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CLASS 11 PHYSICS · NCERT CHAPTER 11 · IMU CET PRACTICE

Thermodynamics

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Questions: 44 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 The zeroth law of thermodynamics leads to the concept of
 - (A) temperature
 - (B) internal energy
 - (C) entropy
 - (D) work
- 2 The first law of thermodynamics is a statement of
 - (A) conservation of mass
 - (B) conservation of energy
 - (C) conservation of momentum
 - (D) increase of entropy
- 3 500 J of heat is supplied to a gas and it does 200 J of work. The change in internal energy is
 - (A) 700 J
 - (B) 300 J
 - (C) -300 J
 - (D) 200 J
- 4 In an isothermal process for an ideal gas,
 - (A) $\Delta U = 0$
 - (B) $Q = 0$
 - (C) $\Delta P = 0$
 - (D) $W = 0$
- 5 In an adiabatic process,
 - (A) volume remains constant
 - (B) pressure remains constant
 - (C) temperature remains constant
 - (D) no heat is exchanged with the surroundings
- 6 In an isochoric process, the work done by the gas is
 - (A) $P\Delta V$
 - (B) maximum
 - (C) zero
 - (D) nRT
- 7 In an isobaric process, the work done by n moles of an ideal gas when temperature rises by ΔT is
 - (A) zero
 - (B) $nR\Delta T$
 - (C) $nC_p\Delta T$
 - (D) $nC_v\Delta T$
- 8 For an adiabatic process of an ideal gas, the relation is
 - (A) $V/T = \text{constant}$
 - (B) $P/T = \text{constant}$
 - (C) $PV^\gamma = \text{constant}$
 - (D) $PV = \text{constant}$



- 9 The slope of an adiabatic curve on a P-V diagram is ___ times the slope of an isothermal curve at the same point.
- (A) 1 (B) $\gamma - 1$
(C) $1/\gamma$ (D) γ
- 10 Work done by an ideal gas in an isothermal expansion from V_1 to V_2 is
- (A) $nRT \ln(V_2/V_1)$ (B) zero
(C) $nR(T_2 - T_1)$ (D) $P(V_2 - V_1)/\gamma$
- 11 Work done in an adiabatic process from (P_1, V_1) to (P_2, V_2) is
- (A) $(P_2V_2 - P_1V_1)/(\gamma - 1)$ (B) $P(V_2 - V_1)$
(C) $nRT \ln(V_2/V_1)$ (D) $(P_1V_1 - P_2V_2)/(\gamma - 1)$
- 12 The area enclosed by a cyclic process on a P-V diagram represents
- (A) change in temperature (B) heat rejected
(C) net work done in the cycle (D) change in internal energy
- 13 In a cyclic process, the change in internal energy is
- (A) negative (B) equal to work done
(C) positive (D) zero
- 14 The efficiency of a Carnot engine working between 500 K and 300 K is
- (A) 40% (B) 20%
(C) 50% (D) 60%
- 15 A Carnot engine has an efficiency of 50% with sink at 300 K. The source temperature is
- (A) 450 K (B) 600 K
(C) 900 K (D) 150 K
- 16 The efficiency of a heat engine can be 100% only if the sink temperature is
- (A) equal to the source temperature (B) 0°C
(C) 273 K (D) 0 K
- 17 The second law of thermodynamics (Kelvin-Planck statement) implies that
- (A) heat flows from cold to hot spontaneously
(B) energy is conserved
(C) no engine can convert all the heat absorbed into work in a cycle
(D) entropy of the universe decreases
- 18 The Clausius statement of the second law states that
- (A) energy is conserved
(B) heat cannot flow by itself from a colder body to a hotter body
(C) heat always flows from cold to hot
(D) all heat can be converted to work
- 19 The coefficient of performance of a refrigerator working between 300 K and 250 K is
- (A) 5 (B) 6
(C) 0.83 (D) 1.2



