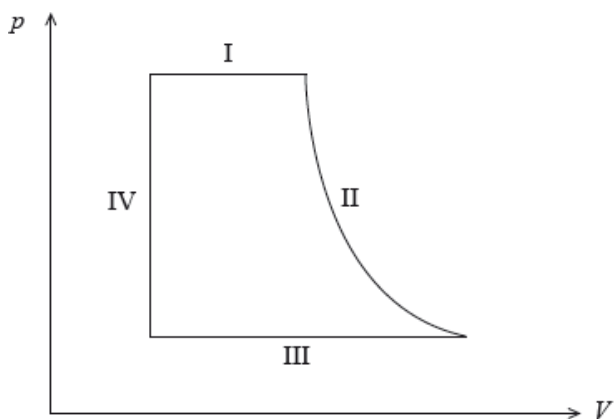


HL Paper 1

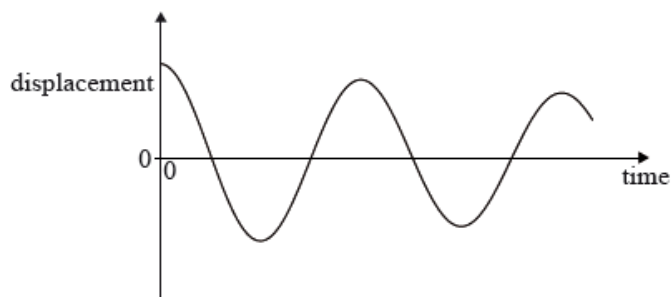
The diagram shows the pressure p and volume V relationship for one cycle of operation of an engine.



Which of the labelled parts of the cycle identify isobaric changes and adiabatic changes of state?

	Isobaric	Adiabatic
A.	IV only	I and II only
B.	I and III only	II and IV only
C.	II and III only	IV only
D.	I and III only	II only

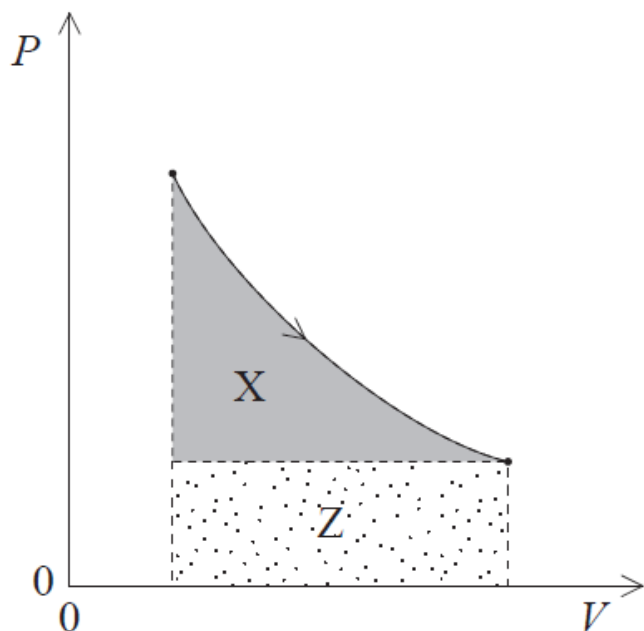
The graph below represents the variation with time of the displacement of an oscillating particle.



The motion of the object is

- A. over damped.
- B. critically damped.
- C. lightly damped.
- D. not damped.

The graph shows the variation of pressure P with volume V for a gas undergoing an adiabatic expansion.



Which of the following areas correctly identifies the work done by the gas?

- A. X
- B. X+Z
- C. X-Z
- D. Z

Microwave ovens cause the water molecules in food to resonate. Water molecules have a natural frequency of vibration f . In order to heat the food most effectively, the frequency of the microwaves should have a value

- A. less than f .
- B. equal to f .
- C. greater than f .
- D. as large as possible.

