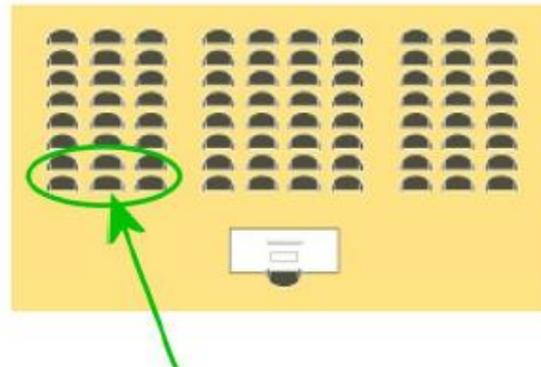# PHYS1013 Mid-semester test
2023

PLEASE PUT YOUR NAME AND TUTOR ON ALL SHEETS

40 minutes long

Student's who are allowed extra time please sit in the marked seats

1. The average temperature in the sun is 1 million Kelvin and the average density is that of water (1000 kg/m³). Assume the plasma is made of an equal number of protons and electrons of size 10^{-15} m across. Calculate
    * the average speed of a proton
    * the mean free path of a proton
    an atomic mass unit is 1.66×10^{-27} kg and Boltzmann's constant is 1.38×10^{-23} JK^{-1}.

    How many years will it take for a proton at the centre to get to the surface of the sun assuming it does a random walk (neglecting gravity)? The radius of the sun is 700,000 km.

    [10 marks]

2. If 1m³ of a gas with $C_V = 3R/2$ is adiabatically compressed from 10^5 Pa to double this pressure, what volume does it then occupy?   [5 marks]

3. Silicon's molar heat capacity is $C = \beta T^3$ for T < 100 K, where $\beta = 7.2 \times 10^{-6}$ JK^{-4}mol^{-1}. Calculate the increase in internal energy of one mole of silicon when its temperature rises from 1 K to 100 K.   [5 marks]

- The test is now finished so please stop all work.

- Please ensure your name & tutor's name are on the front of the answer book.

- Place your revision sheet inside the answer book.

- Pass your book along your row to the nearest aisle. **WHEN** your answer books have been collected from your row then leave QUIETLY by the BACK of the lecture theatre..