PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

THERMODYNAMICS LAWS & SPECIFIC HEATS OF GASES

Illustrative Example

1. One mole of an ideal gas is heated from 0°C to 100°C at a constant pressure of 1 atmosphere. Calculate the work done in the process.

Watch Video Solution

2. In thermodynamic system internal energy decreases by 400 J while it is doing 250J of work.What net heat is taken in by the system in the process.

Watch Video Solution

3. An ideal gas in a cylindrical vessel is confined by a piston at a constant pressure of 10^5 Pa. When 2×10^4 J of heat is added to it,the volume of gas expands from $0.15m^3$ to $0.25m^3$.

What is the work done by the system in this process .

Watch Video Solution

4. An ideal gas in a cylindrical vessel is confined by a piston at a constant pressure of 10^5 Pa. When 2×10^4 J of heat is added to it,the volume of gas expands from $0.15m^3$ to $0.25m^3$.

What is the change in internal energy of the system.

Watch Video Solution

5. A vertical hollow cylinder contains an ideal gas. The gas is enclosed by a $5kg$ movable piston with an area of cross-section $5 \times 10^{-3} m^2$. Now, the gas is heated slowly from $300K$ to $350K$ and the piston rises by $0.1m$. The piston is now clamped at this position and the gas is cooled back to $300K$. Find the difference between the heat energy added during heating process and energy lost during the cooling process. $\left(1\text{atm pressure} = 10^5 Nm^{-2}\right]$

Watch Video Solution

6. Gaseous hydrogen initially at STP in a container of volume $5 \times 10^{-5} m^3$ is cooled by 55 K.Find the change in internal energy and amount of heat lost by the gas.

Watch Video Solution

7. When a thermodynamic system is taken firom an initial state I to a final state F along the path IAF, as shown in figure-3.8, the heat energy absorbed by the system is Q = 55 J and the work done by the system is 25 J. If the same system is taken along the path IBF, the value of Q= 35 J.

Find the work done along the path IBF.

View Text Solution

8. When a thermodynamic system is taken from an initial state I to a final state F along the path IAF, as shown in figure-3.8, the heat energy absorbed by the system is Q = 55 J and the work done by the system is 25 J. If the same system is taken along the path IBF, the value of Q= 35 J.

If W=- 15J for the curved path FI, how much heat energy is lost by the system along this path ?

View Text Solution

9. When a thermodynamic system is taken firom an initial state I to a final state F along the path IAF, as shown in figure-3.8, the heat energy absorbed by the system is Q = 55 J and the work done by the system is 25 J. If the same system is taken along the path IBF, the value of Q= 35 J.

If U_I=10 J, what is U_F ?

10. When a thermodynamic system is taken firom an initial state I to a final state F along the path IAF, as shown in figure-3.8, the heat energy absorbed by the system is Q = 55 J and the work done by the system is 25 J. If the same system is taken along the path IBF, the value of Q= 35 J.

If U_B=20 J, what is Q for the processes BF and IB ?

11. Figure shows an ideal gas changing its state from state A to state C by two different paths ABC and AC.

Find the path along which the work done is the least.

View Text Solution

12. Figure shows an ideal gas changing its state from state A to state C by two different paths ABC and AC.

The internal energy of the gas at A is 10 J and the amount of heat supplied to change its state to C throught he path AC is 200 J. Find the internal energy at C.

View Text Solution

13. Figure shows an ideal gas changing its state from state A to state C by two different paths ABC and AC.

The internal energy of the gas at state B is 20J.Find the amount of heat supplied to the gas to go from state A to state B.

View Text Solution

14. A gas is taken from state -1 to state-2 along the path shown in figure. If 70 cal of heat is extracted from the gas in the process, calculate the change in internal energy ofthe system.

View Text Solution

15. Figure shows a process ABCA performed on one mole of an ideal gas. Find the net heat supplied to the gaseous system during the process.

View Text Solution

16. An ideal gas is taken round a cyclic thermodynamic process ABCA as shown in

figure-3.13. If the internal energy of the gas at point A is assumed zero while at B it is 50 J. The heat absorbed by the gas in the process BC is 90 J.

