Chapter 4. Thermodynamics

MCQ's (1 Mark Each)

1) Which of the following is correct, when the energy is transferred to a system from its environment?

(a) System gains energy (b) System loses energy

(c) System releases energy (d) system does not exchange energy

Ans.: a) System gains energy

2) Which of the following system freely allows exchange of energy and matter with its environment?

(a) Closed (b) Isolated (c) Open (d) partially closed

Ans.: c) Open

3) Two systems at same temperature are said to be in

(a) chemical equilibrium (b) thermal equilibrium

(c) mechanical equilibrium (d) electrical equilibrium

Ans: b) thermal equilibrium

4) For work done to be reversible, the process should be

(a) cyclic (b) isobaric (c) isochoric (d) adiabatic

Ans: d) adiabatic

5) A gas in a closed container is heated with 10 J of energy. Causing the lid of the container to rise 2 m with 3 N of force. What is the total change in energy of the system?

(a) 10 J (b) 4 J (c) -4 J (d) - 10 J

Ans: b) 4 J

6) The second law of thermodynamics deals with transfer of

(a) work done (b) energy (c) momentum (d) heat

Ans.: d) heat

7) Heating a gas in a constant volume container is an example of which process?

(a) isochoric (b) adiabatic (c) isobaric (d) cyclic

Ans: c) isobaric

Very Short Answer (VSA) (1 MARK Each)

1) When two objects are said to be in thermal equilibrium?
2) The science of measuring temperatures is called as?
3) State zeroth law of thermodynamics.
4) What is energy associated with the random, disordered motion of the molecules of a system called as?
5) A group of objects that can form a unit which may have the ability to exchange energy with its surrounding is called what?
6) On what basis a thermodynamic system can be classified?
7) What is a thermodynamic process?
8) Define heat.
9) What is the internal energy of the system, when the amount of heat Q is added to the system and the system does not do any work during the process?
10) When does a system lose energy to its surroundings and its internal energy decreases?
11) State first law of thermodynamics.
12) What are heat engines?
13) write an equation for the efficiency of the Carnot engine.
14) A system releases 100 kJ of heat while 80 kJ of work is done on the system. Calculate the change in internal energy. **(Ans: $\Delta U = 20$ kJ)**

Short Answer I (SA1) (2 MARKS Each)

1) Draw p-V diagram of reversible process.
2) Draw p-V diagram of irreversible process.
3) Draw p-V diagram showing positive work with varying pressure.
4) Draw p-V diagram showing negative work with varying pressure.
5) Draw p-V diagram showing positive work at constant pressure.
6) Explain the cyclic process.
7) Differentiate between reversible and irreversible process.
8) State the assumptions made for thermodynamic processes.
9) Define efficiency of a heat engine.
10) write a short note on Refrigerator.
11) Draw a neat, labeled diagram of energy flow of a refrigerator.
12) Write a short note on the Air Conditioner.
13) write a short note on Heat pumps.

14) Write Kelvin-Planck statement.

15) 3 moles of a gas at temperature 400 K expands isothermally from initial volume of 4 litre to final volume of 8 litre. Find the work done by the gas. ($R = 8.31\ J\ mol^{-1}\ K^{-1}$)

(Ans.: W = $6.919\ kJ$ ***)***

16) An ideal gas of volume 2 L is adiabatically compressed to $(1/10)^{th}$ of its initial volume. Its initial pressure is 1.01 x 105 Pa, calculate the final pressure. (Given γ= 1.4)

(Ans: $P_f = 25.37 \times 10^5\ Pa$)

Short Answer II (SA2) (3 MARKS Each)

1) Classify and explain thermodynamic system.
2) Explain given cases related to energy transfer between the system and surrounding –
    1) energy transferred (Q) > 0
    2) energy transferred (Q) < 0
    3) energy transferred (Q) = 0
3) Explain the different ways through which internal energy of the system can be changed.
4) Write a note on thermodynamic equilibrium.
5) Explain graphically (i) positive work with varying pressure, (ii) negative work with varying pressure and (iii) positive work at constant pressure.
6) Write a note on free expansion.
7) Explain sterling cycle using diagram.
8) Explain: 1) A working substance of a heat engine.
    2) Hot and cold reservoir of a heat engine.
    3) Cylinder of a heat engine.
9) State and explain the limitations of first law of thermodynamics.

10) One gram of water (1 cm^3) becomes 1671 cm^3 of steam at a pressure of 1 atm. The latent heat of vaporization at this pressure is 2256 J/g. Calculate the external work and the increase in internal energy. ***(Ans. W = 169 J,*** ΔU ***= 2087 J)***

11) Calculate the fall in temperature of helium initially at 15°C when it is suddenly expanded to 8 times its original volume ($\gamma = 5/3$). ***(Ans. – 216.0 °C)***

12) A cylinder containing one gram molecule of the gas was compressed adiabatically until its temperature rose from 27°C to 97°C. Calculate the work done and heat produced in the gas ($\gamma = 1.5$). ***(Ans. W =*** $-\ 11.63 \times 10^2$ ***J and Q = 277 cal)***

Long Answer (LA) (4 marks Each)

1) State first law of thermodynamics and derive the relation between the change in internal energy (ΔU), work done (W) and heat (Q).
2) Explain work done during a thermodynamic process.
3) Explain thermodynamics of isobaric process.
4) Explain thermodynamics of isochoric process.
5) Explain thermodynamics of adiabatic process.