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:

To: $-k_b \ln T$ (c)

$A = U - ST$.

$A = -k_B \ln T$.

$TS = U - k_B \ln T$

$TS = U + k$