What is the internal energy of the gas at point C ?

View Text Solution

17. An ideal gas is taken round a cyclic thermodynamic process ABCA as shown in

figure-3.13. If the internal energy of the gas at point A is assumed zero while at B it is 50 J. The heat absorbed by the gas in the process BC is 90 J.

How much heat energy is absorbed by the gas in the process AB ?

View Text Solution

18. An ideal gas is taken round a cyclic thermodynamic process ABCA as shown in

figure-3.13. If the internal energy of the gas at point A is assumed zero while at B it is 50 J. The heat absorbed by the gas in the process BC is 90 J.

Find the heat energy rejected or absorbed by the gas in the process CA.

View Text Solution

19. An ideal gas is taken round a cyclic thermodynamic process ABCA as shown in

figure-3.13. If the internal energy of the gas at point A is assumed zero while at B it is 50 J. The heat absorbed by the gas in the process BC is 90 J.

What is the net work done by the gas in the complete cycle ABCA ?

View Text Solution

20. A sample of 2kg of monoatomic helium (assumed ideal) is taken through the process

ABC and another sample of 2kg of the same gas is taken through the process ADC as shown in figure-3.14. Given, molecular mass of helium = 4.

What is the temperature of helium in each of the states A, B, C and D ?

View Text Solution

21. A sample of 2kg of monoatomic helium (assumed ideal) is taken through the process

ABC and another sample of 2kg of the same gas is taken through the process ADC as shown in figure-3.14. Given, molecular mass of helium = 4.

Is there any way of telling afterwards which sample of helium went through the process ABC and which went through the process ADC ? Write yes or no.

View Text Solution

22. A sample of 2kg of monoatomic helium (assumed ideal) is taken through the process ABC and another sample of 2kg of the same gas is taken through the process ADC as shown in figure-3.14. Given, molecular mass of helium = 4.

How much is the heat involved in each of the process ABC and ADC ?

23. One mole of an ideal monatomic gas is taken round the cyclic process ABCA as shown in figure .

Calculate the workdone by the gas

View Text Solution

24. One mole of an ideal monatomic gas is taken round the cyclic process ABCA as shown in figure .

Calculate the heat rejected by the gas in the path CA and the heat absorbed by the gas in the path AB

View Text Solution

25. One mole of an ideal monatomic gas is taken round the cyclic process ABCA as shown in figure .

Calculate the net heat absorbed by the gas in the path BC

View Text Solution

26. One mole of an ideal monatomic gas is taken round the cyclic process ABCA as shown in figure .

Calculate the maximum temperature attained by the gas during the cycle.

View Text Solution

27. Calculate the heat absorbed by a system in going through the cyclic process shown in figure.

View Text Solution

28. An ideal gas has a specific heat at constant pressure C_P=(5 R/2). The gas is kept in a closed vessel of volume 0.0083 m^3, at a temperature of 300 K and a pressure of

$1.6 \times 10^6 N / m^2$. An amount of 2.49×10^4 J of heat energy is supplied to the gas. Calculate the final temperature and pressure of the gas.

View Text Solution

29. Figure shows a cylindrical container containing oxygen gas and closed by a piston of mass 50kg. Piston can slide smoothly in the cylinder.Its crosssectional area is $100 cm^2$ and atmospheric pressure is 10^5 Pa. Someheat is supplied to the cylinder so that the piston is slowly displaced up by 20 cm. Find the amount ofheat supplied to the gas.

View Text Solution

30. Two moles of an ideal monoatomic gas are confined within a cylinder by a massless spring loaded with a frictionless piston of negligible mass and of cross-sectional area $4 \times 10^{-3} m^2$. The springis initially in its relaxed state. Now the gas is heated by a heater for some time.

During this time the gas expands and does 50 J of work in moving the piston through a distance of 0.1 m. The temperature of the gas increases by 50 K. Calculate the spring constant and the heat supplied by the heater.

