

APOLLO

Thermodynamics

HL

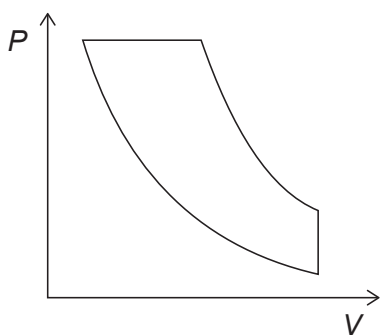
Physics

First assessment 2025

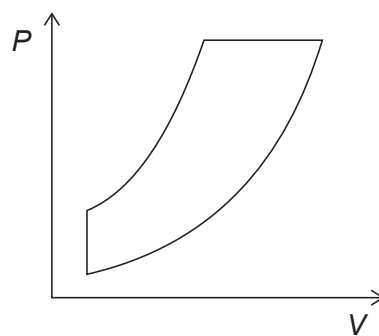
15 questions | questions

13. Which pressure–volume (P–V) diagram represents a Carnot cycle?

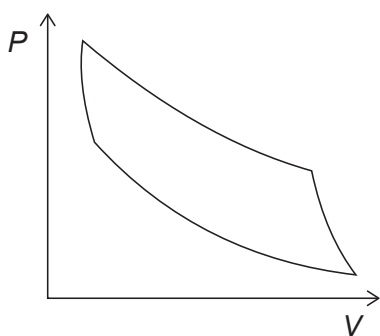
A.



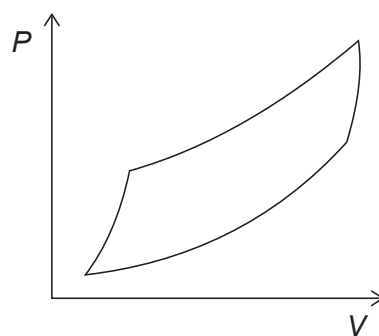
B.



C.



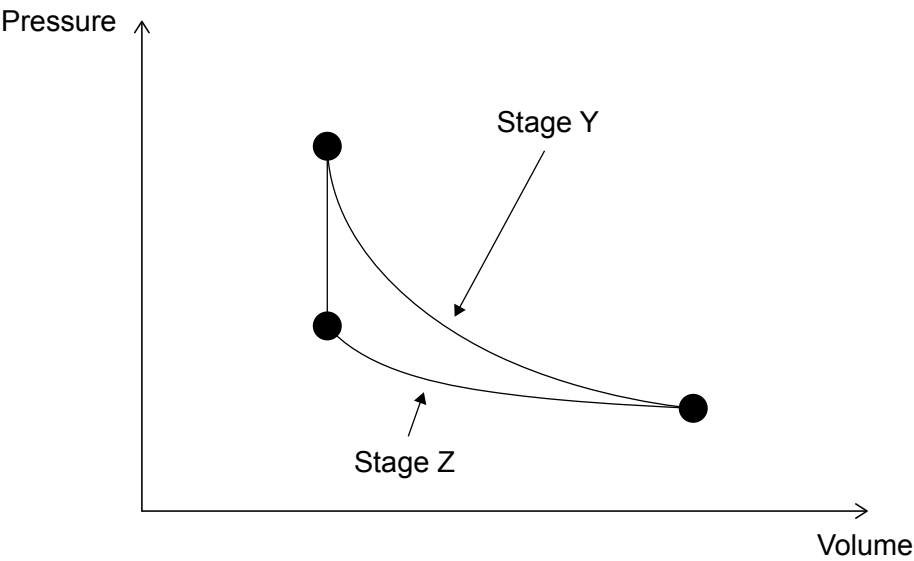
D.



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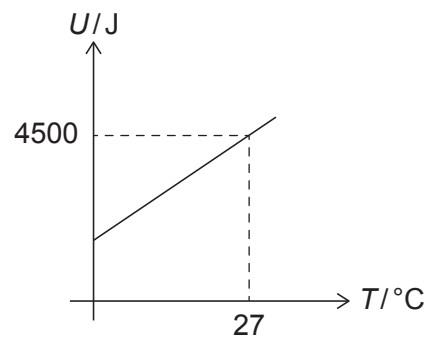
12. A cyclic process for an ideal gas is shown. The cycle has three stages: isovolumetric, adiabatic, and isothermal. Work is done on the gas during the isothermal stage.



Which stage is isothermal and what is the direction of the cyclic process?

