



# PHYSICS

## BOOKS - JBD PUBLICATION

### Thermodynamics

#### Exercise

1. In a cyclic process, the internal energy of gas:

A. Increase

B. Decreases

C. Remain constant

D. Becomes zero

**Answer:**



**Watch Video Solution**

2. In which of the following thermodynamics process no heat flow between the system and surroundings?

A. Adiabatic

B. Isothermal

C. Isobaric

D. Isochoric

**Answer:**



**Watch Video Solution**

**3.** If  $n$  be the degrees of freedom of a gas molecule, then the value of  $\gamma( = c_p / C_v )$  is :

A.  $1 + \frac{2}{n}$

B.  $1 - \frac{2}{n}$

C.  $1 + \frac{1}{2n}$

D.  $1 - \frac{1}{2n}$

**Answer:**



**Watch Video Solution**

**4.** An ideal gas undergoes isobaric expansion at pressure  $P$  from volume  $V_1$  to  $V_2$  the work done is :

A.  $P(V_2 - V_1)$

B.  $Rt(V_2 / V_1)$

C.  $P_1 V_1 (V_1 / V_2)$

D.  $R(T_1 - T_2) / (g - 1)$ .

**Answer:**



**Watch Video Solution**

5. If one mole of a mono-atomic gas ( $\gamma = 5/3$ ) is mixed with one mole of a

diatomic gas ( $\gamma = 7/5$ ), the value of  $\gamma$  for the mixture is :

A.  $\frac{1}{40}$

B. 1.50

C. 1.53

D. 1.43.

**Answer:**



**Watch Video Solution**

6. The equation  $PV^\gamma = \text{constant}$  is applicable for :

A. isothermal change

B. isobaric change

C. isochoric change

D. adiabatic change.

**Answer:**



**Watch Video Solution**

7. If  $\gamma$  denotes the ratio of specific heats ( $C_p/C_v$ ) of a gas, then the ratio of slopes of adiabatic to isothermal on P-V curve at their point of intersection is :

A.  $(\gamma + 1)$

B.  $(\gamma - 1)$

C.  $\gamma$

D.  $1/\gamma$ .

**Answer:**



**Watch Video Solution**



8. How will you justify that first law of thermodynamics is the law of conservation of energy?

A. momentum

B. energy

C. angular momentum

D. mass

**Answer:**



**Watch Video Solution**

9. A slab consists of two parallel layers of different materials of same thickness and thermal conductivities  $K_1$  and  $K_2$ . The equivalent thermal conductivity of the slab is :

A.  $K_1 + K_2$

B.  $K_1 K_2$

C.  $\left( \frac{K_1 + K_2}{2} \right)$

D.  $\frac{2K_1 K_2}{(K_1 + K_2)}$ .

**Answer:**



**Watch Video Solution**

**10.** The internal energy of a gas will increase when it:

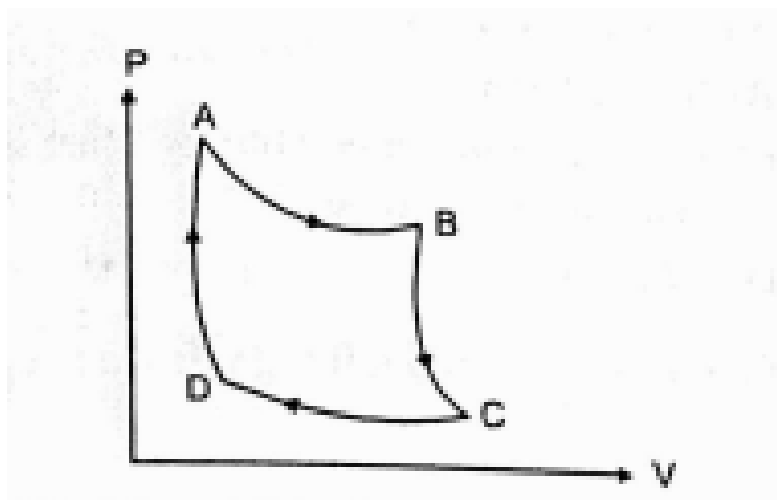
- A. expands adiabatically
- B. is compressed adiabatically
- C. expands isothermally
- D. is compressed isothermally

