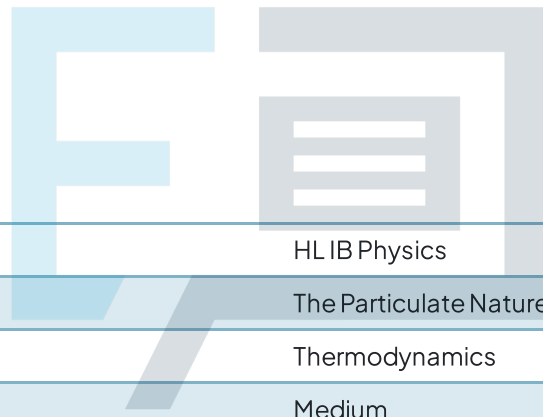




# Thermodynamics

## Question Paper



Course	HL IB Physics
Section	The Particulate Nature of Matter
Topic	Thermodynamics
Difficulty	Medium

# Exam Papers Practice

To be used by all students preparing for HL IB Physics  
Students of other boards may also find this useful

### Question 1

An ideal gas in a simple engine begins in state X. It then undergoes a cyclic process with 4 stages.

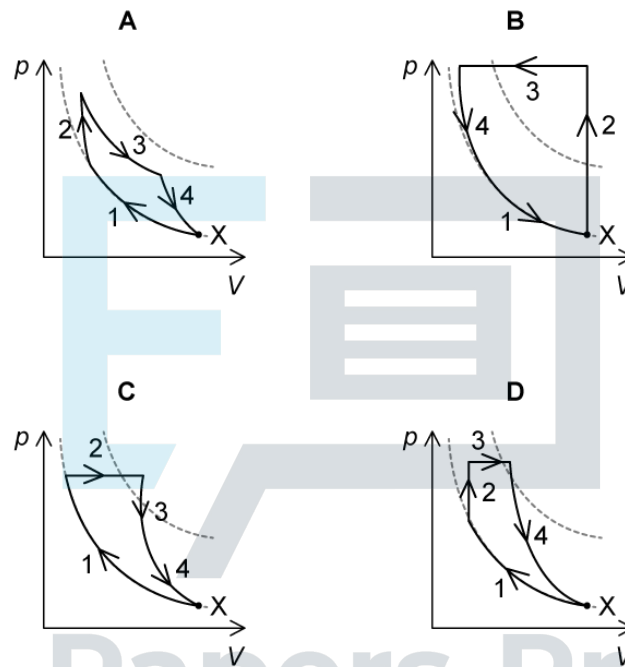
Stage 1: The gas is isothermally compressed

Stage 2: The gas gains thermal energy without doing any work

Stage 3: The gas does work isobarically

Stage 4: The gas expands adiabatically

Which diagram correctly shows this cyclic process?



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[1 mark]

### Question 2

In a box containing an unknown number of partitions, 15 particles are kept in a single section of the box behind one of the partitions.

When a small hole is opened in each of the partitions, the entropy increases by  $1.12 \times 10^{-22} \text{ J K}^{-1}$ .

What is the final number of microstates of the system?

- A. 8
- B. 3300
- C. 3400
- D. 50 000

[1 mark]

### Question 3

A simple heat engine contains 3 moles of an ideal gas. When the gas is cooled, the mean kinetic energy per particle drops by  $3.11 \times 10^{-21} \text{ J}$ .

Additionally, 2 kJ of work is done on the gas.

What is the thermal energy transferred from the gas to its surroundings?

- A. 2000 J
- B. 3620 J
- C. 5620 J
- D. 7620 J

[1 mark]

### Question 4

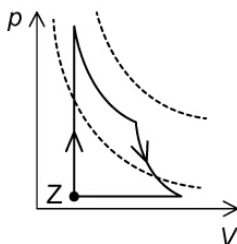
A refrigerator in its surroundings does work and freezes a small amount of liquid water. Which row of the table is correct?

	entropy of the water	temperature of the surroundings	entropy of the surroundings
<b>A</b>	increases	increases	increases
<b>B</b>	decreases	increases	increases
<b>C</b>	stays the same	decreases	decreases
<b>D</b>	decreases	increases	stays the same

[1 mark]

### Question 5

The pressure-volume diagram below shows a cyclic process. The grey dashed lines represent isotherms.



Which option best describes the stages of the cyclic process, which begins at Z?

- A. The gas expands isovolumetrically, loses pressure at constant internal energy, expands adiabatically. Work is then done on the gas in an isobaric manner.
- B. The gas undergoes isovolumetric heating. It then does work adiabatically, before cooling adiabatically again but faster. Work is done on the gas in the final stage.
- C. The gas does no work while being heated, follows an isotherm and then expands adiabatically. Work is then done by the gas in the final stage.
- D. The gas undergoes isovolumetric heating. It then does work isothermally, before cooling adiabatically. Work is done on the gas finally.

[1 mark]

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