

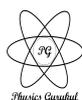


PHYSICS GURUKUL

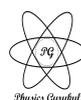
DPP - Daily Practice Problems

Chapter-wise Sheets

Date : Start Time : End Time :



PHYSICS



CP11

SYLLABUS : Thermodynamics

Max. Marks : 180 Marking Scheme : (+4) for correct & (-1) for incorrect answer Time : 60 min.

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

- The relation between U , P and V for an ideal gas in an adiabatic process is given by relation $U = a + bP^{\gamma}V$. Find the value of adiabatic exponent (γ) of this gas
 (a) $\frac{b+1}{b}$ (b) $\frac{b+1}{a}$ (c) $\frac{a+1}{b}$ (d) $\frac{a}{a+b}$
- Carbon monoxide is carried around a closed cycle abc in which bc is an isothermal process as shown in the figure. The gas absorbs 7000 J of heat as its temperature increases from 300 K to 1000 K in going from a to b . The quantity of heat rejected by the gas during the process ca is
 (a) 4200 J (b) 5000 J (c) 9000 J (d) 9800 J
- A Carnot engine, having an efficiency of $\eta = 1/10$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is
 (a) 100 J (b) 99 J (c) 90 J (d) 1 J
- In a thermodynamic process, fixed mass of a gas is changed in such a manner that the gas release 20 J of heat and 8 J of work was done on the gas. If the initial internal energy of the gas was 30 J. Then the final internal energy will be
 (a) 2 joule (b) 18 joule (c) 42 joule (d) 58 joule
- A closed gas cylinder is divided into two parts by a piston held tight. The pressure and volume of gas in two parts respectively are $(P, 5V)$ and $(10P, V)$. If now the piston is left free and the system undergoes isothermal process, then the volumes of the gas in two parts respectively are
 (a) $2V, 4V$ (b) $3V, 3V$ (c) $5V, V$ (d) $\frac{10}{11}V, \frac{20}{11}V$
- The efficiency of an ideal gas with adiabatic exponent ' γ ' for the shown cyclic process would be
 (a) $\frac{(2 \ln 2 - 1)}{\gamma/(\gamma - 1)}$ (b) $\frac{(1 - 2 \ln 2)}{\gamma/(\gamma - 1)}$
 (c) $\frac{(2 \ln 2 + 1)}{\gamma/(\gamma - 1)}$ (d) $\frac{(2 \ln 2 - 1)}{\gamma/(\gamma + 1)}$
- A mass of diatomic gas ($\gamma = 1.4$) at a pressure of 2 atmospheres is compressed adiabatically so that its temperature rises from 27°C to 927°C . The pressure of the gas in final state is
 (a) 28 atm (b) 68.7 atm (c) 256 atm (d) 8 atm

RESPONSE
GRID

1. (a) (b) (c) (d) 2. (a) (b) (c) (d) 3. (a) (b) (c) (d) 4. (a) (b) (c) (d) 5. (a) (b) (c) (d)
 6. (a) (b) (c) (d) 7. (a) (b) (c) (d)

Space for Rough Work

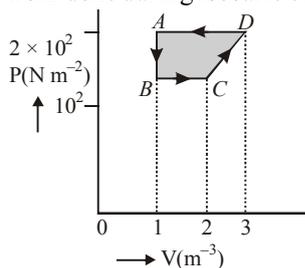


8. A diatomic ideal gas is used in a Carnot engine as the working substance. If during the adiabatic expansion part of the cycle the volume of the gas increases from V to $32V$, the efficiency of the engine is

- (a) 0.5 (b) 0.75 (c) 0.99 (d) 0.25

9. The P - V diagram of a gas system undergoing cyclic process is shown here. The work done during isobaric compression is

- (a) 100J
(b) 200J
(c) 600J
(d) 400J



10. During an adiabatic process of an ideal gas, if P is proportional to $\frac{1}{\sqrt{1.5}}$, then the ratio of specific heat capacities at constant pressure to that at constant volume for the gas is