**Answer:**



**Watch Video Solution**

**11.** The P-V graph of Carnot cycle is shown in figure. The adiabatic processes are described by curves:



A. AB and BC

B. AB and CD

C. BC and CD

D. BC and DA

**Answer:**



**Watch Video Solution**

**12.** A carnot engine works between constant temps.  $T_1$  and  $T_2$  of source and sink resp. For efficiency to be greatest

A.  $T_1$  and  $T_2$  should be high

B.  $T_1$  and  $T_2$  should be high

C.  $T_1$  should be low and  $T_2$  should be low

D.

**Answer:**



**Watch Video Solution**

**13.** A Carnot heat engine working between  $27^\circ$  C and  $127^\circ$  C takes up 800 J of heat from the

reservoir in one cycle. The work done by engine

is :

A. 200 J

B. 400 J

C. 600 J

D. none of these.

**Answer:**



**Watch Video Solution**

14. At room temperature ( $27^{\circ}C$ ), the rms speed of a diatomic gas molecules is found to be  $1930\text{ms}^{-1}$ . The gas is :

A.  $H_2$

B.  $N_2$

C.  $O_2$

D.  $Cl_2$ .

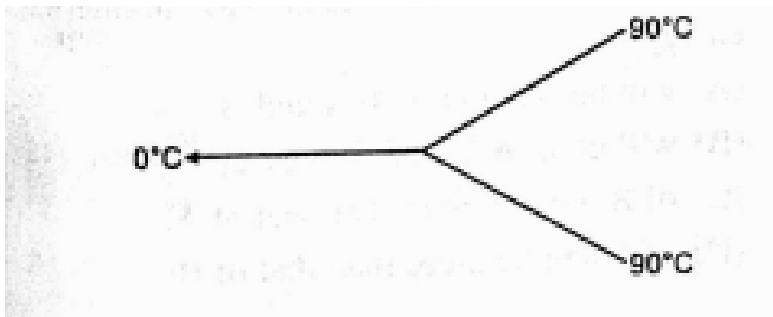
**Answer:**



**Watch Video Solution**



15. Three rods of same material and having the same cross-section are joined as shown in the figure. The temperature of junction of three rods is :



A.  $45^{\circ}\text{C}$

B.  $60^{\circ}\text{C}$

C.  $30^{\circ}\text{C}$

D.  $20^{\circ} C$ .

**Answer:**



**Watch Video Solution**

**16.** How many calories of heat are required to completely evaporate 1 g of ice at  $0^{\circ} C$ ?

A. 620

B. 720

C. 820

D. 920

**Answer:**



**Watch Video Solution**

**17.** Newton's law of cooling is a special case of :

- A. Kirchoff's law
- B. Botzmann's law
- C. Einstein's law
- D. Stefan's law

**Answer:**



**Watch Video Solution**

**18.** If  $\lambda_m$  is the wavelength corresponding to maximum radiation for a body at temperature  $T$ , then which of the following relations is true?

A.  $\lambda_m T = \text{constant}$

B.  $\lambda_m / T = \text{constant}$

C.  $\lambda_m T^4 = \text{constant}$

D.  $\lambda_m T^3 = \text{constant}$ .

**Answer:**



**Watch Video Solution**

**19.** A sphere, a cube and a thin circular plate, all of same material and same mass are initially heated to same high temperature.

- A. Sphere
- B. Cube
- C. Thin circular plate
- D. none of these.

