta methods work and how they improve upon simpler numerical integration methods like the Euler methods.

2. (3 points) **Finite-difference method for ODEs**

Write down (i) the central-difference approximated derivatives and (ii) the resulting matrix form of the following boundary-value problem:

$$\frac{d^2 y}{dx^2} + 4y - 4x = 0$$

with the boundary conditions as $y(0) = 0$ and $\frac{dy}{dx}(\frac{\pi}{2}) = 0$.

3. **(1.5 points) Secure Shell (SSH) protocol**

Briefly explain what the SSH protocol is and provide an example on how to use it.

4. **(1.5 points) MPI parallelisation**

Explain the difference between point-to-point and collective MPI communication for code parallelisation.

5. **(2 points) Point-to-point MPI parallelisation**

Sketch a workflow that shows the main steps that need to be followed to parallelise python code using point-to-point MPI communication.