- (a) 1.5 (b) 0.25 (c) 0.75 (d) 0.4

11. The work of 146 kJ is performed in order to compress one kilo mole of gas adiabatically and in this process the temperature of the gas increases by 7°C . The gas is ($R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$)

- (a) diatomic
(b) triatomic
(c) a mixture of monoatomic and diatomic
(d) monoatomic

12. Consider a spherical shell of radius R at temperature T . The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume $u = \frac{U}{V} \propto T^4$ and pressure $p = \frac{1}{3} \left(\frac{U}{V} \right)$. If the shell now undergoes an adiabatic expansion the relation between T and R is:

- (a) $T \propto \frac{1}{R}$ (b) $T \propto \frac{1}{R^3}$ (c) $T \propto e^{-R}$ (d) $T \propto e^{-3R}$

13. The specific heat capacity of a metal at low temperature (T) is given as $C(\text{kJ K}^{-1} \text{kg}^{-1}) = 32 \left(\frac{T}{400} \right)^3$. A 100 g vessel of this metal is to be cooled from 20 K to 4 K by a special refrigerator operating at room temperature (27°C). The amount of work required to cool in vessel is

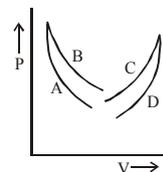
- (a) equal to 0.002 kJ
(b) greater than 0.148 kJ
(c) between 0.148 kJ and 0.028 kJ
(d) less than 0.028 kJ

14. 5.6 litre of helium gas at STP is adiabatically compressed to 0.7 litre. Taking the initial temperature to be T_1 , the work done in the process is

- (a) $\frac{9}{8}RT_1$ (b) $\frac{3}{2}RT_1$ (c) $\frac{15}{8}RT_1$ (d) $\frac{9}{2}RT_1$

15. Four curves A, B, C and D are drawn in the figure for a given amount of a gas. The curves which represent adiabatic and isothermal changes are

- (a) C and D respectively
(b) D and C respectively
(c) A and B respectively
(d) B and A respectively



16. In an adiabatic process, the pressure is increased by $\frac{2}{3}\%$.

If $\gamma = \frac{3}{2}$, then the volume decreases by nearly

- (a) $\frac{4}{9}\%$ (b) $\frac{2}{3}\%$ (c) 1% (d) $\frac{9}{4}\%$

17. A reversible engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C , the efficiency of the engine is doubled. The temperatures of the source and sink are

- (a) $99^\circ\text{C}, 37^\circ\text{C}$ (b) $80^\circ\text{C}, 37^\circ\text{C}$
(c) $95^\circ\text{C}, 37^\circ\text{C}$ (d) $90^\circ\text{C}, 37^\circ\text{C}$

18. A diatomic ideal gas is compressed adiabatically to $\frac{1}{32}$ of its initial volume. If the initial temperature of the gas is T_i (in Kelvin) and the final temperature is aT_i , the value of a is

- (a) 8 (b) 4 (c) 3 (d) 5

19. When the state of a gas adiabatically changed from an equilibrium state A to another equilibrium state B an amount of work done on the system is 35 J. If the gas is taken from state A to B via process in which the net heat absorbed by the system is 12 cal, then the net work done by the system is (1 cal = 4.19 J)

- (a) 13.2J (b) 15.4J (c) 12.6J (d) 16.8J

20. Calculate the work done when 1 mole of a perfect gas is compressed adiabatically. The initial pressure and volume of the gas are 10^5 N/m^2 and 6 litre respectively. The final volume of the gas is 2 litres. Molar specific heat of the gas at constant volume is $3R/2$. [Given $(3)^{5/3} = 6.19$]

- (a) -957J (b) +957J (c) -805J (d) +805J

21. A Carnot engine whose efficiency is 40%, receives heat at 500K. If the efficiency is to be 50%, the source temperature for the same exhaust temperature is