**Answer:**



**Watch Video Solution**

**20.** If temperature of hot body is increased by 50% the amount of heat radiation emitted by the body would become nearly:

A. 0.5

B. 2.25

C. 400%

D. 500%.

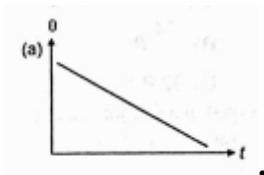
**Answer:**



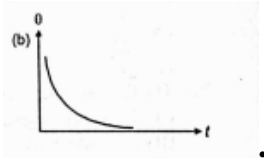
**Watch Video Solution**

21. A block of copper is heated in a furnace and left in a room to cool. Which of the following curves represents the correct behaviour?

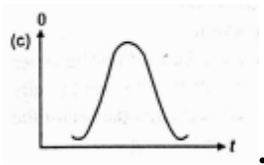
A.



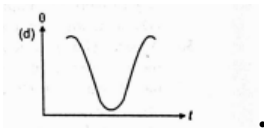
B.



C.



D.



**Answer:**



**Watch Video Solution**



22. The absorption power of a perfectly perfectly black body is :

A. 1

B. 0

C.  $\infty$

D. 100

**Answer:**



**Watch Video Solution**

23. The heat required to raise the temperature of a body by 1C degree is called

- A. specific heat
- B. water equivalent
- C. thermal capacity
- D. entropy

**Answer:**



**Watch Video Solution**

24. The first law of thermodynamics which accounts for the conservation of energy ,is valid:

- A. only for reversible processes
- B. only for irreversible processes
- C. in either of the above two processes
- D. in one of the above processes.

**Answer:**



**Watch Video Solution**

**25. Fill in the Blank:**

At absolute zero, the molecular motion of a gas \_\_\_\_\_.

- A. molecular motion eases
- B. gas becomes liquid
- C. gas cannot be liquefied
- D. random motion of molecules occur.

**Answer:**



**Watch Video Solution**

**26.** Two identical samples of a gas are allowed to expand

isothermally, adiabatically. Work done is:

A. more in the isothermal process

B. more in the adiabatic process

C. neither of them

D. equal in both processes.

**Answer:**



**Watch Video Solution**

27. Two samples A and B, of a gas at the same initial temperature and pressure are compressed from volume  $V$  to  $V/2$ , A isothermally and B adiabatically. The final pressure of A will be:

- A. greater than that of B
- B. equal to that of B
- C. less than that of B
- D. twice that of B.

**Answer:**



Watch Video Solution

28. For a gas  $\gamma = 5/3$  and 800 cc of this gas are suddenly compressed to 100 cc. If the initial pressure is  $P$ , then the final pressure will be :

A.  $\frac{p}{32}$

B.  $\frac{24}{5}P$

C.  $8p$

D.  $32 P$ .

**Answer:**



Watch Video Solution

**29.** The first operation involved in a Carnot cycle is :

- A. isothermal expansion
- B. adiabatic expansion
- C. isothermal compression
- D. adiabatic compression.

**Answer:**





30. A piece of iron is heated in a flame. It first becomes dull red, then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible using:

- A. Kirchhoff's law
- B. Newton's law of cooling
- C. Stefan's law
- D. Wien's displacement law.

**Answer:**



**Watch Video Solution**

**31.** An ideal gas is compressed to half its initial volume by means of several processes. Which of the process results in the maximum work done on a gas?



**Watch Video Solution**

32. Heat capacity of a substance is infinite. It means

A. heat is given out

B. heat is taken in

C. no change in temperature whether heat is taken in or given out

D. all of these.

**Answer:**



**Watch Video Solution**

33. If for a gas,  $\frac{R}{C_v} = 0.67$ , this gas is made-up of

:

A. diatomic molecules

B. mixture of diatomic and polyatomic molecules

C. monatomic molecules

D. polyatomic molecules.

**Answer:**



**Watch Video Solution**

**34.** Which of the following statements is correct for a thermodynamic system?

A. The internal energy changes in all processes.

B. The work done in an adiabatic process is always zero.

C. The change in entropy can never be zero.

D. Internal energy and entropy are state functions.

**Answer:**



**Watch Video Solution**

**35.** Entropy of a thermodynamic system does not change when this system is used for:

A. conduction of heat from a hot reservoir to a cold reservoir.

B. conversion of heat into work isobarically.

C. conversion of heat into internal energy

isochorically.