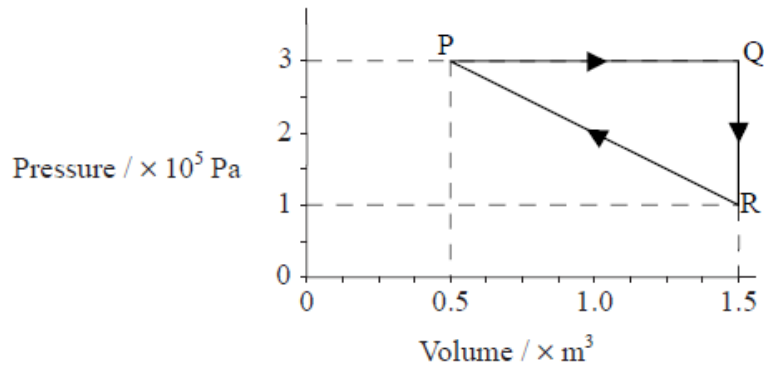
Which of the following can be deduced from the second law of thermodynamics?

- A. Thermal energy cannot spontaneously transfer from a low temperature region to a high temperature region.
- B. Thermal energy cannot spontaneously transfer from a high temperature region to a low temperature region.
- C. The entropy of an isolated system always decreases with time.
- D. The entropy of an isolated system is the measure of the internal energy of the system.

Which of the following is equivalent to the principle of energy conservation?

- A. Newton's first law
- B. The first law of thermodynamics
- C. Newton's second law
- D. The second law of thermodynamics

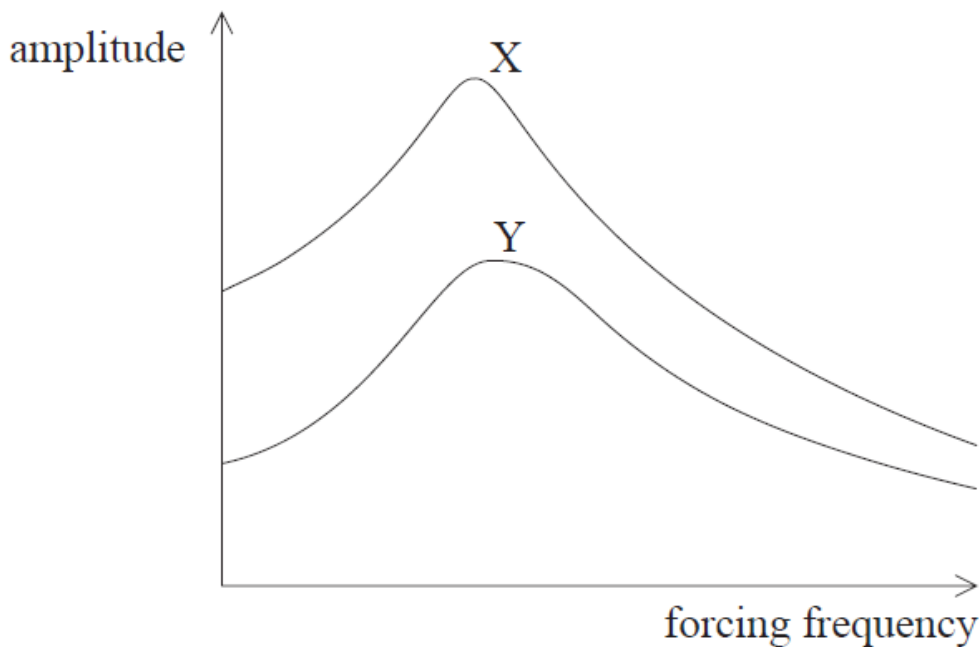
An ideal gas undergoes the thermodynamic changes represented in the $P-V$ diagram below ($P \rightarrow Q \rightarrow R \rightarrow P$).



Which of the following is the net work done by the gas in a cycle?

- A. $4.5 \times 10^5 J$
- B. $3.0 \times 10^5 J$
- C. $1.0 \times 10^5 J$
- D. Zero

Two oscillators X and Y are undergoing forced oscillations each at a frequency close to the natural frequency of each oscillator. The graph shows the variation of amplitude with forcing frequency for each oscillator.



Which of the following correctly identifies the system that has the greater amount of damping and the greater natural frequency of oscillation?