View Text Solution

31. Consider the cyclic process shown in figure. An ideal gas of 2 moles is undergone this process.A total of 1200 J heat is rejected by the gas in the complete cycle. Find the work done by the gas during the process BC.

View Text Solution

32. An ideal monoatomic gas is confined in a cylinder by a spring loaded piston of cross-section $8 \times 10^{-3} m^2$. Initially the gas is at 300K and occupies a volume of $2.4 \times 10^{-3} m^3$ and the spring is in its relaxed (unstretched, uncompressed) state(see figure- 3.27). The gas is heated by a small electric heater until the piston moves out slowly by 0.1 m. Calculate the final temperature of the gas and the heat supplied (injoule) by the heater. The force constant of the spring is 8000 N/m, atmospheric pressure is $1 \times 10^5 N/m^2$. The cylinder and the piston are thermally insulated. The piston is massless and there is no friction between the piston and the cylinder. Neglect heat-loss through the lead wires of the heater.The heat-capacity of the heater coilis negligible.Assume the spring to be massless.

33. A monoatomic ideal gas is taken through the process ABC as shown in figure-3.28. The temperature at the point A is 300 K. Find the temperatures at points B and C. Also find the work done and heat supplied to the gas in paths AB and BC.

View Text Solution

34. The volume of an ideal diatomic gas with γ = 1.5 is changed adiabatically from 16 litre to 12 litre. Find the ratio of the final and initial pressures and temperatures.

Watch Video Solution

35. A sample of diatomic gas with y=1.5 is compressed from a volume of 1600 cc to 400 cc adiabatically. The initial pressure of gas was 1.5×10^5 Pa.Find the final pressure and work done by the gas in the process.

36. Two moles of a certain ideal gas at temperature T_0= 300 K were cooled isochorically so that the gas pressure reduced η= 2.0 times. Then, as a result of the isobaric process, the gas expanded till its temperature get back to the initial value. Find the total amount of heat absorbed by the gas in this process.

37. One mole of a gas is isothermally expanded at $27^{\circ}C$ till the volume is doubled. Then it is adiabatically compressed to its original volume. Find the total workdone. (γ= 1.4 and R = 8.4 joule/mole/.$^{\circ}$ K).

View Text Solution

38. Calculate the work done when one mole of an ideal monoatomic gas is compressed adiabatically. The initial pressure and volume of the gas are $10^5 N/m^2$ and 6 litre respectively. The final volume of the gas is 2litres. Molar specific heat of the gas at constant volume is 3R/2.

View Text Solution

39. An ideal gas at 75 cm mercury pressure is compressed isothermally until its volume is reduced to three quarters of its original volume. It is then allowed to expand adiabatically to a volume 20% greater than its original volume. If the initial temperature of the gas is $17^\circ C$,calculate the final pressure and temperature (γ= 1.5).

View Text Solution

40. One mole of a certain ideal gas is contained under a weight-less piston of a vertical cylinder at a temperature T. The space over the piston opens into the atmosphere. What work has to be performed on order to increase isothermally the gas volume under the piston n times by slowly raising the piston ? The friction of the piston against the cylinder walls is negligibly small.

Watch Video Solution

41. Figure shows a cylindrical container of volume V . Whose walls are adiabatic. Initially a light adiabatic piston divides the container in two equal parts as shown. In left part there is n moles of an ideal gas with adiabatic exponent γ is filled at temperature T_A and in other part there is vacuum.If the piston is released,the gas fills the whole container uniformly. Find the final pressured and temperature of gas. Now if the piston is slowly displaced externally back to its initial position. Find the final pressure and temperature of gas.

View Text Solution

42. There are two thermally insulated vessel.One with 0.025 moles of helium and other with n moles of hydrogen.Initially both the gases are at room temperature.Now equal amount of heat is supplied to both the vessels. It is found that in both the gases temperature rises by same amount. Find the number of moles of hydrogen in second vessel.

