PHYUGMCC2305: Thermodynamics, Aliah University, Physics Department

July 29, 2024

Hello students: Complete these tutorial assignments and submit within 7 days

1. Define open, close and isolated system. Give suitable example of each.
2. State and explain Zeroth law of thermodynamics.
3. What do you mean by a thermodynamic process? What are quasistatic process. Can a quasistatic process be reversible?,irreversible? or both of them? Can a reversible process be non-quasistatic?
4. What do you mean by an equation of state? Explain.
5. What do you mean by free expansion of a gas? How do you compute the work done in the free expansion of a gas?
6. Define and extensive in intensive variables. Give examples of each.
7. Write down mathematical expressions for evaluation of the work done in i) isothermal, ii) isobaric, iii) adiabatic, and iv) isochoric processes.
8. Define internal energy of a system. How does internal energy of an ideal gas changes in isothermal and adiabatic processes?
9. State and explain the first law of thermodynamics. Using this law show that C_p-C_v = R/J.
10. What is indicator diagram? What is its significance? Compare the work done in isothermal and adiabatic expansion of one mole of an ideal gas.
11. Will there be any work if one mole of an ideal gas is taken through a cyclic process in the P-V diagram represented by i) a circle ii) an ellipse, iii) a triangle, etc.
12. With the help of the first law of thermodynamics show that for an adiabatic process $TV^{\gamma-1}$=constant, where the symbols have their usual meanings. Also, derive the adiabatic relations for the other pairs of thermodynamic varablres (P,T) and (P,V).
13. What do you mean by a heat engine. What are the main objectives of a heat engine? What are the essential ingredients of a heat engine? How do you define efficiency of a heat engine?
14. State the Kelvin-Planck statement fof the second law of thermodynamics. Also state the Clausius statement. Is there any fundamental difference between the two statements?If yes explain.
15. With a suitable diagram explain the processes involved in a Carnot cycle. Hence obtain an expression for the efficiency of a Carnot cycle. What could be the limiting values the efficiency of a Carnot engine?
16. State and prove Carnot's theorem with suitable diagram.
17. Define the thermodynamic scale of temperature. Describe it with reference to the Carnot cycle. Is it possible to attain absolute zero on the

thermodynamic scale of temperature? Justify your answer.

18. How do you define entropy of a thermodynamic system? Express entropy change of system in terms of i) P,V; ii) P, T; and iii) T,V with the help of the first law of thermodynamics.
19. Show how entropy changes in the following thermodynamic processes? i) Reversible adiabatic process, ii) Reversible isothermal process, and iii) Irreversible process.
20. State the principle of increase of entropy.
21. Define- Enthalpy (H), internal energy (U), Helmholtz free energy (F), Gibbs free energy (G), entropy (S). Hence, derive Maxwell's thermodynamic relations.
22. Derive the Clausius-Clapeyron equation: $(\frac{dp}{dT})_{sat} = \frac{L}{T(v_{vap}-v_{liq})}$. Symbols have their usual meanings.
23. With suitable diagram explain the working principle of an Otto cycle and a Diesel cycle.
24. Assuming the specific heat capacity of water (s=1 k cal/(kg ^{o}C)), find the change in entropy when 0.1 kg of water at 15^{o}C is mixed with 0.16 kg of water at 40^{o}C.
25. How much time will it take for a layer of ice of thickness 20 cm to increase by 20 cm, on the surface of a pond, when the temperature of surroundings is -25 ^{o}C? K=0.005 CGS units, L=80 cal/gm, ρ= 0.90 gm/cm^3.
26. A mass of a liquid at temperature T_1 is mixed with an equal mass of same liquid at temperature T_2. The system is thermally insulated. Show that the entropy change of the universe is $2mC_P \log_e \frac{(T_1+T_2)}{\sqrt{T_1 T_2}}$.
27. An inventor from Aliah University claims to have developed an engine working between 600 K and 300 K capable of having an efficiency of 52%. Comment on his claim.

Follow for further update. Best wishes,
Sir

Dr M A Khan