D. conversion of work into heat

isothermally.

**Answer:**



**Watch Video Solution**

**36.** An ideal gas A and a real gas B have their volumes increased from  $V$  to  $2V$  under

isothermal conditions. The increase in internal energy:

A. will be same in both A and B.

B. will be zero in both the gases.

C. of B will be more than that of A.

D. of A will be more than that of B.

**Answer:**



**Watch Video Solution**



### 37. Fill in the Blanks

During isothermal process ..... remains constant.



[Watch Video Solution](#)

### 38. Fill in the Blanks

During adiabatic process ..... does not remain constant.



[Watch Video Solution](#)

### 39. Fill in the Blanks

Internal energy of gas molecules rises due to rise in..... .



[Watch Video Solution](#)

### 40. Fill in the Blanks

First law of thermodynamics does not tell the ..... in which the process takes place.



[Watch Video Solution](#)

## 41. Fill in the Blanks

Working of heat engine is based upon .....  
law of thermodynamics.



[Watch Video Solution](#)

## Example

1. Which state of matter has the greatest and least internal energy having the same mass and same temperature?



[Watch Video Solution](#)

2. Two systems are said to be in thermal equilibrium with each other, if they are at the same\_\_\_\_\_.



[Watch Video Solution](#)

3. Is it true to say that a body at higher temperature contains more heat?



[Watch Video Solution](#)

4. On what factors does the internal energy of an ideal gas depend?



[Watch Video Solution](#)

5. What do you mean by thermodynamical state?



[Watch Video Solution](#)

6. What is the importance of an absolute scale of temperature?



[Watch Video Solution](#)

7. Define thermodynamical variables, equation of state



[Watch Video Solution](#)

8. Is it possible to devise a heat engine which will create no thermal pollution?



[Watch Video Solution](#)

9. What is change in internal energy in isothermal process?



**Watch Video Solution**

10. Does the internal energy of an ideal gas change in an adiabatic process?



**Watch Video Solution**

**11.** What is the significance of the indicator diagram or PV-diagram?



**Watch Video Solution**

**12.** Is boiling of water at normal pressure an isothermal process or adiabatic process?



**Watch Video Solution**



**13.** What is nature of PV-diagram for a cyclic process?



**Watch Video Solution**

**14.** If  $\gamma$  denotes the ratio of specific heats ( $C_p / C_v$ ) of a gas, then the ratio of slopes of adiabatic to isothermal on P-V curve at their point of intersection is :



**Watch Video Solution**

**15.** What are values of isothermal and adiabatic elasticities of a gas?



**Watch Video Solution**

**16.** Which type of motion of molecules of monoatomic gas is responsible for its internal energy?



**Watch Video Solution**

**17.** A volume of gas at atmospheric pressure is compressed adiabatically to half its original volume. Calculate the resulting pressure ( $\gamma = 1.4$ )



**Watch Video Solution**

**18.** What is work done by a gas in isochoric process?



**Watch Video Solution**

**19.** On what factors does the internal energy of an ideal gas depend?



**Watch Video Solution**

**20.** On what factors does the efficiency of Carnot's heat engine depend?



**Watch Video Solution**

**21.** Why efficiency of ideal heat engine cannot be 100%?



**Watch Video Solution**

**22.** Give an example of heat pump.



**Watch Video Solution**

**23.** Refrigerator transfers heat from a cold body(from inside) to hot body(outside

atmosphere). Does it violate second law of thermodynamics?



[Watch Video Solution](#)

**24.** From the indicator diagram find an expression for work done in a cyclic process.



[Watch Video Solution](#)

**25.** What is relation between the efficiency of heat engine ( $\eta$ ) and coefficient of

performance ( $\alpha$ ) of refrigerator?