View Text Solution

43. There are two vessels. Each of them contains one moles of a monoatomic ideal gas. Initial volume of the gas in each vessel is $8.3 \times 10^{-3} m^3 at 27^\circ C$. Equal amount of heat is supplied to each vessel. In one of the vessels, the volume of the gas is doubled without change in its internal energy, whereas the volume of the gas is held constant in the second vessel. The vessels are now connected to allow free mixing of the gas. Find the final temperature and pressure of the combined gas system.

Watch Video Solution

44. Two moles of helium gas undergo a cyclic process as shown in figure. Assuming the gas to be ideal, calculate the following quantities in this process.

(a)The net change in the heat energy.

(b)The net work done.

(c)The net change in internal energy.

View Text Solution

45. Two moles of helium gas$(\lambda = 5/3)$ are initially at temperature $27^{\circ}C$ and occupy a volume of 20 litres. The gas is first expanded at constant pressure until the volume is doubled. Then it undergoes an adiabatic change until the temperature returns to its initial value.

(i) Sketch the process on a p-V diagram.

(ii) What are the final volume and pressure of the gas?

(iii) What is the work done by the gas ?

Watch Video Solution

46. Two moles of helium gas (γ=5/3)are initially at temperature 27° C and occupy a volume of 20litres.The gas is first expanded at constant pressure until the volume is doubled. Then it undergoes an adiabatic change until the temperature returns to its initial value.

What are the final volume and pressure of the gas ?

View Text Solution

47. Two moles of helium gas$(\lambda = 5/3)$ are initially at temperature $27^{\circ} C$ and occupy a volume of 20 litres. The gas is first expanded at constant pressure until the volume is doubled. Then it undergoes an adiabatic change until the temperature returns to its initial value.

(i) Sketch the process on a p-V diagram.

(ii) What are the final volume and pressure of the gas?

(iii) What is the work done by the gas ?

Watch Video Solution

48. Figure shows on adiabatic cylindrical container of volume V_0 divided by an adiabatic smooth piston in two equal parts. An ideal gas$(C_P / C_V = \gamma)$ is at a pressure P_1 and temperature T_2 in left part and gas at pressure P_2 and temperature in right part. The piston is slowly displaced and released at a position where it can stay in equilibrium. Find the final pressure, volume and temperature of the two parts.

View Text Solution

49. A piston can freely move inside a horizontal cylinder closed from both ends. Initially, the piston separates the inside space of the cylinder into two equal parts each of volmek V_0 in which an ideal gas is contained under the same pressure p_0 and at the same temperature. What work has to be performed in order to increase isothermally the volume of one part of gas η times compared to that of the other by slowly moving the piston ?

Watch Video Solution

50. An amount Q of heat is added to a mono atomic ideal gas in a process in which the gas perfoms a work $Q/2$ on its surrounding. Find equation of the process.

Watch Video Solution

51. An ideal gas has a molar heat capacity C_v at constant volume. Find the molar heat capacity of this gas as a function of its volume V, if the gas undergoes the following process :

(a) $T = T_0 e^{\alpha v}$,

(b) $p = p_0 e^{\alpha v}$,

where T_0, p_0, and α are constants.

Watch Video Solution

52. An ideal gas has a molar heat capacity C_v at constant volume. Find the molar heat capacity of this gas as a function of its volume

V, if the gas undergoes the following process

:

(a) $T = T_0 e^{\alpha v}$,

(b) $p = p_0 e^{\alpha v}$,

where T_0, p_0, and α are constants.

Watch Video Solution

53. An ideal gas is taken through a process in which the process equation is given as $P = kV^{\alpha}$, where k and α are positive constants. Find the value of α for which in this process molar heat capacity becomes zero.

Watch Video Solution

54. n moles of a monoatomic ideal gas undergone in a thermodynamic process along the path shown in figure from state-1 to state-2. The gas pressure in state-1 is P_0. Find the amount of heat supplied to the gas in this process and work done by the gas in the process.

View Text Solution

55. One mole of an ideal gas with heat capacity at constant pressure C_p undergoes the process $T = T_0 + \alpha V$, where T_0 and α are constants. Find :

(a) heat capacity of the gas as a function of its volume ,

(b) the amount of heat transferred to the gas, if its volume increased from V_1 to V_2.

