Chapter- 12

THERMODYNAMICS

Very Short Answer Type Questions

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01. What is the change in internal energy of a system that has absorbed 2 kcal of heat and done 500J of work?

02. When two bodies will be said to be in thermal equilibrium. Write the physical quantity that determines the thermal equilibrium.

03. Name the thermodynamic variables defined by (i) Zeroth law and (ii) 1st law of thermodynamics

04. What do you mean by the internal energy of the system?

05. What is an indicator diagram? What do the area between p - v curve and volume axis signify?

06. What is an isothermal process?

07. What is an adiabatic process?

08. What is the equation of state of (i) Isothermal process. (ii) Adiabatic process.

09. What is the cyclic process?

10. What is a reversible process? Give an example.

11. On what factors efficiency of a Carnot heat engine depends?

12. Explain how heat engine is different from the refrigerator.

Short questions (2 Marks)

13. Why $C_P > C_V$? Can the specific heat of gas be infinity?

14. What is a heat pump? Give an example.

15. Derive an expression for the work done by gas, undergoing expansion from volume V_1 and V_2.

16. What is the isobaric process? Plot P versus V graph. What is the work done in the isobaric process.

17. Find the bulk modulus of gas for the isothermal, adiabatic, isobaric and isochoric process.

18. State the 1st Law of Thermodynamics. What are the limitations of the first law of thermodynamics?

19. A gas of heat capacity 1200J/kg absorbs 1500 Cal of heat and does 6300J of work. Find the increase in temperature of the system.

20. A gas is compressed from V_1 to V_2. In which case work is done will be more isothermal compression or adiabatic compression?

21. A refrigerator is to maintain eatables kept inside at 9^0C. If the room temperature is 36^0c, calculate the coefficient of performance. What is a refrigerator draw its block diagram to explain its working?

22. Define the coefficient of performance of the refrigerator. Show the heat flow in case of an engine and refrigerator using a schematic diagram.

3 Marks questions.

23. Derive the expression for the work done by the gas during isothermal expansion.

24. Derive an expression for the work done in an adiabatic process.

25. What is heat engine? Obtain a general expression for its efficiency. Discuss the essential parts of a Carnot heat engine.

26. Write Kelvin-Planck and Clausius statements for the second law of thermodynamics. Define coefficient of efficiency and coefficient of performance. What are the limitations of the 2nd law of thermodynamics?

27. An ideal Carnot engine is working between $227^{o}C$ and $77^{0}C$. This engine delivers the power of 10kW. Find the rate at which engine rejects the heat to the sink.

28. An electric heater supplies heat to a system at a rate of 100W. If the system performs work at a rate of 75 Joules per second. At what rate is the internal energy increases?.

29. Establish the relation between specific heat capacity at constant volume and specific heat capacity a constant pressure.

30. State the second law of thermodynamics. No real engine can have an efficiency greater than that of a Carnot engine working between the same two temperatures. Give reason.

31. (a) Draw p - v diagram for the Carnot cycle

(b) Write the name of the thermodynamic process carried out by each part of the cycle.

(c) Label and shade the area corresponding to net work done by the engine in one cycle.

(d) Find the efficiency of Carnot's heat engine.

32. Using the first law of thermodynamics, discuss

(i) Iso thermal process (ii) Adiabatic Process

(iii) Isobaric Process (iv) Isochoric Process

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(v) Cyclic Process. Also derive equation of state for isothermal and adiabatic process.

MODEL QUESTIONS

01. What is an indicator diagram.

02. Is internal energy a path function.

03. What is the equation of state for (i) Isobaric and (ii) Isochoric process.

04. Heat is supplied to the gas, but its internal energy does not increase. What is the process involved.

05. A Carnot heat engine operating between temperature T_1 and T_2 has efficiency 1/6. When T_2 is lowered by 62k its efficiency increase to 1/3. Find T_1 and T_2.

06. Explain why (i) the coolant in a chemical or a nuclear plant should have high specific heat. (ii) Air pressure in a car tire increase during driving.

07. A geyser heats water flowing at the rate of 3 litres per minute from 27^0C to 77^0C. If the geyser operates on a gas burner, what is the rate of consumption of the fuel if its heat of combustion is 4.0 X 10^4J/g?

08. A steam engine delivers 5.4 X 10^8J of work per minute and services 3.6 X 10^9J of heat per minute from its boiler. What is the efficiency of the engine? How much heat is wasted per minute.

09. Carnot engine 3x10^6 cal of heat from a reservoir at 627^0C and give it to sink at 27^0C. What is the work done by the engine?

10. Establish the relation between C_P and C_V. Where C_P is the specific heat at constant pressure and C_V is the specific heat at constant volume.

11. State Carnot's theorem. Prove that the efficiency of a reversible heat engine is maximum.

12. What is the efficiency of a Carnot heat engine working between ice point and steam point.

13. What amount of heat must be supplied to $2x10^{-2}$kg of N_2 at room temperature to raise its temperature by 45^oC at constant pressure. Given the molecular weight of N_2 is 28 and R = 8.3J mol^{-1} k^{-1}. and C_P=7R/2.

14. What is an irreversible process? Write the causes of irreversibility.

15. A cylinder with movable piston contains 3moles of hydrogen at STP. The walls of the cylinder are made of a heat insulator and the piston is insulated by heaving a pile of sand on it. By what factor pressure of gas increase if the gas is compressed to half its original volume

16. Why the climate of a harbour town is more temperate than that of a town in a desert at the same latitude?

17. Show that the slope of an adiabatic curve at any point is γ times the slope of an isothermal curve at the corresponding point.

18. A certain amount of gas occupies volume V_0 at pressure P_0 and temperature T_0. It is allowed to expand (i) isobarically (ii) adiabatically and (iii) isothermally. In which case the work is done is maximum and in which case it is minimum? Explain

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19. Two samples of a gas initially at the same temperature and pressure and compressed from a volume V to V/2, one isothermally, the other adiabatically. In which sample is the final pressure greater?

20. Two gases have the same initial pressure P_0, volume V_0 and temperature T_0. They expand to the same volume, one adiabatically and the other isothermally.

(a) In which case is the final pressure greater?

(b) In which case is the work done greater?

(c) In which case is the final temperature greater?

21. The work of 146 J is performed to compress one kilo mole of gas adiabatically and in this process, the temperature of the gas increases by 7^oC. Identify the atomicity of the gas. Given $R = 8.3J\,mol^{-1}K^{-1}$.

22. In a given process on an ideal gas, dW = 0 and dQ < 0. What happens to the temperature of the gas?

23. A monoatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a frictionless position. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the lengths of the gas column before and after expansion respectively then, what is the ratio T_1/T_2?

24. Let the temperatures T_1 and T_2 of the two heat reservoirs in an ideal Carnot engine be 1500^0C and 500^0C respectively. Which of these, increasing T_1 by 100^0C or decreasing T_2 by 100^0C, would result in a greater improvement in the efficiency of the engine?

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