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JEE MAIN THERMODYNAMICS (PHYSICS) — THERMODYNAMIC PROCESSES (ISOTHERMAL, ADIABATIC, ISOBARIC, ISOCHORIC) — PYQS

Max. Marks: 72 **Questions:** 18

Section A (MCQ) — 15 questions

Q.1 Initial pressure and volume of a monoatomic ideal gas are P and V. The change in internal energy of this gas in adiabatic expansion to volume $V_{final} = 27V$ is _____ J.

[JEE Main 2026 (Online) 8th April Evening Shift]

(1) $-2PV\left(3\sqrt{3}-1\right)$ (2) $\frac{4}{3}PV$

(3) $-\frac{4}{3}PV$ (4) $\frac{3}{4}PV$

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Q.2 A cylinder with adiabatic walls is closed at both ends and is divided into two compartments by a frictionless adiabatic piston. Ideal gas is filled in both (left and right) the compartments at same P, V, T. Heating is started from left side until pressure changes to $\frac{27P}{8}$. If initial volume of each compartment was 9 litres then the final volume in right-hand side compartment is _____ litres. (for this ideal gas $C_P/C_V = 1.5$)

[JEE Main 2026 (Online) 6th April Evening Shift]

(1) 3 (2) 4 (3) 14 (4) 9

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Q.3 An ideal gas undergoes a process maintaining relation between pressure (P) and volume (V) as $P = P_0\left(1+\left(\frac{V_0}{V}\right)^2\right)^{-1}$, where P_0 and V_0 are constants. If two samples A and B (two moles each) with initial volumes V_0 and $3V_0$ respectively undergo above mentioned process and attain same pressure, then the difference in the temperatures of these samples, $T_B - T_A$ is _____.
(R = gas constant)

[JEE Main 2026 (Online) 4th April Morning Shift]

(1) $\frac{9P_0V_0}{8R}$ (2) $\frac{11P_0V_0}{10R}$

(3) $\frac{7P_0V_0}{6R}$ (4) $\frac{13P_0V_0}{11R}$

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Q.4 Heat is supplied to a diatomic gas at constant pressure. Then the ratio of ΔQ:ΔU:ΔW is _____.

[JEE Main 2026 (Online) 2nd April Morning Shift]

(1) 2 : 3 : 5 (2) 5 : 3 : 2 (3) 2 : 5 : 7 (4) 7 : 5 : 2

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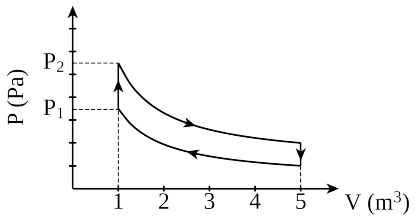
Q.5 10 mole of an ideal gas is undergoing the process shown in the figure. The heat involved in the process from P_1 to P_2 is α Joule (P_1 = 21.7 Pa and P_2 = 30 Pa, C_v = 21 J/K mol, R = 8.3 J/mol K). The value of α is _____.

[JEE Main 2026 (Online) 24th January Evening Shift]



(1) 21 (2) 28 (3) 24 (4) 15

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Q.6 One mole of an ideal diatomic gas expands from volume V to 2V isothermally at a temperature 27°C and does W joule of work. If the gas undergoes same magnitude of expansion adiabatically from 27°C doing the same amount of work W, then its final temperature will be (close to) _____ °C.
($\log_e 2 = 0.693$)

[JEE Main 2026 (Online) 23rd January Evening Shift]

(1) -56 (2) -117 (3) -30 (4) -189

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Q.7 The volume of an ideal gas increases 8 times and temperature becomes $(1/4)^{th}$ of initial temperature during a reversible change. If there is no exchange of heat in this process ($\Delta Q = 0$) then identify the gas from the following options (Assuming the gases given in the options are ideal gases) :

[JEE Main 2026 (Online) 22nd January Morning Shift]

(1) NH_3 (2) O_2 (3) CO_2 (4) He

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Q.8 A monoatomic gas having $\gamma = \frac{5}{3}$ is stored in a thermally insulated container and the gas is suddenly compressed to $\left(\frac{1}{8}\right)^{th}$ of its initial volume. The ratio of final pressure and initial pressure is:
(γ is the ratio of specific heats of the gas at constant pressure and at constant volume)

[JEE Main 2025 (Online) 8th April Evening Shift]

(1) 16 (2) 32 (3) 28 (4) 40

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Q.9 Match **List - I** with **List - II**.