Watch Video Solution

56. One mole of an ideal gas with heat capacity at constant pressure C_p undergoes the process $T = T_0 + \alpha V$, where T_0 and α are constants. Find :

(a) heat capacity of the gas as a function of its volume ,

(b) the amount of heat transferred to the gas, if its volume increased from V_1 to V_2.

Watch Video Solution

57. One mole of an ideal gas whose pressure changes with volume as $P = \alpha V$, where α is a constant, is expanded so that its volume increase η times. Find the change in internal energy and heat capacity of the gas.

Watch Video Solution

58. An ideal gas whose adiabatic exponent equals γ is expanded so that the amount of heat transferred to the gas is equal to the decrease of its internal energy. Find :

(a) the molar heat capacity of the gas in the process ,

The equation of the process in the variables t, V ,

(c) the work performed by one mole of the gas when its volume increases η times if the initial temperature of the gas is T_0.

Watch Video Solution

59. One mole of an ideal gas, whose adiabatic exponent equal to γ, is expanded so that the amount of heat transferred to the gas is equal to the decrease in internal energy. Find the equation of the process in the variables T, V

Watch Video Solution

60. An ideal gas whose adiabatic exponent (γ) equal 1.5, expands so that the amount of heat transferred to it is equal to the decrease in its internal energy. Find the $T - V$ equation for the process

Watch Video Solution

61. One mole of oxygen undergoes a cyclic process in which volume of the gas changes 10 times within the cycle as shown in figure. The processes AB and CD are adiabatic while processes BC and DA are isochoric. What is the efficiency of the process ?

View Text Solution

62. Three moles of an ideal gas $\left(C_p = \frac{7}{2}R\right)$ at pressure, P_A and temperature T_A is isothermally expanded to twice its initial volume. It is then compressed at constant pressure to its original volume. Finally gas is compressed at constant volume to its original pressure P_A.

(a) Sketch P-V and P-T diagrams for the complete process.

(b) Calculate the net work done by the gas, and net heat supplied to the gas during the complete process.

Watch Video Solution

63. Three moles of an ideal gas $\left(C_p = \frac{7}{2}R\right)$ at pressure, P_A and temperature T_A is isothermally expanded to twice its initial volume. It is then compressed at constant pressure to its original volume. Finally gas is compressed at constant volume to its original pressure P_A.

(a) Sketch P-V and P-T diagrams for the complete process.

(b) Calculate the net work done by the gas, and net heat supplied to the gas during the complete process.

Watch Video Solution

64. One mole of a diatomic ideal gas $(\gamma = 1.4)$ is taken through a cyclic process starting from point A. The process $A \to B$ is an adiabatic compression, $B \to C$ is isobaric expansion,

$C \rightarrow D$ is an adiabatic expansion, and $D \rightarrow A$ is isochoric. The volume ratios are $V_A / V_B = 16$ and $V_C / V_B = 2$ and the temperature at A is $T_A = 300K$. Calculate the temperature of the gas at the points B and D and find the efficiency of the cycle.

Watch Video Solution

65. One mole of a monatomic ideal gas is taken through the cycle shown in figure.

A $\rightarrow$ B adiabatic , expansion

$B \rightarrow C$ cooling at constant volume

$C \rightarrow D$ adiabatic compression

$D \rightarrow A$ heating at constant volume

The pressure and temperature at A,B etc. are denoted by $P_A, P_B,$ ...., T_A, T_B ,...., etc. respectively. Given that

$T_A = 1000K, P_B = (2/3)P_A$ and $P_C = (1/3)P_A$.

Calculate the following quantities :

The work done by the gas in process $A \rightarrow B$

View Text Solution

66. One mole of a monatomic ideal gas is taken through the cycle shown in figure.

A $\rightarrow$ B adiabatic , expansion

$B \rightarrow C$ cooling at constant volume

$C \rightarrow D$ adiabatic compression

$D \rightarrow A$ heating at constant volume

The pressure and temperature at A,B etc. are denoted by $P_A, P_B,$ ...., T_A, T_B ,...., etc. respectively. Given that

$T_A = 1000K, P_B = (2/3)P_A$ and $P_C = (1/3)P_A$.

