PART 1 - PHYSICS

Topic : Thermodynamics (physics)

SECTION–1 : (Maximum Marks : 12)

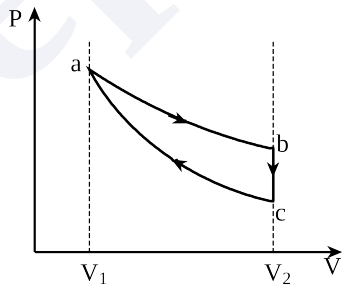
- This section contains **THREE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks	: +4	ONLY if (all) the correct option(s) is(are) chosen;
Partial Marks	: +3	If all the four options are correct but ONLY three options are chosen;
Partial Marks	: +2	If three or more options are correct but ONLY two options are chosen, both of which are correct;
Partial Marks	: +1	If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	: 0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	: −2	In all other cases.

- For example, in a question, if **(A), (B) and (D)** are the ONLY three options corresponding to correct answers, then choosing ONLY (A), (B) and (D) will get +4 marks; choosing ONLY (A) and (B) will get +2 marks; choosing ONLY (A) and (D) will get +2 marks; choosing ONLY (B) and (D) will get +2 marks; choosing ONLY (A) will get +1 mark; choosing ONLY (B) will get +1 mark; choosing ONLY (D) will get +1 mark; choosing no option (i.e. the question is unanswered) will get 0 marks; and choosing any other combination of options will get −2 marks.

1. A quasi-static cycle of a monoatomic ideal gas contains an isothermal process (ab), followed by an isochoric process (bc) and an adiabatic process (ca) as shown in the figure. The volumes of the gas are V_1 and V_2 at a and b, respectively. If the cycle has heat input Q_{in} and output Q_{out}, then the efficiency of the cycle is defined as $\eta = \frac{Q_{in} - Q_{out}}{Q_{in}}$. The correct statement(s) is/are:

[Given: $\ln 2 \approx 0.7$] [JEE Advanced 2026 Paper 1]



(A) If $V_2/V_1 = 8$, the heat released in the process bc is smaller than the heat absorbed in the process ab.

(B) For a given value of V_2/V_1, η does not depend on the temperature of the isothermal process.

(C) If $V_2/V_1 = 8$, then the temperature of the gas at a is 4 times the temperature of the gas at c.

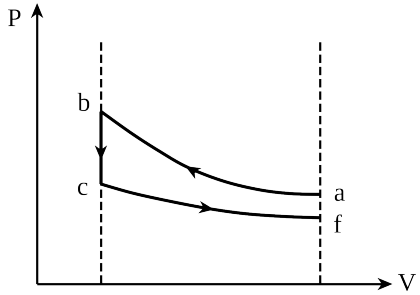
(D) If $V_2/V_1 = 8$, then the pressure of the gas at a is 4 times the pressure of the gas at b.

Scan or tap for the full solution

Space for Rough Work

2. Ten moles of an ideal monoatomic gas, initially in state a at atmospheric pressure and temperature T_a = 27°C, is enclosed in a metal cylinder of volume V_0 fitted with a frictionless piston. The gas is suddenly compressed to state b with volume $V_0/3$. Now, keeping the piston stationary, the cylinder is submerged in a water bath of temperature 11°C until the gas reaches the temperature of the water bath, which is denoted as state c. Finally, while still in the water bath, the piston is brought slowly to its initial position, which is denoted as state f. If R is universal gas constant, then the correct option(s) is/are:
[Given: $9^{1/3} = 2.08$] [JEE Advanced 2026 Paper 2]

(A) The schematic P-V diagram of the processes described above is:



(B) The change in internal energy in going from state a to b is 4860R.

(C) The net change in the internal energy in the whole process is −240R.

(D) The pressure and temperature of the state b are 2.08 times the atmospheric pressure and 624 K, respectively.

Scan or tap for the full solution

3. The efficiency of a Carnot engine operating with a hot reservoir kept at a temperature of 1000 K is 0.4. It extracts 150 J of heat per cycle from the hot reservoir. The work extracted from this engine is being fully used to run a heat pump which has a coefficient of performance 10. The hot reservoir of the heat pump is at a temperature of 300 K. Which of the following statements is/are correct: [JEE Advanced 2025 Paper 2]

(A) Work extracted from the Carnot engine in one cycle is 60 J.

(B) Temperature of the cold reservoir of the Carnot engine is 600 K.

(C) Temperature of the cold reservoir of the heat pump is 270 K.

(D) Heat supplied to the hot reservoir of the heat pump in one cycle is 540 J.