List - I		List - II	
A.	Isothermal	I.	ΔW (work done) = 0
B.	Adiabatic	II.	ΔQ (supplied heat) = 0
C.	Isobaric	III.	ΔU (change in internal energy) $\neq 0$
D.	Isochoric	IV.	$\Delta U = 0$

Choose the **correct** answer from the options given below : [JEE Main 2025 (Online) 7th April Evening Shift]

(1) A-III, B-II, C-I, D-IV (2) A-II, B-IV, C-I, D-III
(3) A-IV, B-II, C-III, D-I (4) A-IV, B-I, C-III, D-II

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Q.10 Match **List - I** with **List - II**.
ΔQ = Heat supplied
ΔW = Work done by the system
ΔU = Change in internal energy
P = Pressure of the system
ΔV = Change in volume of the system

List - I		List - II	
A.	Isobaric	I.	$\Delta Q = \Delta W$
B.	Isochoric	II.	$\Delta Q = \Delta U$
C.	Adiabatic	III.	ΔQ = zero
D.	Isothermal	IV.	$\Delta Q = \Delta U + P\Delta V$

Choose the correct answer from the options given below : [JEE Main 2025 (Online) 4th April Evening Shift]

(1) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
(2) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
(3) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(4) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

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Q.11 A gas is kept in a container having walls which are thermally non-conducting. Initially the gas has a volume of 800 cm^3 and temperature 27°C. The change in temperature when the gas is adiabatically compressed to 200 cm^3 is:
(Take γ = 1.5; γ is the ratio of specific heats at constant pressure and at constant volume)

[JEE Main 2025 (Online) 3rd April Morning Shift]

(1) 300 K (2) 600 K (3) 327 K (4) 522 K

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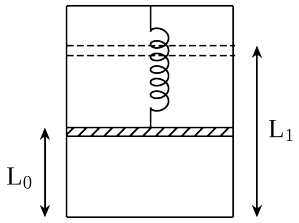
Q.12



A piston of mass M is hung from a massless spring whose restoring force law goes as $F = -kx^3$, where k is the spring constant of appropriate dimension. The piston separates the vertical chamber into two parts, where the bottom part is filled with 'n' moles of an ideal gas. An external work is done on the gas isothermally (at a constant temperature T) with the help of a heating filament (with negligible volume) mounted in lower part of the chamber, so that the piston goes up from a height L_0 to L_1, the total energy delivered by the filament is: (Assume spring to be in its natural length before heating)

[JEE Main 2025 (Online) 3rd April Morning Shift]

(1) $nRT\ln\left(\frac{L_1}{L_0}\right) + Mg(L_1 - L_0) + \frac{3k}{4}(L_1^4 - L_0^4)$

(2) $nRT\ln\left(\frac{L_1}{L_0}\right) + Mg(L_1 - L_0) + \frac{k}{4}(L_1^4 - L_0^4)$

(3) $nRT\ln\left(\frac{L_1^2}{L_0^2}\right) + \frac{Mg}{2}(L_1 - L_0) + \frac{k}{4}(L_1^4 - L_0^4)$

(4) $3nRT\ln\left(\frac{L_1}{L_0}\right) + 2Mg(L_1 - L_0) + \frac{k}{3}(L_1^3 - L_0^3)$

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Q.13 In an adiabatic process, which of the following statements is true?

[JEE Main 2025 (Online) 2nd April Morning Shift]

(1) The internal energy of the gas decreases as the temperature increases
(2) The molar heat capacity is zero
(3) Work done by the gas equals the increase in internal energy
(4) The molar heat capacity is infinite

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Q.14 Identify the characteristics of an adiabatic process in a monoatomic gas.
A. Internal energy is constant.
B. Work done in the process is equal to the change in internal energy.
C. The product of temperature and volume is a constant.
D. The product of pressure and volume is a constant.
E. The work done to change the temperature from T_1 to T_2 is proportional to $(T_2 - T_1)$.
Choose the correct answer from the options given below : [JEE Main 2025 (Online) 2nd April Evening Shift]
(1) (B), (D) only (2) (B), (E) only
(3) (A), (C), (E) only (4) (A), (C), (D) only

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Q.15 The work done in an adiabatic change in an ideal gas depends upon only :
[JEE Main 2025 (Online) 29th January Morning Shift]
(1) change in its pressure
(2) change in its temperature
(3) change in its specific heat
(4) change in its volume

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Section B (Numerical) — 3 questions

Q.16 A certain gas is isothermally compressed to $\left(\frac{1}{3}\right)^{rd}$ of its initial volume (V_0 = 3 litre) by applying required pressure. If the bulk modulus of the gas is 3×10^5 N/m^2, the magnitude of work done on the gas is _____ J.
[JEE Main 2026 (Online) 6th April Morning Shift]

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Q.17 A vessel contains 0.15 m^3 of a gas at pressure 8 bar and temperature 140 °C with c_p = 3R and c_v = 2R. It is expanded adiabatically till pressure falls to 1 bar. The work done during this process is _____ kJ. (R is gas constant)
[JEE Main 2026 (Online) 2nd April Morning Shift]

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Q.18 A diatomic gas (γ = 1.4) does 100 J of work when it is expanded isobarically. Then the heat given to the gas _____ J.
[JEE Main 2026 (Online) 21st January Evening Shift]

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ANSWER KEY

Section A (MCQ) — 15 questions

Ques.	1	2	3	4	5	6	7	8	9	10	11
Ans.	**3**	**2**	**2**	**4**	**1**	**1**	**4**	**2**	**3**	**2**	**1**
Ques.	12	13	14	15							
Ans.	**2**	**2**	**2**	**2**							

Section B (Numerical) — 3 questions

Ques.	16	17	18				
Ans.	**989**	**120**	**350**				