

PYQSide

JEE MAIN THERMODYNAMICS (PHYSICS) — PYQS

Max. Marks: 124

Questions: 31

Section A (MCQ)

- Q.1** One mole of diatomic gas having rotational modes only is kept in a cylinder with a piston system. The cross-section area of the cylinder is 4 cm^2 . The gas is heated slowly to raise the temperature by 1.2°C during which the piston moves by 25 mm . The amount of heat supplied to the gas is ____ J. (Atmospheric pressure = 100 kPa , $R = 8.3 \text{ J/mol} \cdot \text{K}$) (Neglect mass of the piston)

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

- (1) 24.8 (2) 10.96 (3) 15.04 (4) 29.98

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- Q.2** 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 $V_{\text{final}} = 27V$ is ____ J.

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

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

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- Q.3** 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.4** Consider the following statements:
A. Zeroth law of thermodynamics gives concept of temperature
B. First law of thermodynamics gives concept of internal energy
C. In isothermal expansion of ideal gas, $\Delta Q \neq \Delta W$

D. Product of intensive and extensive variables is extensive

E. The ratio of any extensive variable to mass will be an extensive variable

Choose the correct combination of statements from the options given below:

[JEE Main 2026 (Online) 5th April Morning Shift]

- (1) C, D and E Only (2) A, B and C Only
(3) A, B and D Only (4) B, C and D Only

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- Q.5** 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.6** Heat is supplied to a diatomic gas at constant pressure. Then the ratio of $\Delta Q : \Delta U : \Delta W$ is ____.

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

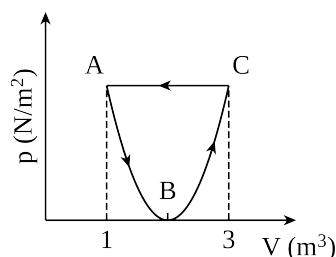
- (1) 2 : 3 : 5 (2) 5 : 3 : 2 (3) 2 : 5 : 7 (4) 7 : 5 : 2

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- Q.7** In the following $p - V$ diagram the equation of state along the curved path is given by $(V - 2)^2 = 4ap$ where a is a constant. The total work done in the closed path is

[JEE Main 2026 (Online) 28th January Morning Shift]



- (1) $+\frac{1}{3a}$ (2) $-\frac{1}{a}$ (3) $\frac{1}{2a}$ (4) $-\frac{1}{3a}$

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Q.8 Densities of water at 4°C and 20°C are 1000 kg/m³ and 998 kg/m³ respectively. The increase in internal energy of 4 kg of water when it is heated from 4°C to 20°C is _____ J.

(specific heat capacity of water = 4.2 kJ/kg K and 1 atmospheric pressure = 10⁵ Pa)

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

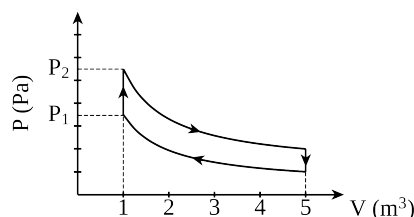
- (1) 268799.2 (2) 315826.2
(3) 234699.2 (4) 258700.8

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Q.9 10 mole of an ideal gas is undergoing the process shown in the figure. The heat involved in the process from P₁ to P₂ is α Joule (P₁ = 21.7 Pa and P₂ = 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.10 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.11 The internal energy of a monoatomic gas is 3nRT. One mole of helium is kept in a cylinder having internal cross section area of 17 cm² and fitted with a light movable frictionless piston. The gas is heated slowly by supplying 126 J heat. If the temperature rises by 4°C, then the piston will move _____ cm. (atmospheric pressure = 10⁵ Pa)

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

- (1) 1.55 (2) 14.5 (3) 15.5 (4) 1.45

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Q.12 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 (ΔQ = 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) NH₃ (2) O₂ (3) CO₂ (4) He

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Q.13 A monoatomic gas having $\gamma = \frac{5}{3}$ is stored in a thermally insulated container and the gas is suddenly compressed to $\left(\frac{1}{8}\right)^{\text{th}}$ 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.14 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) ≠ 0
D.	Isochoric	IV.	ΔU = 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.15 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.	ΔQ = ΔW
B.	Isochoric	II.	ΔQ = ΔU
C.	Adiabatic	III.	ΔQ = zero
D.	Isothermal	IV.	ΔQ = ΔU + PΔV

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.16 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 $\gamma = 1.5$; 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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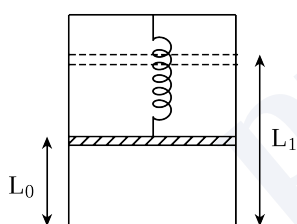


Q.17 During the melting of a slab of ice at 273 K at atmospheric pressure :

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

- (1) Internal energy of ice-water system remains unchanged.
 (2) Positive work is done by the ice-water system on the atmosphere.
 (3) Positive work is done on the ice-water system by the atmosphere.
 (4) Internal energy of the ice-water system decreases.