Solution

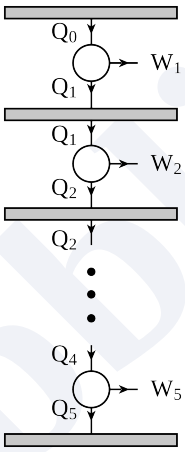
Space for Rough Work

SECTION–2 : (Maximum Marks : 8)

- This section contains **TWO** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer (in decimal notation, truncated / rounded-off to the **SECOND DECIMAL PLACE**; e.g. 6.25, 7.00, −0.33, −.30, 30.27, −127.30) in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +4 If ONLY the correct answer is entered;
Zero Marks : 0 In all other cases.

4. As shown in the figure, five Carnot engines, each with efficiency η and same number of cycles per unit time, are operating between six heat reservoirs. The amount of heat released per cycle by one engine is completely absorbed by the next engine. Consider Q_0 to be the amount of heat absorbed per cycle by the first engine and W as the amount of total work done by all the engines per cycle, then the net efficiency of the system is found to be $\eta_{net} = \frac{W}{Q_0} = \frac{211}{243}$. The value of η is: [JEE Advanced 2026 Paper 1]



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5. An ideal monatomic gas of n moles is taken through a cycle WXYZW consisting of consecutive adiabatic and isobaric quasi-static processes, as shown in the schematic V-T diagram. The volume of the gas at W, X and Y points are, 64 cm^3, 125 cm^3 and 250 cm^3, respectively. If the absolute temperature of the gas T_W at the point W is such that nRT_W = 1 J (R is the universal gas constant), then the amount of heat absorbed (in J) by the gas along the path XY is ___ [JEE Advanced 2025 Paper 2]

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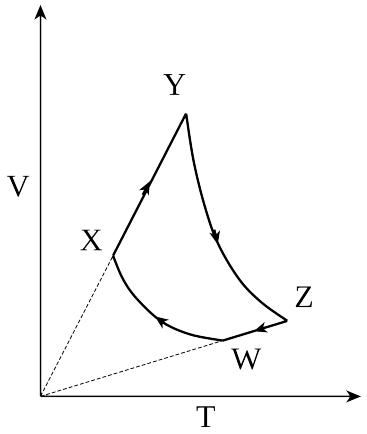

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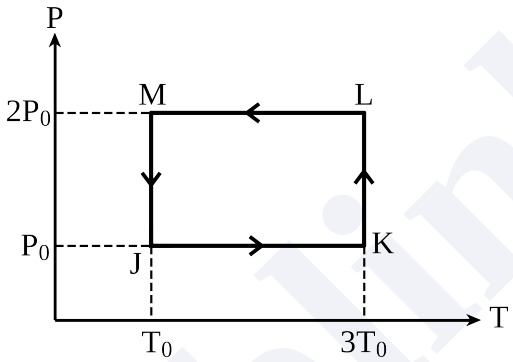
Space for Rough Work

SECTION–3 : (Maximum Marks : 3)

- This section contains **ONE** question.
- Each question has **TWO** lists: **List-I** and **List-II**.
- Four options are given representing matching of elements from List-I and List-II. **ONLY ONE** of these four options corresponds to a correct matching.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +3 If ONLY the correct option is chosen;
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks : −1 In all other cases.

6. One mole of a monatomic ideal gas undergoes the cyclic process J ⟶ K ⟶ L ⟶ M ⟶ J, as shown in the P-T diagram.



Match the quantities mentioned in **List-I** with their values in **List-II** and choose the correct option. [R is the gas constant.] [JEE Advanced 2024 Paper 1]

	List-I		List-II
P.	Work done in the complete cyclic process	1.	$RT_0 - 4RT_0 \ln 2$
Q.	Change in the internal energy of the gas in the process JK	2.	0
R.	Heat given to the gas in the process KL	3.	$3RT_0$
S.	Change in the internal energy of the gas in the process MJ	4.	$-2RT_0 \ln 2$
		5.	$-3RT_0 \ln 2$

(A) P → 1; Q → 3; R → 5; S → 4
(B) P → 4; Q → 3; R → 5; S → 2
(C) P → 4; Q → 1; R → 2; S → 2
(D) P → 2; Q → 5; R → 3; S → 4

Solution

Space for Rough Work

JEE ADVANCED THERMODYNAMICS (PHYSICS) — PYQS

Test Pattern : **JEE (Advanced)**

ANSWER KEY

SECTION–1

Ques.	1	2	3														
Ans.	A, B, C	A, B, C	A, B, C														

SECTION–2

Ques.	4	5										
Ans.	0.32 to 0.34	1.6										

SECTION–3

Ques.	6																											
Ans.	B																											

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