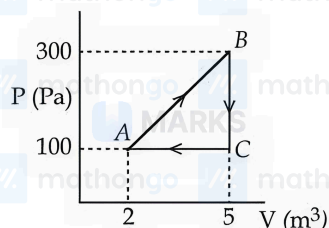


Q1. JEE Main 2026 (21 January Shift 2)

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

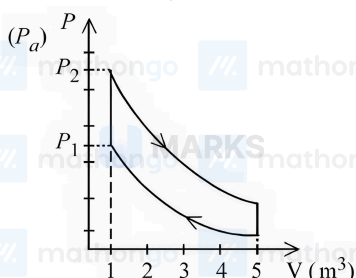
Q2. JEE Main 2026 (28 January Shift 2)

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.



Q3. JEE Main 2026 (24 January Shift 2)

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 _____.



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

Q4. JEE Main 2026 (24 January Shift 2)

When 300 J of heat given to an ideal gas with $C_p = \frac{7}{2}R$ its temperature raises from 20°C to 50°C keeping its volume constant. If n is the number of moles of the gas, then what is the value of $100n$? ($R = 8.314$ J/mol. K)

Q5. JEE Main 2026 (22 January Shift 2)

An insulated cylinder of volume 60 cm^3 is filled with a gas at 27°C and 2 atmospheric pressure. Then the gas is compressed making the final volume as 20 cm^3 while allowing the temperature to rise to 77°C . The final pressure is _____ atmospheric pressure.

Q6. JEE Main 2026 (23 January Shift 2)

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) _____ $^\circ\text{C}$.

($\log_e 2 = 0.693$)

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

Q7. JEE Main 2026 (23 January Shift 2)

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 cm^2 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 = 10^5 Pa)

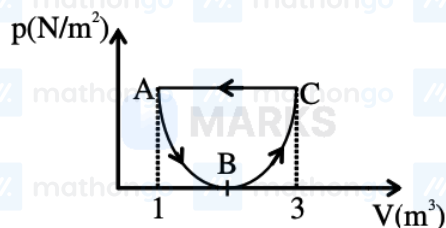
- (1) 1.45 (2) 15.5 (3) 1.55 (4) 14.5

Q8. JEE Main 2026 (21 January Shift 1)

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, $C_P = 7\text{ cal/mol}\cdot^\circ\text{C}$ and $R = 2\text{ cal/mol}\cdot^\circ\text{C}$.)

Q9. JEE Main 2026 (28 January Shift 1)

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



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

Q10. JEE Main 2026 (24 January Shift 1)

Density of water at 4°C and 20°C are 1000 kg/m^3 and 998 kg/m^3 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 = $4.2\text{ J/kg}\cdot^\circ\text{C}$ and 1 atmospheric pressure = 10^5 Pa)

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

ANSWERS AND SOLUTIONS

1. 350 2. 300 3. (1) 4. 481 5. 7 6. (4) 7. (2) 8. 500
9. (2) 10. (4)

1. (350) For an isobaric process, the first law gives: $Q = \Delta U + W$.

For a diatomic gas with $\gamma = 1.4$, we have $C_V = \frac{5}{2}R$ and $C_P = \frac{7}{2}R$.

Since $W = nR\Delta T = 100$ J for isobaric expansion, the change in internal energy is:

$$\Delta U = nC_V\Delta T = \frac{5}{2}nR\Delta T = \frac{5}{2} \times 100 = 250 \text{ J.}$$

Therefore, $Q = 250 + 100 = 350$ J.

2. (300) From the P-V diagram: A(2,100), B(5,300), C(5,100) in Pa and m^3 units.

Process A $\rightarrow$ B is linear. Equation: $P = 100 + \frac{200}{3}(V - 2)$

$$W_{AB} = \int_2^5 \frac{200V-100}{3} dV = \frac{1}{3}[100V^2 - 100V]_2^5 = \frac{1800}{3} = 600 \text{ J}$$

Process B $\rightarrow$ C is isobaric: $W_{BC} = 300(5 - 5) = 0$ J

Process C $\rightarrow$ A is isobaric: $W_{CA} = 100(2 - 5) = -300$ J

Total work done by system: $W = 600 + 0 - 300 = 300$ J

3. (1) From the given $P - V$ diagram, the process from P_1 to P_2 is an isochoric process because the volume remains constant at $V = 1 \text{ m}^3$.

For an isochoric process, the work done $W = 0$.

According to the first law of thermodynamics, the heat involved is $Q = \Delta U + W = \Delta U$.

The change in internal energy is given by $\Delta U = nC_v\Delta T$.

Using the ideal gas equation $PV = nRT$, we have $n\Delta T = \frac{V\Delta P}{R}$.

Substituting this into the expression for Q :

$$Q = C_v \left(\frac{V(P_2 - P_1)}{R} \right)$$

Given values: $n = 10$ moles, $V = 1 \text{ m}^3$, $P_1 = 21.7$ Pa, $P_2 = 30$ Pa, $C_v = 21 \text{ J/mol} \cdot \text{K}$, and $R = 8.3 \text{ J/mol} \cdot \text{K}$.

$$Q = 21 \times \frac{1 \times (30 - 21.7)}{8.3}$$

$$Q = 21 \times \frac{8.3}{8.3} = 21 \text{ J.}$$

Thus, the value of α is 21.