- (a) 900K (b) 600K (c) 700K (d) 800K

22. 1 gm of water at a pressure of $1.01 \times 10^5 \text{ Pa}$ is converted into steam without any change of temperature. The volume of 1 g of steam is 1671 cc and the latent heat of evaporation is 540 cal. The change in internal energy due to evaporation of 1 gm of water is

- (a) $\approx 167 \text{ cal}$ (b) 500 cal (c) 540 cal (d) 581 cal

RESPONSE
GRID

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|---------------------|---------------------|---------------------|---------------------|---------------------|
| 8. (a) (b) (c) (d) | 9. (a) (b) (c) (d) | 10. (a) (b) (c) (d) | 11. (a) (b) (c) (d) | 12. (a) (b) (c) (d) |
| 13. (a) (b) (c) (d) | 14. (a) (b) (c) (d) | 15. (a) (b) (c) (d) | 16. (a) (b) (c) (d) | 17. (a) (b) (c) (d) |
| 18. (a) (b) (c) (d) | 19. (a) (b) (c) (d) | 20. (a) (b) (c) (d) | 21. (a) (b) (c) (d) | 22. (a) (b) (c) (d) |

Space for Rough Work

DPP/ CP11

23. One mole of an ideal gas at temperature T was cooled isochorically till the gas pressure fell from P to $\frac{P}{n}$. Then, by an isobaric process, the gas was restored to the initial temperature. The net amount of heat absorbed by the gas in the process is

- (a) nRT (b) $\frac{RT}{n}$
 (c) $RT(1-n^{-1})$ (d) $RT(n-1)$

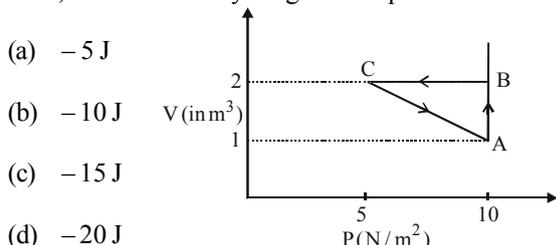
24. A Carnot engine, having an efficiency of $\eta = \frac{1}{10}$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

- (a) 99 J (b) 90 J (c) 1 J (d) 100 J

25. The volume of an ideal gas is 1 litre and its pressure is equal to 72 cm of mercury column. The volume of gas is made 900 cm³ by compressing it isothermally. The stress of the gas will be

- (a) 8 cm of Hg (b) 7 cm of Hg
 (c) 6 cm of Hg (d) 4 cm of Hg

26. An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$, as shown in figure. If the net heat supplied to the gas in the cycle is 5 J, the work done by the gas in the process $C \rightarrow A$ is



- (a) -5 J
 (b) -10 J
 (c) -15 J
 (d) -20 J

27. An ideal gas undergoing adiabatic change has the following pressure-temperature relationship

- (a) $P^\gamma T^{-\gamma} = \text{constant}$ (b) $P^\gamma T^{\gamma-1} = \text{constant}$
 (c) $P^\gamma T^{1-\gamma} = \text{constant}$ (d) $P^{1-\gamma} T^\gamma = \text{constant}$

28. In a thermodynamic process, fixed mass of a gas is changed in such a manner that the gas release 20 J of heat and 8 J of work was done on the gas. If the initial internal energy of the gas was 30 J, the final internal energy will be

- (a) 2 joule (b) 18 joule (c) 42 joule (d) 58 joule

29. The coefficient of performance of a refrigerator is 5. If the inside temperature of freezer is -20°C , then the temperature of the surroundings to which it rejects heat is

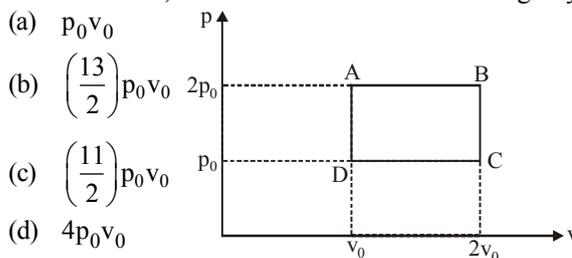
- (a) 41°C (b) 11°C (c) 21°C (d) 31°C

30. Monatomic, diatomic and polyatomic ideal gases each undergo slow adiabatic expansions from the same initial volume and same initial pressure to the same final volume. The magnitude of the work done by the environment on the gas is