**Watch Video Solution**

**26.** Define critical temperature.



**Watch Video Solution**

**27.** What is critical temperature and critical pressure of water?



**Watch Video Solution**

**28.** What is a phase diagram?



**Watch Video Solution**

**29.** What is the value of triple point of water?



**Watch Video Solution**

**30.** Can we distinguish between the internal energy of a body acquired by heat transfer or work done by external agent?





[Watch Video Solution](#)

**31.** State second law of thermodynamics ?



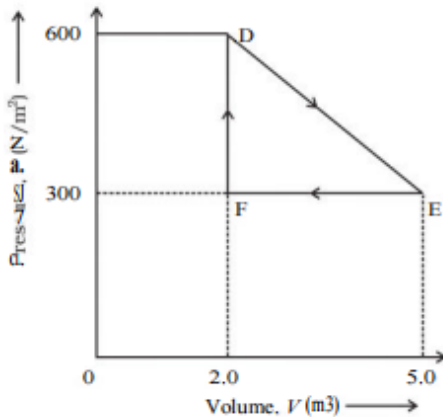
[Watch Video Solution](#)

**32.** Explain adiabatic process on the basis of first law of thermodynamics.



[Watch Video Solution](#)

**33.** A thermodynamic system is taken from an original state to an intermediate state by the linear process shown in Fig. (12.13) Its volume is then reduced to the original value from E to F by an isobaric process. Calculate the total work done by the gas from D to E to F :



**Watch Video Solution**

**34.** A refrigerator is to maintain eatables kept inside at  $9^{\circ}C$ . If room temperature is  $36^{\circ}C$ , calculate the coefficient of performance.



**Watch Video Solution**

**35.** Two cylinders A and B of equal capacity are connected to each other via a stopcock. A contains a gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stopcock is

suddenly opened. Answer the following : What is the final pressure of the gas in A and B ?



[Watch Video Solution](#)

**36.** Two cylinders A and B of equal capacity are connected to each other via a stopcock. A contains a gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stopcock is suddenly opened. Answer the following : What is the change in internal energy of the gas ?



[Watch Video Solution](#)

**37.** Two cylinders A and B of equal capacity are connected to each other via a stopcock. A contains a gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stopcock is suddenly opened. Answer the following : What is the change in the temperature of the gas ?



[Watch Video Solution](#)

**38.** Two cylinders A and B of equal capacity are connected to each other via a stopcock. A contains a gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stopcock is suddenly opened. Answer the following : Do the intermediate states of the system (before settling to the final equilibrium state) lie on its P-V-T surface ?



**Watch Video Solution**

**39.** A geyser heats water flowing at the rate of 3.0 litres per minute from  $27^{\circ}C$  to  $77^{\circ}C$ . If the geyser operates on a gas burner, what is the rate of consumption of the fuel if its heat of combustion is  $4.0 \times 10^4 J/g$ ?



**Watch Video Solution**

**40.** What amount of heat must be supplied to  $2.0 \times 10^{-2} kg$  of nitrogen (at room temperature) to raise its temperature by

$45^\circ C$  at constant pressure ? (Molecular mass of  $N_2 = 28$ ,  $R = 8.3 J mol^{-1} K^{-1}$ .)



[Watch Video Solution](#)

**41.** Explain why Two bodies at different temperatures  $T_1$  and  $T_2$  if brought in thermal contact do not necessarily settle to the mean temperature  $(T_1 + T_2) / 2$ .



[Watch Video Solution](#)



**42.** Explain why The coolant in a chemical or a nuclear plant (i.e., the liquid used to prevent the different parts of a plant from getting too hot) should have high specific heat.



**Watch Video Solution**

**43.** Explain why Air pressure in a car tyre increases during driving.



**Watch Video Solution**

**44.** Explain why The climate of a harbour town is more temperate than that of a town in a desert at the same latitude.



**Watch Video Solution**

**45.** Carnot engine takes in a 3 thousand kilocalories of heat from a reservoir at  $627^{\circ}C$  and exhausts it to a sink at  $27^{\circ}C$  How much work does it perform?