4. (481) Given: $C_P = \frac{7}{2}R$, so $C_V = C_P - R = \frac{5}{2}R$

$\Delta Q = nC_V\Delta T$ (constant volume)

$$300 = n \times \frac{5}{2} \times 8.314 \times 30$$

$$n = 0.48 \text{ mol}$$

$$100n = 48$$

5. (7) $PV = nRT$

$$\frac{P_1 V_1}{RT_1} = \frac{P_2 V_2}{RT_2}$$

$$\frac{2 \times 10^5 \times 60}{300} = \frac{P_2 \times 20}{350}$$

$$P_2 = \frac{2 \times 10^5 \times 7 \times 3}{6}$$

$$P_2 = 7 \times 10^5 = 7 \text{ atm}$$

6. (4) For isothermal expansion of 1 mole diatomic gas from V to 2V at 300 K:

$$W = RT \ln 2 = R(300) \ln 2$$

For adiabatic expansion with same volume change and same work output:

$$W = nC_V \Delta T = C_V(T_i - T_f)$$

For diatomic gas, $C_V = \frac{5}{2}R$. Setting work equal:

$$R(300) \ln 2 = \frac{5}{2}R(300 - T_f)$$

Simplifying:

$$300 \ln 2 = 2.5(300 - T_f), \text{ so } 300(0.693) = 2.5(300 - T_f)$$

$$207.9 = 750 - 2.5T_f, \text{ giving } T_f = 216.84 \text{ K} \approx -56^\circ\text{C}.$$

7. (2) The question states the internal energy of the gas is $U = 3nRT$.

The change in internal energy is $\Delta U = 3nR\Delta T$.

Given: $n = 1$ mole, $\Delta T = 4^\circ\text{C} = 4 \text{ K}$, and $R \approx 8.314 \text{ J/mol}\cdot\text{K}$.

$$\Delta U = 3 \times 1 \times 8.314 \times 4 = 99.768 \text{ J}.$$

According to the first law of thermodynamics, $\Delta Q = \Delta U + W$.

Given heat supplied $\Delta Q = 126 \text{ J}$.

$$\text{Work done by the gas } W = \Delta Q - \Delta U = 126 - 99.768 = 26.232 \text{ J}.$$

Since the piston is light and movable, the process occurs at constant atmospheric pressure $P = 10^5 \text{ Pa}$.

Work done $W = P\Delta V = P(A \times d)$, where A is the cross-section area and d is the displacement of the piston.

$$A = 17 \text{ cm}^2 = 17 \times 10^{-4} \text{ m}^2.$$

$$26.232 = 10^5 \times (17 \times 10^{-4}) \times d.$$

$$26.232 = 170 \times d.$$

$$d = \frac{26.232}{170} \approx 0.1543 \text{ m}.$$

Converting to cm: $d \approx 15.43 \text{ cm}$.

Rounding to the nearest option, we get 15.5 cm.

8. (500) Given: $n = 10 \text{ mol}$,

$$\Delta T = 40 - 30 = 10^\circ\text{C},$$

$$C_P = 7 \text{ cal/mol}\cdot^\circ\text{C},$$

$$R = 2 \text{ cal/mol}\cdot^\circ\text{C}$$

For ideal gas: $C_V = C_P - R = 7 - 2 = 5 \text{ cal/mol}\cdot^\circ\text{C}$

Change in internal energy: $\Delta U = nC_V \Delta T = 10 \times 5 \times 10 = 500 \text{ cal}$

9. (2) From the equation of state $(V - 2)^2 = 4ap$, we get $p = \frac{(V-2)^2}{4a}$.

$$\text{At } V = 1: p = \frac{1}{4a} \text{ and at } V = 3: p = \frac{1}{4a}.$$

The curved path $A \rightarrow B \rightarrow C$ follows the given equation, while $C \rightarrow A$ is a straight line at constant pressure.

Work along the curved path:

$$W_{ABC} = \int_1^3 \frac{(V-2)^2}{4a} dV = \frac{1}{4a} \left[\frac{(V-2)^3}{3} \right]_1^3 = \frac{1}{4a} \cdot \frac{2}{3} = \frac{1}{6a}.$$

Work along $C \rightarrow A$ at constant pressure:

$$W_{CA} = \frac{1}{4a}(1-3) = -\frac{1}{2a}.$$

$$\text{Total work: } W_{total} = \frac{1}{6a} - \frac{1}{2a} = -\frac{1}{3a}.$$

10. (4) Heat absorbed by water: $Q = mc\Delta T = 4 \times 4200 \times 16 = 268800 \text{ J}.$

Volume change: $V_1 = 4/1000 = 0.004 \text{ m}^3$ at 4°C , $V_2 = 4/998 \approx 0.00401 \text{ m}^3$ at 20°C .

Work done by water at constant pressure: $W = P_{atm}\Delta V = 10^5 \times 0.00001 = 0.8 \text{ J}.$

By first law of thermodynamics: $\Delta U = Q - W = 268800 - 0.8 = 268799.2 \text{ J}$