- 20 A refrigerator extracts 600 J of heat from the cold reservoir using 200 J of work. Its COP is
(A) 3 (B) 2
(C) 4 (D) 0.33
- 21 A Carnot engine absorbs 1000 J from the source and rejects 600 J to the sink. Its efficiency is
(A) 167% (B) 25%
(C) 40% (D) 60%
- 22 Which is a state function?
(A) Internal energy (B) Work
(C) Both heat and work (D) Heat
- 23 When an ideal gas expands freely into vacuum in an insulated container,
(A) it does positive work (B) its temperature remains unchanged
(C) its temperature increases (D) its temperature decreases
- 24 For a monatomic gas, $\gamma = C_p/C_v$ equals
(A) 9/7 (B) 7/5
(C) 4/3 (D) 5/3
- 25 For a diatomic gas (rigid molecules), γ equals
(A) 1 (B) 4/3
(C) 5/3 (D) 7/5
- 26 Mayer's relation is
(A) $C_p - C_v = R$ (B) $C_p/C_v = R$
(C) $C_p C_v = R$ (D) $C_p + C_v = R$
- 27 A gas is compressed adiabatically. Its temperature
(A) remains constant (B) decreases
(C) increases (D) becomes zero
- 28 A gas expands adiabatically. Its temperature
(A) first increases then decreases (B) remains constant
(C) increases (D) decreases
- 29 For an ideal gas, $TV^{(\gamma-1)}$ is constant in a/an
(A) isobaric process (B) adiabatic process
(C) isochoric process (D) isothermal process
- 30 A process in which the system passes through a series of equilibrium states is called
(A) free expansion (B) irreversible
(C) cyclic (D) quasi-static
- 31 Which of the following processes is irreversible?
(A) Quasi-static isothermal expansion
(B) Frictionless adiabatic expansion done very slowly
(C) Carnot cycle
(D) Heat transfer through a finite temperature difference



- 32** A Carnot cycle consists of
(A) two isobaric and two isochoric processes
(B) two isothermal and two isobaric processes
(C) two isothermal and two adiabatic processes
(D) four adiabatic processes
-
- 33** 2 moles of an ideal gas at 300 K are heated at constant pressure to 400 K. The work done by the gas is ($R = 8.3 \text{ J/mol K}$)
(A) 1660 J (B) 3320 J
(C) 830 J (D) 4980 J
-
- 34** 1 mole of a monatomic ideal gas is heated at constant volume from 300 K to 400 K. The heat supplied is ($R = 8.3 \text{ J/mol K}$)
(A) 1245 J (B) 415 J
(C) 830 J (D) 2075 J
-
- 35** In the previous question, if the same gas is heated at constant pressure from 300 K to 400 K, the heat required is
(A) 830 J (B) 1245 J
(C) 2075 J (D) 2905 J
-
- 36** The internal energy of an ideal gas depends on
(A) pressure and volume both independently (B) temperature only
(C) pressure only (D) volume only
-
- 37** Heat pumps and refrigerators are essentially
(A) heat engines working in reverse (B) devices that create energy
(C) perpetual motion machines (D) adiabatic devices
-
- 38** The efficiency of a Carnot engine is 25%. If the sink temperature is lowered by 50 K, efficiency becomes 50%. The source temperature is
(A) 400 K (B) 100 K
(C) 200 K (D) 300 K
-
- 39** A gas does 300 J of work during adiabatic expansion. The change in its internal energy is
(A) zero (B) -300 J
(C) 600 J (D) +300 J
-
- 40** The P-V graph of an isochoric process is
(A) a parabola (B) a rectangular hyperbola
(C) a vertical line (D) a horizontal line
-
- 41** The P-V graph of an isothermal process for an ideal gas is
(A) a straight line (B) a rectangular hyperbola
(C) a vertical line (D) a circle
-
- 42** Thermodynamic variables that depend on the size of the system are called
(A) path functions (B) intensive variables
(C) extensive variables (D) state functions only
-



43 A sample of gas follows a cyclic process where it absorbs 1000 J and rejects 700 J. Net work done by the gas is

(A) 1000 J

(B) 1700 J

(C) 700 J

(D) 300 J

44 Isothermal bulk modulus of an ideal gas equals

(A) P/γ

(B) P

(C) γP

(D) RT

Answer Key

1	2	3	4	5	6	7	8	9	10
A	B	B	A	D	C	B	C	D	A
11	12	13	14	15	16	17	18	19	20
D	C	D	A	B	D	C	B	A	A
21	22	23	24	25	26	27	28	29	30
C	A	B	D	D	A	C	D	B	D
31	32	33	34	35	36	37	38	39	40
D	C	A	A	C	B	A	C	B	C
41	42	43	44						
B	C	D	B						

Hints & Solutions

1. (A) If A and B are each in thermal equilibrium with C, they are in equilibrium with each other — defining temperature.