	Greater amount of damping	Greater natural frequency
A.	X	X
B.	X	Y
C.	Y	X
D.	Y	Y

A fixed mass of gas is compressed in a very short period of time. Which of the following describes this process?

- A. Adiabatic
- B. Isobaric
- C. Isochoric (isovolumetric)
- D. Isothermal

The entropy of a system is a measure of the system's

- A. total energy only.
- B. degree of disorder and total energy.
- C. degree of disorder only.
- D. degree of disorder and average kinetic energy.

A system consists of a refrigerator with its door open operating in a thermally insulated room. What are the change in the entropy of the system and the change in temperature of the room?

	Entropy change of system	Temperature change of room
A.	decreases	decreases
B.	decreases	increases
C.	increases	decreases
D.	increases	increases

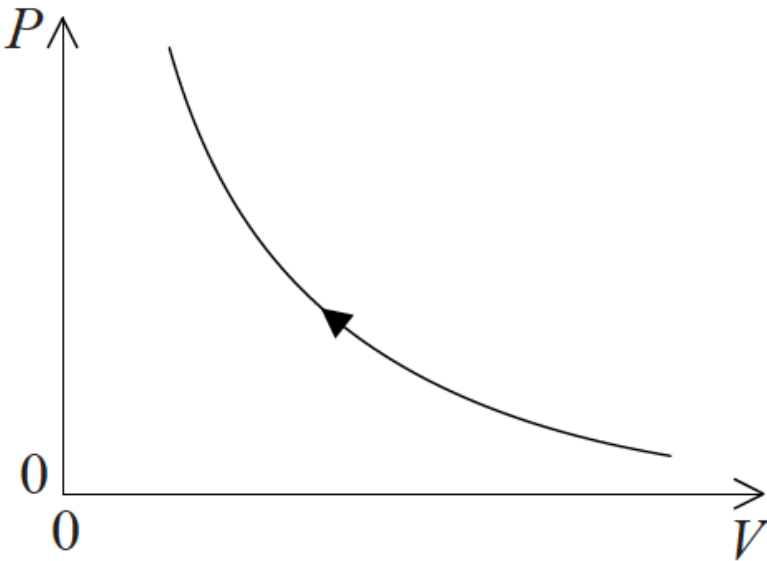
An ideal gas expands isothermally from a state X to a new state of volume V . The work done by the gas is W . Which of the following is correct for an adiabatic expansion of the gas from state X to a new state of volume V ?

	Change in internal energy	Work done
A.	$\Delta U > 0$	greater than W
B.	$\Delta U < 0$	greater than W
C.	$\Delta U > 0$	less than W
D.	$\Delta U < 0$	less than W

Which of the following correctly describes the entropy changes of the water molecules and the universe when a sample of water freezes?

	Water molecules	Universe
A.	increases	increases
B.	decreases	increases
C.	increases	decreases
D.	decreases	decreases