- (a) the greatest for the polyatomic gas
 (b) the greatest for the monatomic gas
 (c) the greatest for the diatomic gas

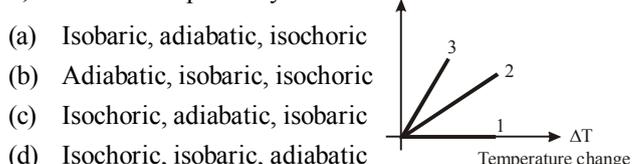
(d) the question is irrelevant, there is no meaning of slow adiabatic expansion

31. The given p-v diagram represents the thermodynamic cycle of an engine, operating with an ideal monatomic gas. The amount of heat, extracted from the source in a single cycle is



- (a) $p_0 v_0$
 (b) $\left(\frac{13}{2}\right) p_0 v_0$
 (c) $\left(\frac{11}{2}\right) p_0 v_0$
 (d) $4 p_0 v_0$

32. For an ideal gas graph is shown for three processes. Process 1, 2 and 3 are respectively.



- (a) Isobaric, adiabatic, isochoric
 (b) Adiabatic, isobaric, isochoric
 (c) Isochoric, adiabatic, isobaric
 (d) Isochoric, isobaric, adiabatic

33. During an adiabatic process an object does 100J of work and its temperature decreases by 5K. During another process it does 25J of work and its temperature decreases by 5K. Its heat capacity for 2nd process is

- (a) 20 J/K (b) 24 J/K (c) 15 J/K (d) 100 J/K

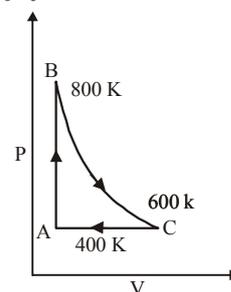
34. A refrigerator works between 4°C and 30°C . It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is: (Take 1 cal = 4.2 joule)

- (a) 2.365 W (b) 23.65 W (c) 236.5 W (d) 2365 W

35. A perfect gas goes from a state A to another state B by absorbing 8×10^5 J of heat and doing 6.5×10^5 J of external work. It is now transferred between the same two states in another process in which it absorbs 10^5 J of heat. In the second process

- (a) work done by gas is 10^5 J
 (b) work done on gas is 10^5 J
 (c) work done by gas is 0.5×10^5 J
 (d) work done on the gas is 0.5×10^5 J

36. One mole of a diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperatures at A, B and C are 400 K, 800 K and 600 K respectively. Choose the correct statement:

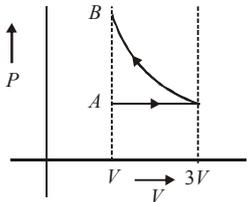
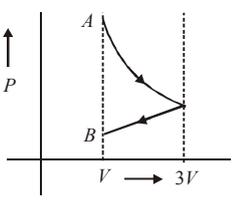
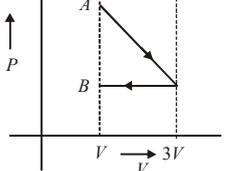
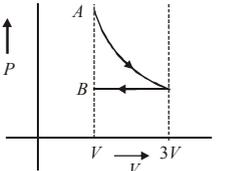
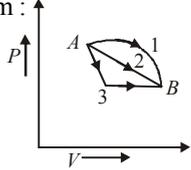


- (a) The change in internal energy in whole cyclic process is 250 R
 (b) The change in internal energy in the process CA is 700 R.
 (c) The change in internal energy in the process AB is -350 R.
 (d) The change in internal energy in the process BC is -500 R.