	Stage	Direction
A.	Y	Anti-clockwise
B.	Z	Anti-clockwise
C.	Y	Clockwise
D.	Z	Clockwise

14. The graph shows the variation of the internal energy U with temperature T for a sample of an ideal monatomic gas. R is the gas constant.



How many moles of the gas are in the sample?

- A. $\frac{500}{3R}$
- B. $\frac{15}{R}$
- C. $\frac{1000}{9R}$
- D. $\frac{10}{R}$

15. 75 J of thermal energy is transferred to an ideal monatomic gas at a constant pressure of $1.0 \times 10^5 \text{ Pa}$. The volume of the gas increases from $2.7 \times 10^{-3} \text{ m}^3$ to $3.0 \times 10^{-3} \text{ m}^3$.

What is the change in the internal energy of the gas?

- A. 45 J
- B. 105 J
- C. -45 J
- D. -105 J

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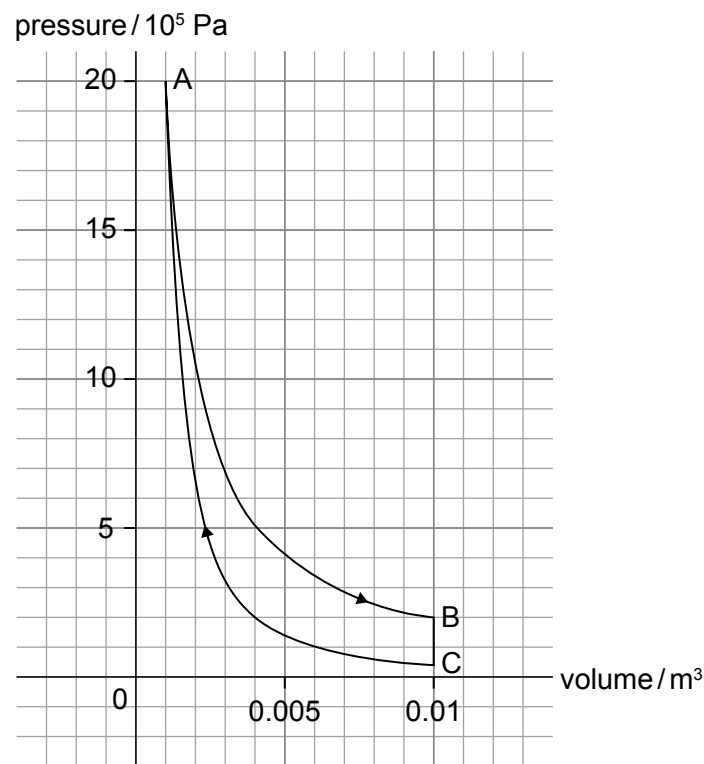
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16. A gas is compressed at constant temperature.

What are the changes in entropy of the gas and its surroundings during the compression?

	Entropy of the gas	Entropy of surroundings
A.	Increases	Increases
B.	Increases	Decreases
C.	Decreases	Increases
D.	Decreases	Decreases

3. The pressure–volume diagram shows a 3-stage cyclic process of 0.20 moles of an ideal gas in a closed container. A–B is an isothermal process. C–A is an adiabatic process.



The following data are available:

Pressure at A = $2.0 \times 10^6 \text{ Pa}$
 Volume at A = $1.0 \times 10^{-3} \text{ m}^3$
 Pressure at B = $2.0 \times 10^5 \text{ Pa}$
 Volume at B = $1.0 \times 10^{-2} \text{ m}^3$

- (a) Show that the temperature at C is about 260 K. [2]

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(Question 3 continued)

(b) Determine the work done by the gas in C–A. [2]

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(c) Outline why this cycle can be used for a heat engine. [1]

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14. Two containers are filled with monatomic gas of equal mass at the same temperature. One container holds helium and the other neon.

The mass of a neon atom is five times the mass of a helium atom.

What is $\frac{\text{internal energy of the helium gas}}{\text{internal energy of the neon gas}}$?

- A. $\frac{1}{5}$
- B. 1
- C. $\sqrt{5}$
- D. 5

15. A thermal energy of 7.0 J is removed from an ideal gas, and a work of 2.0 J is done by the gas. What is the change in the internal energy of the gas?
- A. -9.0 J
 - B. -5.0 J
 - C. $+5.0\text{ J}$
 - D. $+9.0\text{ J}$

14. A substance changes from a liquid into a solid without a change in temperature.

What is true about the internal energy of the substance and the total intermolecular potential energy of the substance when this phase change occurs?