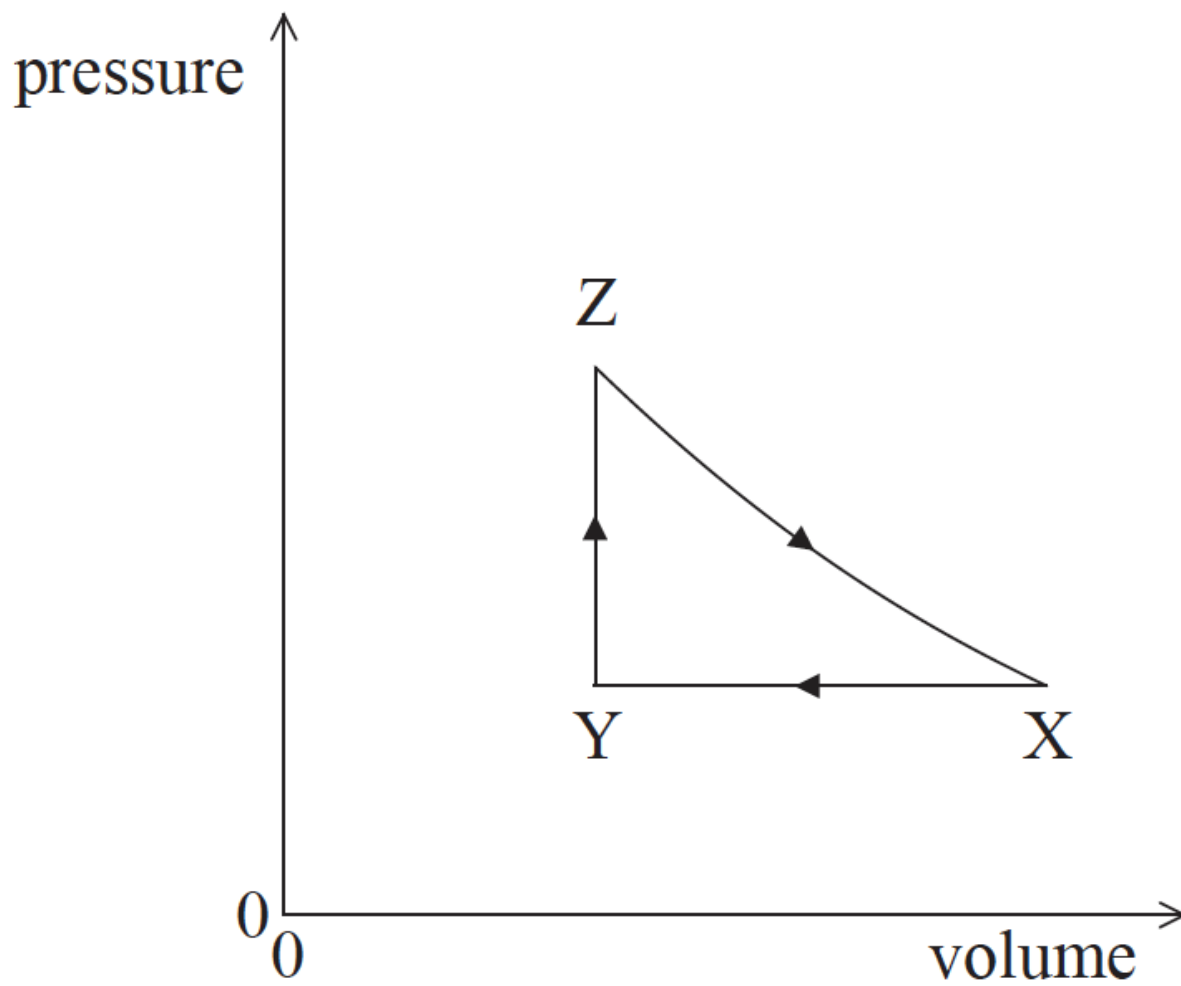
The pressure–volume (P – V) graph shows an adiabatic compression of a fixed mass of an ideal gas.



Which of the following correctly describes what happens to the temperature and the internal energy of the gas during the compression?

	Temperature	Internal energy
A.	decreases	decreases
B.	increases	no change
C.	decreases	no change
D.	increases	increases

The diagram shows the pressure volume relationship for a fixed mass of an ideal gas that undergoes a cycle XYZ.



In which part(s) of the cycle is external work done **on** the gas?

- A. Y→Z only
- B. Y→Z and Z→X only
- C. X→Y and Z→X only
- D. X→Y only

Water in a container freezes. Which of the following correctly describes the change in entropy of the water and its surroundings?

	Change in entropy of water	Change in entropy of surroundings
A.	decrease	decrease
B.	decrease	increase
C.	increase	decrease
D.	increase	increase

An isolated system consists of a block of ice floating in a glass of water. The ice melts completely at constant temperature. Which of the following identifies the change in internal energy of the system and the change in entropy of the system?

	Internal energy	Entropy
A.	no change	increase
B.	no change	decrease
C.	increase	decrease
D.	increase	increase

An ideal gas expands adiabatically. What energy change is **true** for the gas?

- A. It gains thermal energy from the surroundings
- B. It loses thermal energy to the surroundings
- C. Its internal energy increases
- D. Its internal energy decreases

An ideal gas undergoes adiabatic expansion from state X to a new state of volume V . During this process the work done by the gas is W . What is the change in internal energy and the work done in an **isothermal** expansion of this gas from X to V ?