RESPONSE
GRID

- | | | | | |
|---------------------|---------------------|---------------------|---------------------|---------------------|
| 23. (a) (b) (c) (d) | 24. (a) (b) (c) (d) | 25. (a) (b) (c) (d) | 26. (a) (b) (c) (d) | 27. (a) (b) (c) (d) |
| 28. (a) (b) (c) (d) | 29. (a) (b) (c) (d) | 30. (a) (b) (c) (d) | 31. (a) (b) (c) (d) | 32. (a) (b) (c) (d) |
| 33. (a) (b) (c) (d) | 34. (a) (b) (c) (d) | 35. (a) (b) (c) (d) | 36. (a) (b) (c) (d) | |

Space for Rough Work

37. Two Carnot engines A and B are operated in series. The engine A receives heat from the source at temperature T_1 and rejects the heat to the sink at temperature T . The second engine B receives the heat at temperature T and rejects to its sink at temperature T_2 . For what value of T the efficiencies of the two engines are equal?
- (a) $\frac{T_1+T_2}{2}$ (b) $\frac{T_1-T_2}{2}$ (c) T_1T_2 (d) $\sqrt{T_1T_2}$
38. An ideal gas is initially at P_1, V_1 is expanded to P_2, V_2 and then compressed adiabatically to the same volume V_1 and pressure P_3 . If W is the net work done by the gas in complete process which of the following is true?
- (a) $W > 0; P_3 > P_1$ (b) $W < 0; P_3 > P_1$
 (c) $W > 0; P_3 < P_1$ (d) $W < 0; P_3 < P_1$
39. Which of the following statements is correct for any thermodynamic system?
- (a) The change in entropy can never be zero
 (b) Internal energy and entropy are state functions
 (c) The internal energy changes in all processes
 (d) The work done in an adiabatic process is always zero.
40. One mole of an ideal gas goes from an initial state A to final state B via two processes : It first undergoes isothermal expansion from volume V to $3V$ and then its volume is reduced from $3V$ to V at constant pressure. The correct P-V diagram representing the two processes is :
- (a)  (b) 
- (c)  (d) 
41. What will be the final pressure if an ideal gas in a cylinder is compressed adiabatically to $\frac{1}{3}$ rd of its volume?
- (a) Final pressure will be three times less than initial pressure.
- (b) Final pressure will be three times more than initial pressure.
 (c) Change in pressure will be more than three times the initial pressure.
 (d) Change in pressure will be less than three times the initial pressure.
42. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then :
- (a) Compressing the gas isothermally will require more work to be done.
 (b) Compressing the gas through adiabatic process will require more work to be done.
 (c) Compressing the gas isothermally or adiabatically will require the same amount of work.
 (d) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.
43. An ideal gas goes from state A to state B via three different processes as indicated in the P-V diagram :  If Q_1, Q_2, Q_3 indicate the heat absorbed by the gas along the three processes and $\Delta U_1, \Delta U_2, \Delta U_3$ indicate the change in internal energy along the three processes respectively, then
- (a) $Q_1 > Q_2 > Q_3$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$
 (b) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$
 (c) $Q_1 = Q_2 = Q_3$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$
 (d) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$
44. In P-V diagram shown in figure ABC is a semicircle. The work done in the process ABC is
- (a) 4 J (b) $-\frac{\pi}{2}$ J (c) $\frac{\pi}{2}$ J (d) zero
45. For an isothermal expansion of a perfect gas, the value of $\frac{\Delta P}{P}$ is equal to
- (a) $\gamma^{1/2} \frac{\Delta V}{V}$ (b) $-\frac{\Delta V}{V}$ (c) $-\gamma \frac{\Delta V}{V}$ (d) $\gamma^2 \frac{\Delta V}{V}$

RESPONSE GRID	37. (a)(b)(c)(d)	38. (a)(b)(c)(d)	39. (a)(b)(c)(d)	40. (a)(b)(c)(d)	41. (a)(b)(c)(d)
	42. (a)(b)(c)(d)	43. (a)(b)(c)(d)	44. (a)(b)(c)(d)	45. (a)(b)(c)(d)	

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP11 - PHYSICS

Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