	Internal energy of the substance	Total intermolecular potential energy of the substance
A.	decrease	decrease
B.	no change	decrease
C.	decrease	no change
D.	no change	no change

15. The entropy of a system is S , and the number of possible microstates is Ω . What is the number of possible microstates for a system of entropy $\frac{S}{2}$?

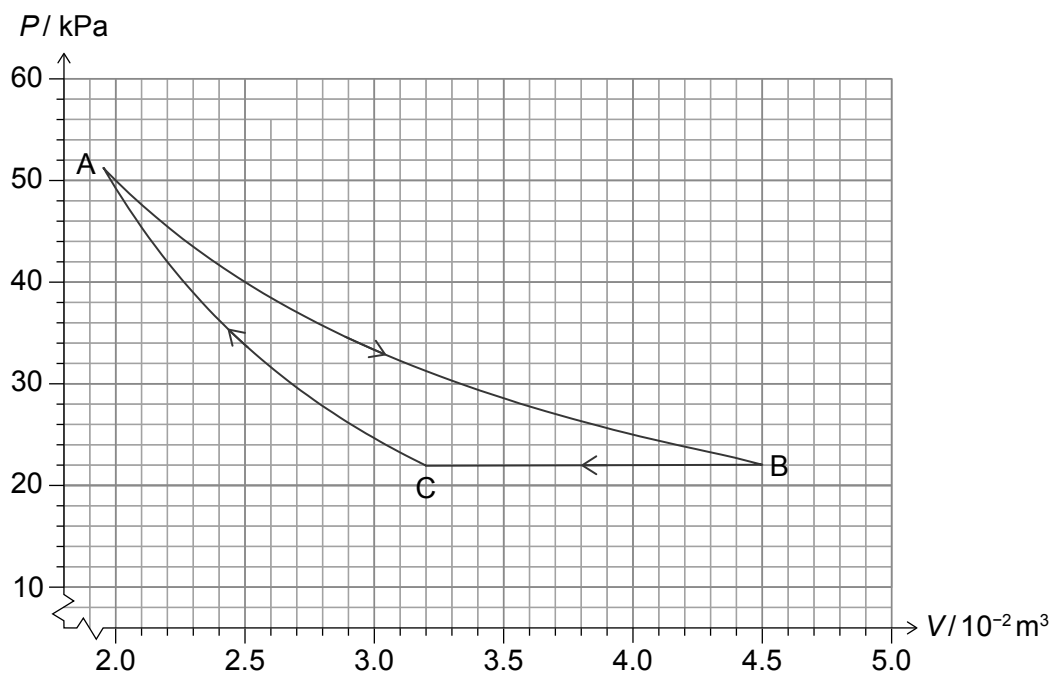
- A. $\frac{\Omega}{2}$
- B. $\frac{\sqrt{\Omega}}{2}$
- C. $\sqrt{\Omega}$
- D. Ω^2

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16. The Carnot efficiency of a heat engine is 0.4 when the cold reservoir temperature is T_c . The hot reservoir is held at a constant temperature. What is the Carnot efficiency when the cold reservoir temperature is $\frac{T_c}{2}$?
- A. 0.2
 - B. 0.3
 - C. 0.7
 - D. 0.8

5. The graph shows the cycle of a heat engine operating with an ideal monatomic gas. It consists of three stages: an isothermal $A \rightarrow B$, an isobaric $B \rightarrow C$ and an adiabatic $C \rightarrow A$. The temperature at A is 560 K.



- (a) Show that the thermal energy transferred from the gas along $B \rightarrow C$ is about 700 J. [3]

[illegible]

- (b) The work done along $A \rightarrow B$ is 840 J. Calculate the efficiency of the engine. [3]

[illegible]

10. The internal energy of a real gas is

- A. zero.
- B. equal to the intermolecular potential energy of the particles.
- C. equal to the total kinetic energy of the particles.
- D. equal to the sum of the intermolecular potential energy and the total kinetic energy of the particles.

11. A gas undergoes one cycle of a cyclic process.

The net change in internal energy of the gas is

- A. zero.
- B. positive.
- C. negative.
- D. determined by the initial temperature of the gas.

12. A working refrigerator with the door open is placed in a sealed room.

The entropy of the room

- A. is zero.
- B. decreases.
- C. remains unchanged.
- D. increases.

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