Answer the following questions:

Question (1) [15 marks]

a) Prove that, the efficiency of Carnot engine, the ideal imaginary engine, is limited by the operating temperature of the engine

b) Two moles of an ideal gas initially at 27°C and one atm are compressed reversibly to half its initial volume. Calculate q, w, ΔE and ΔH when the process is carried on isothermally.

Question (2) [15 marks]

a) Define each of the following:

b) The boiling point of water at 50 atm is 265°C. Compare theoretical efficiencies of a steam engine operating between 550°C and i) boiling point of water at 1 atm
   ii) Boiling point of water at 50 atm

Question (4) [15 marks]

a) For an adiabatic reversible ideal gas expansion prove that

\[ P_1 V_1^γ = P_2 V_2^γ \]

b) Calculate ΔS for the reversible isothermal expansion of 2.00 moles of an ideal gas from 10.0 to 12.0 liters at 50°C.

\[ R = 1.987 \text{ cal/deg. mol} \quad \text{Atomic weight for H}=1, \text{ O}=16, \text{ C}=12 \]