**Watch Video Solution**

**46.** Carnot engine takes in a thousand kilocalories of heat from a reservoir at  $627^{\circ}C$  and exhausts it to a sink at  $27^{\circ}C$ . What is its efficiency? How much work does it perform?

Express it in

kilowatt-hour



**Watch Video Solution**

**47.** Carnot engine takes in a thousand kilocalories of heat from a reservoir at  $627^{\circ}C$

and exhausts it to a sink at  $27^{\circ}C$ . What is its efficiency? How much work does it perform?

Express it in

electron-volt.



[Watch Video Solution](#)

**48.** A Carnot engine having sink at  $27^{\circ}C$  has an efficiency of 40%. It is desired to increase the efficiency of 10%. By how many degrees the temperature of the source has to be increased?



[Watch Video Solution](#)

**49.** Find the work required to compress adiabatically 1 g of air initially at N.T.P. to half its volume. Density of air at N.T.P. =  $0.00129 \text{ g/}$  and  $\gamma = 1.4$ .



[Watch Video Solution](#)

**50.** A tyre is pumped to a pressure of 3.375 atmospheres and at  $27^\circ \text{C}$  suddenly

bursts. What is the final temperature?

( $\gamma = 1.5$ ).



**Watch Video Solution**

**51.** Assuming a domestic refrigerator a reversible engine working between melting point of ice and the room temperature of  $17^\circ C$ . Calculate the energy in joule that must be supplied to freeze 2kg of water. Given that temperature of water =  $0^\circ C$  and  $L = 80 cal/g$ .



[Watch Video Solution](#)

**52.** Give two statements of second law of thermodynamics.



[Watch Video Solution](#)

**53.** Write short note on cyclic process.



[Watch Video Solution](#)

54. 5 moles of oxygen are heated at constant volume from  $10^{\circ}C$  to  $20^{\circ}C$ . What will be the change in the internal energy of the gas? The molar specific heat of oxygen at constant pressure is  $C_p = 7.03 \text{ cal mol}^{-1} \text{ deg}^{-1}$  and  $R = 8.36 \text{ J mol}^{-1} \text{ }^{\circ}C^{-1}$ .



**Watch Video Solution**

55. The molar heat capacity of a gas at constant volume is to be  $5 \text{ cal mol}^{-1} \text{ K}^{-1}$ . Find



the ratio  $\gamma = C_p / C_v$  for the gas. The gas constant  $R = 2 \text{ cal mol}^{-1} \text{ K}^{-1}$ .



[Watch Video Solution](#)

**56.** 0.32 g of oxygen is kept in a rigid container and is heated. Find the heat energy needed to raise the temperature from  $25^\circ \text{C}$  to  $35^\circ \text{C}$ . The molar heat capacity of oxygen at constant volume is  $20 \text{ J mol}^{-1} \text{ K}^{-1}$ .



[Watch Video Solution](#)

57. What do you understand by isobaric and isochoric process?



[Watch Video Solution](#)

58. What is the relation between  $C_P$  and  $C_v$ ?



[Watch Video Solution](#)

59. How can you explain that  $C_p$  is greater than  $C_v$  ?





[Watch Video Solution](#)

60. Write detail of specific heats of gases.



[Watch Video Solution](#)

61. A gas expands in such a manner that its pressure and volume comply with the condition  $pV^2 = a$  constant. Will the gas cool or get heated on expansion?



[Watch Video Solution](#)

**62.** A gas occupying one litre at 80 cm pressure is expanded adiabatically to 1190 cc. If the pressure falls to 60 cm in the process, deduce the value of  $\gamma$ .



[Watch Video Solution](#)

**63.** If at  $50^\circ C$  and 75 cm of mercury pressure, a definite mass of a gas is compressed slowly, then what will be the final pressure and

temperature of the gas if the final volume is one-fourth of the initial volume?