	Change in internal energy	Work done
A.	0	greater than W
B.	0	less than W
C.	greater than 0	less than W
D.	less than 0	same as W

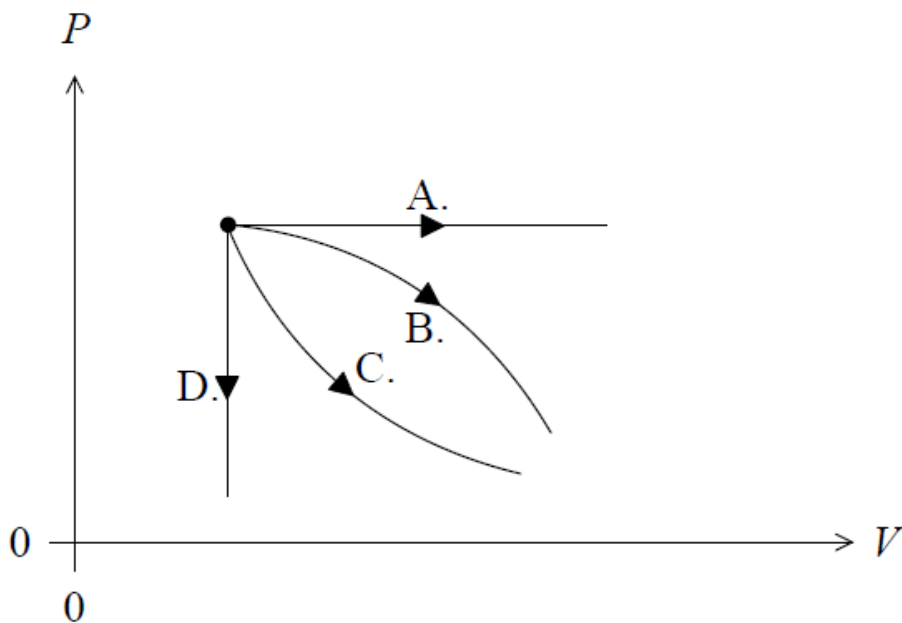
The entropy of a system

- A. will decrease if the system's temperature is increased.
- B. is related to the degree of disorder in the system.
- C. must always increase.
- D. is always conserved.

A positive amount of thermal energy Q is transferred to an ideal gas from its surroundings. The internal energy of the gas increases and the gas does a positive amount of work W on its surroundings. The change of state of the gas is

- A. isochoric (isovolumetric).
- B. isobaric.
- C. isothermal.
- D. adiabatic.

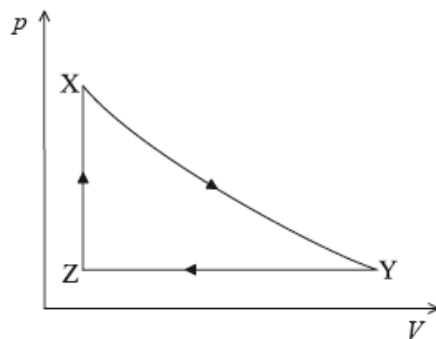
In the P - V diagram below, which line could represent an adiabatic change for an ideal gas?



A block of ice at 0°C is placed on a surface and allowed to melt completely to give water at 0°C . During this process the entropy of the

- A. molecules in the block has decreased.
- B. surroundings has increased.
- C. universe has increased.
- D. universe has decreased.

The graph below shows the variation of the pressure p with volume V of an ideal gas during one cycle of an engine.



Which of the following correctly names the thermodynamic process associated with the parts $Y \rightarrow Z$ and $Z \rightarrow X$ of the cycle?

	$Y \rightarrow Z$	$Z \rightarrow X$
A.	isobaric	isochoric
B.	isobaric	isothermal
C.	isochoric	isobaric
D.	isochoric	isothermal

Which of the following statements is consistent with the second law of thermodynamics?

- A. Thermal energy can flow by itself from a cold to a hot body.
 - B. A heat engine can be 100 % efficient.
 - C. In natural processes, total entropy tends to increase.
 - D. The entropy in every closed system is constant.
-

Which process will increase the entropy of the local surroundings?