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full solution



Q.18

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.19 An ideal gas exists in a state with pressure P_0 , volume V_0 . It is isothermally expanded to 4 times of its initial volume (V_0), then isobarically compressed to its original volume. Finally the system is heated isochorically to bring it to its initial state. The amount of heat exchanged in this process is

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

- (1) $P_0 V_0 (\ln 2 - 0.75)$ (2) $P_0 V_0 (2 \ln 2 - 0.75)$
 (3) $P_0 V_0 (2 \ln 2 - 0.25)$ (4) $P_0 V_0 (\ln 2 - 0.25)$

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Q.20 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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full solution



Q.21 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.22 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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Q.23 A Carnot engine (E) is working between two temperatures 473 K and 273 K. In a new system two engines - engine E_1 works between 473 K to 373 K and engine E_2 works between 373 K to 273 K. If η_{12} , η_1 and η_2 are the efficiencies of the engines E , E_1 and E_2 , respectively, then

[JEE Main 2025 (Online) 28th January Morning Shift]

- (1) $\eta_{12} = \eta_1 \eta_2$
- (2) $\eta_{12} = \eta_1 + \eta_2$
- (3) $\eta_{12} \geq \eta_1 + \eta_2$
- (4) $\eta_{12} < \eta_1 + \eta_2$

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Section B (Numerical)

Q.24 A certain gas is isothermally compressed to $\left(\frac{1}{3}\right)^{\text{rd}}$ of its initial volume ($V_0 = 3$ litre) by applying required pressure. If the bulk modulus of the gas is $3 \times 10^5 \text{ N/m}^2$, the magnitude of work done on the gas is _____ J.

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

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Q.25 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.26 5 moles of unknown gas is heated at constant volume from 10°C to 20°C . The molar specific heat of this gas at constant pressure $c_p = 8 \text{ cal/mol}^\circ\text{C}$ and $R = 8.36 \text{ J/mol}^\circ\text{C}$. The change in the internal energy of the gas is _____ calorie.

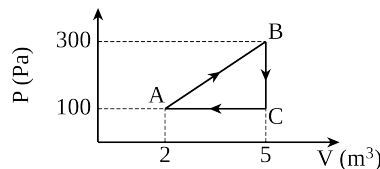
[JEE Main 2026 (Online) 2nd April Evening Shift]

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Q.27 A thermodynamic system is taken through the cyclic process ABC as shown in the figure. The total work done by the system during the cycle ABC is _____ J.

[JEE Main 2026 (Online) 28th January Evening Shift]



Scan or tap for the full solution



Q.28 When 300 J of heat is given to an ideal gas with $C_p = \frac{7}{2}R$, its temperature rises from 20°C to 50°C keeping its volume constant. The amount of the gas is (approximately) _____ $\times 10^{-3}$ mol. ($R = 8.314 \text{ J/mol K}$)

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

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Q.29 10 mole of oxygen is heated at constant volume from 30°C to 40°C . The change in the internal energy of the gas is _____ cal. (The molecular specific heat of oxygen at constant pressure, $C_p = 7 \text{ cal/mol }^\circ\text{C}$ and $R = 2 \text{ cal/mol }^\circ\text{C}$.)

[JEE Main 2026 (Online) 21st January Morning Shift]

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Q.30 A diatomic gas ($\gamma = 1.4$) does 100 J of work when it is expanded isobarically. Then the heat given to the gas _____ J.

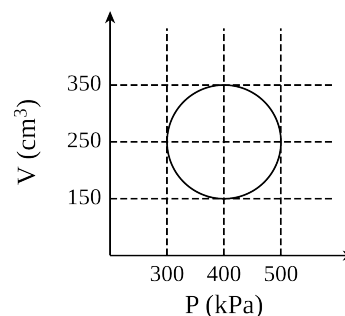
[JEE Main 2026 (Online) 21st January Evening Shift]

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Q.31 An ideal gas has undergone through the cyclic process as shown in the figure. Work done by the gas in the entire cycle is _____ $\times 10^{-1}$ J. (Take $\pi = 3.14$)

[JEE Main 2025 (Online) 7th April Morning Shift]



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ANSWER KEY

Section A (MCQ)

Ques.	1	2	3	4	5	6	7	8	9	10	11
Ans.	2	3	2	3	2	4	4	1	1	1	3
Ques.	12	13	14	15	16	17	18	19	20	21	22
Ans.	4	2	3	2	1	3	2	2	2	2	2
Ques.	23										
Ans.	4										

Section B (Numerical)

Ques.	24	25	26	27	28	29	30
Ans.	989	120	300	300	481	500	350
Ques.	31						
Ans.	314						