2. (B) $\Delta Q = \Delta U + \Delta W$.

3. (B) $\Delta U = Q - W = 500 - 200 = 300 \text{ J}$.

4. (A) Internal energy of an ideal gas depends only on T; T constant $\rightarrow \Delta U = 0$.

5. (D) Adiabatic means $Q = 0$.

6. (C) $W = \int P dV = 0$ when V is constant.

7. (B) $W = P\Delta V = nR\Delta T$.

8. (C) In a reversible adiabatic process, $PV^\gamma = \text{constant}$.

9. (D) Adiabatic: $dP/dV = -\gamma P/V$; isothermal: $dP/dV = -P/V$.

10. (A) $W = \int P dV = nRT \int dV/V = nRT \ln(V_2/V_1)$.

11. (D) $W_{\text{adiabatic}} = (P_1V_1 - P_2V_2)/(\gamma - 1) = nR(T_1 - T_2)/(\gamma - 1)$.

12. (C) For a closed cycle, the enclosed area equals net work done.

13. (D) Internal energy is a state function; returning to the initial state gives $\Delta U = 0$.

14. (A) $\eta = 1 - T_2/T_1 = 1 - 300/500 = 0.4$.

15. (B) $0.5 = 1 - 300/T_1 \rightarrow T_1 = 600 \text{ K}$.

16. (D) $\eta = 1 - T_2/T_1 = 1$ only when $T_2 = 0 \text{ K}$, which is unattainable.

17. (C) Some heat must always be rejected to a sink.

18. (B) A refrigerator needs external work to transfer heat from cold to hot.

19. (A) $\text{COP} = T_2/(T_1 - T_2) = 250/50 = 5$.

20. (A) $\beta = Q_2/W = 600/200 = 3$.

21. (C) $\eta = W/Q_1 = (1000 - 600)/1000 = 0.4$.

22. (A) Internal energy depends only on the state; heat and work depend on the path.

23. (B) Free expansion: $Q = 0$, $W = 0 \rightarrow \Delta U = 0 \rightarrow T$ constant for an ideal gas.
24. (D) $C_v = 3R/2$, $C_p = 5R/2 \rightarrow \gamma = 5/3$.
25. (D) $C_v = 5R/2$, $C_p = 7R/2 \rightarrow \gamma = 1.4$.
26. (A) For one mole of an ideal gas, $C_p - C_v = R$.
27. (C) Work done on the gas raises internal energy ($Q = 0$), so temperature increases.
28. (D) The gas does work at the cost of its internal energy, so it cools.
29. (B) Combining $PV^\gamma = \text{const}$ with $PV = nRT$ gives $TV^{\gamma-1} = \text{const}$.
30. (D) A quasi-static process is infinitely slow so that the system stays near equilibrium.
31. (D) Heat flow across a finite temperature difference cannot be reversed without external changes.
32. (C) Isothermal expansion, adiabatic expansion, isothermal compression, adiabatic compression.
33. (A) $W = nR\Delta T = 2 \times 8.3 \times 100 = 1660 \text{ J}$.
34. (A) $Q = nC_v\Delta T = 1 \times (3/2)(8.3) \times 100 = 1245 \text{ J}$.
35. (C) $Q = nC_p\Delta T = (5/2)(8.3)(100) = 2075 \text{ J}$.
36. (B) For an ideal gas, $U = nC_vT$, a function of T only.
37. (A) Work is done to transfer heat from a cold body to a hot body.
38. (C) $0.25 = 1 - T_2/T_1 \rightarrow T_2 = 0.75T_1$. $0.5 = 1 - (T_2 - 50)/T_1 \rightarrow T_2 - 50 = 0.5T_1 \rightarrow 0.25T_1 = 50 \rightarrow T_1 = 200 \text{ K}$.
39. (B) $Q = 0 \rightarrow \Delta U = -W = -300 \text{ J}$.
40. (C) V is constant while P changes $\rightarrow$ line parallel to the P -axis.
41. (B) $PV = \text{constant}$ gives a rectangular hyperbola.
42. (C) Extensive variables (e.g., U , V , mass) scale with system size; intensive (P , T , density) do not.
43. (D) In a cycle $\Delta U = 0 \rightarrow W = Q_{\text{net}} = 1000 - 700 = 300 \text{ J}$.
44. (B) For $PV = \text{const}$, $B = -V dP/dV = P$. (Adiabatic bulk modulus is γP .)

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