

Science I (Quiz 1) [22 marks]

- (1) Define the Hamiltonian of an interacting N-particle system. [1]
- (2) What are Hamilton's equations of motion? Why do we need them? [2]
- (3) Show that for an isolated system, the Hamiltonian is a constant of motion. [2]
- (4) Compare the phase space trajectories of an isolated and a closed one-dimensional harmonic oscillators. [3]
- (5) What is Boltzmann's entropy formula? What is its significance? [1]
- (6) How do you define the entropy of a closed system? Calculate the entropy of an ideal gas when it is (a) isolated and (b) closed. Compare these entropies. [1+3+3+1]
- (7) What is the physical significance of energy fluctuations in a closed system? [5]

$$A = U - TS = -k_B \ln T \quad (6)$$

$$A = U - ST$$

$$A = -k_B \ln T$$

$$TS = U - k_B \ln T$$

$$TS = U + k$$