- A. The melting of a block of ice
 - B. Evaporation of water vapour
 - C. The isothermal expansion of a gas
 - D. The adiabatic expansion of a gas
-

During an adiabatic expansion, a gas does 50J of work against the surroundings. It is then cooled at constant volume by removing 20J of energy from the gas. The magnitude of the total change in internal energy of the gas is

- A. 70 J.
 - B. 50 J.
 - C. 30 J.
 - D. 20 J.
-

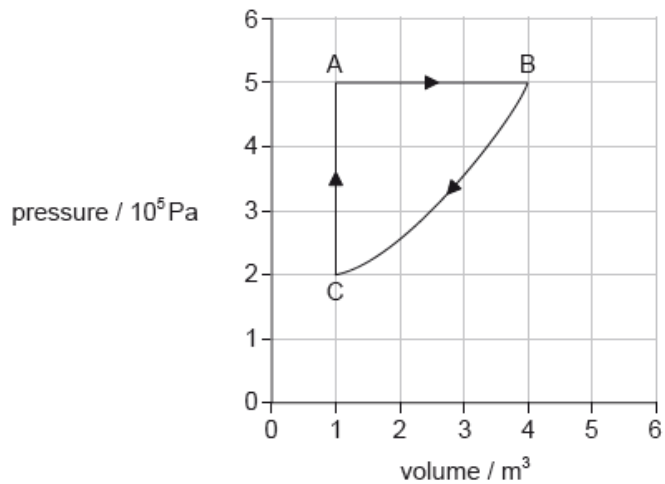
The following statement refers to question 11 and question 12.

A gas is contained in a thermally insulated cylinder by a freely moving piston. The volume of the gas is increased reversibly by moving the piston.

Which term identifies the change of state of the gas?

- A. Isobaric
 - B. Isochoric
 - C. Isothermal
 - D. Adiabatic
-

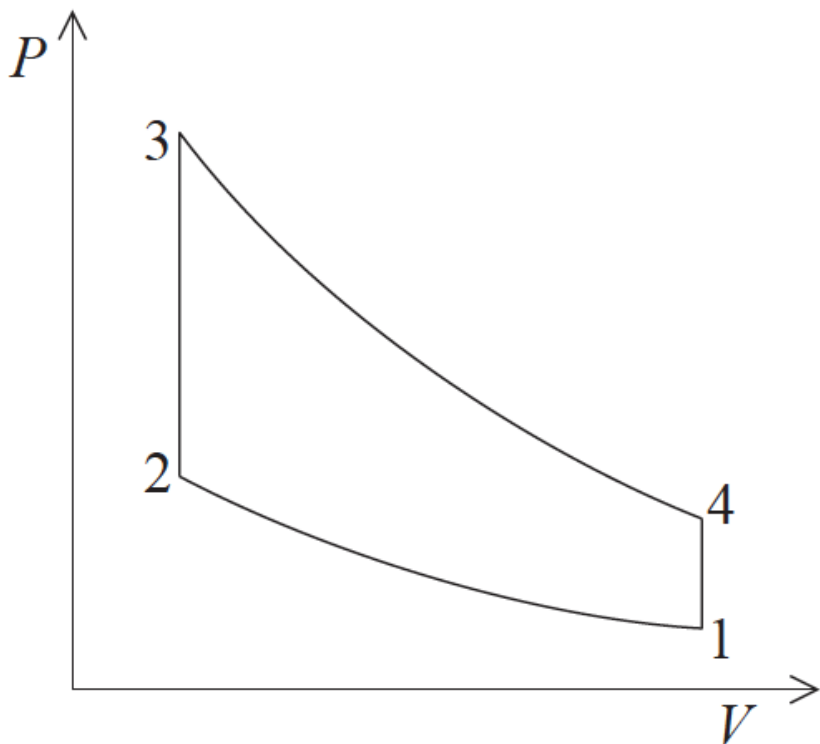
The graph shows how the volume of a system varies with pressure during a cycle ABCA.



What is the work done in joules during the change AB?