[Watch Video Solution](#)

**64.** Write short note on thermal equilibrium.



[Watch Video Solution](#)

**65.** Consider a PV-diagram in which the path followed by one mole of perfect gas a cylindrical container is shown in (fig.).

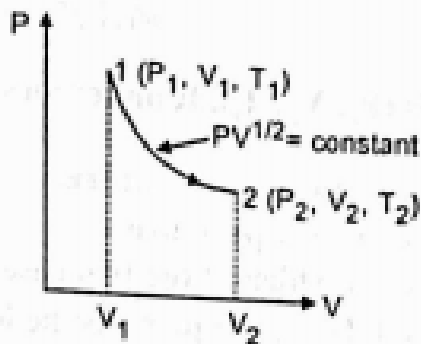


Fig.

Find the work done when the gas is taken from state 1 to state 2.



[Watch Video Solution](#)

**66.** Consider a PV-diagram in which the path followed by one mole of perfect gas a cylindrical container is shown in (fig.).

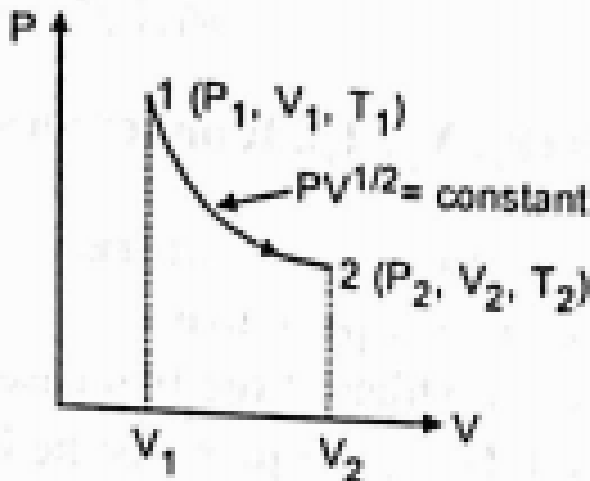


Fig.

What is

the ratio of temperature  $T_1 / T_2$ , if  $V_2 = 2V_1$ ?



[Watch Video Solution](#)

**67.** Consider a PV-diagram in which the path followed by one mole of perfect gas a cylindrical container is shown in (fig.).

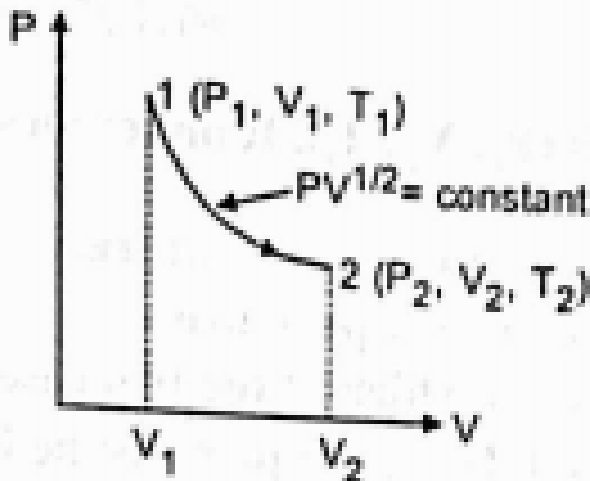


Fig.

Given to

internal energy for one mole of gas at temperature  $T$  is  $(3/2) RT$ , find the heat supplied to the gas when it is taken from state 1 to 2, with  $V_2 = 2V_1$ .



[Watch Video Solution](#)



**68.** The initial state of a certain gas is  $(P_i, V_i, T_i)$ . It undergoes expansion till its volume becomes  $V_f$ . Consider the following case.

the expansion takes place at constant temperature. Plot the P-V diagram.



**Watch Video Solution**

**69.** The initial state of a certain gas is  $(P_i, V_i, T_i)$ . It undergoes expansion till its

volume becomes  $V_f$  Consider the following case.

The expansion takes place at constant pressure. Plot the P-V diagram.



**Watch Video Solution**