- A. 15×10^5
- B. 9.0×10^5
- C. 4.5×10^5
- D. 0

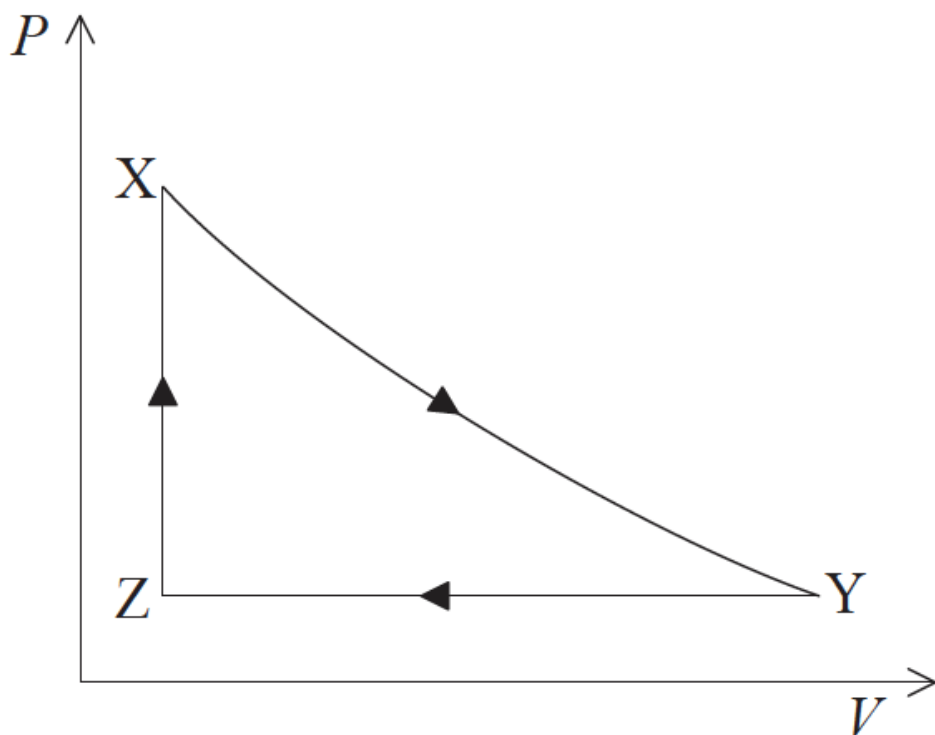
The diagram shows a P - V cycle for a particular gas.



In which of the following changes is **no** work being done?

- A. $1 \rightarrow 2$
- B. $1 \rightarrow 2 \rightarrow 3$
- C. $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$
- D. $2 \rightarrow 3$

The graph shows the variation of pressure P with volume V of an ideal gas during a thermodynamic cycle.



During which stages is work done on the gas and work done by the gas?

	Work done on gas	Work done by gas
A.	$X \rightarrow Y$ only	$Y \rightarrow Z$ only
B.	$X \rightarrow Y$ and $Z \rightarrow X$	$Y \rightarrow Z$ only
C.	$Y \rightarrow Z$ only	$Z \rightarrow X$ and $X \rightarrow Y$
D.	$Y \rightarrow Z$ only	$X \rightarrow Y$ only

Which of the following gives the conditions for maximum amplitude in forced, but damped, oscillations?

	Driving frequency	Damping
A.	greater than natural frequency	as large as possible
B.	equal to natural frequency	as large as possible
C.	greater than natural frequency	as small as possible
D.	equal to natural frequency	as small as possible

The following statement refers to question 11 and question 12.

A gas is contained in a thermally insulated cylinder by a freely moving piston. The volume of the gas is increased reversibly by moving the piston.

Which of the following gives the correct entropy change of the gas and the surroundings?

	Entropy change of the gas	Entropy change of the surroundings
A.	decrease	decrease
B.	no change	decrease
C.	decrease	no change
D.	no change	no change

A piece of ice melts at constant temperature. Which of the following gives the correct change in the entropy of the water molecules and that of the surroundings?

	entropy of water molecules	entropy of surroundings
A.	increases	decreases
B.	decreases	decreases
C.	increases	increases
D.	decreases	increases