Calculate the following quantities :

The heat lost by the gas in process $B \rightarrow C$

View Text Solution

67. One mole of a monatomic ideal gas is taken through the cycle shown in figure.

A $\rightarrow$ B adiabatic , expansion

$B \rightarrow C$ cooling at constant volume

$C \rightarrow D$ adiabatic compression

$D \rightarrow A$ heating at constant volume

The pressure and temperature at A,B etc. are denoted by P_A, P_B, ..., T_A, T_B ,...., etc. respectively. Given that

$T_A = 1000K, P_B = (2/3)P_A$ and $P_C = (1/3)P_A$.

Calculate the following quantities :

The temperature T_D

View Text Solution

68. Figure shows three isothermals at temperature T_1=4000 K, T_2=2000K,T_3 = 1000

K.When one mole of an ideal monatomic gas is taken through the paths AB, EC, CD and DA, find the changein internal energy ΔU, the work done by the gas W and the heat Q absorbed by the gas in each path. Also find these quantities for complete cycle ABCDA.

Given $V_A = 1m^3$ and $V_B = 2m^3$

View Text Solution

Discussion Question

1. When a thermos flask with some water in it is vigorously shaken. Does its temperature rise. Has some heat added to water during the process.

Watch Video Solution

2. Some gas is enclosed in a piston-cylinder system. It is expanded to double its volume by isobaric or isothermal process. In which process more work is done by the gas.

Watch Video Solution

3. In a room if door of refrigerator is kept open, will the room temperature decrease.

Watch Video Solution

4. When a block moves in a straight line on a rough surface. Some heat is dissipated. Is this process reversible.

Watch Video Solution

5. Can whole of work be converted into heat?

Watch Video Solution

6. Can we convert heat completely into mechanical work in a cyclic process.

Watch Video Solution

7. When a gas is compressed adiabaticlly, it becomes more elasitc. Is this ture ?

Watch Video Solution

8. Represent the Carnot cycle on a VT diagram.

Watch Video Solution

9. The molar heat capacity at constant pressure of all diatomic gases is always same.

Watch Video Solution

10. A gas is first compressed adiabatically and then isothermally. In both cases, the initial state of the gas is the same. Find in which case more work is done on the gas.

Watch Video Solution

11. In the polytropic process PV^2 = constant, is the gas cooled'or heated with increase in volume.

Watch Video Solution

12. When a mountaineer who eats food, gets warm a lot during a climb and does a lot of mechanical work in raising himself upwards. When he descents, again he also gets warm during descent. Is the source of this energy the same as during the ascent.

Watch Video Solution

13. The temperature of a gas is increasing, hence its internal energy also increases. Just be observing initial and final states, can we determine whether the internal energy increment was due to work or by heat transfer.

Watch Video Solution

14. When a hand pump is used to inflate the tires of a bicycle, the pump gets warm after a while. Why?

Watch Video Solution

15. A disc rotated about its central axis and gently placed on another coaxial disc at rest. Due to friction between the two first disc retards and the second one starts rotating and after some time both with rotate with a common angular speed. In this process the total internal energy of the system of two discs does not change. State and justify whether this statement is true or false.

Watch Video Solution

16. "When heat is added to a system, the internal energy of the system must increase". Justify this statement.

Watch Video Solution

17. When a tyre bursts, the air coming out is cooler than the surrounding air.Explain.

Watch Video Solution

Conceptual Mcqs Single Option Correct

1. A mass of an ideal gas undergoes a reversible isothermal compression. Its molecules will then have compared with initial state, the same

(i) root mean square velocity (ii) mean mometum (iii) mean kinetic energy

A. (i), (ii) & (iii) are correct

B. (i)&(ii) are correct

C. (ii)&(iii) are correct

D. only (i) is correct

Answer:

Watch Video Solution

2. In an isothermal expansion of an ideal gas. Select wrong statement:

A. There is no change in the temperature of the gas

B. There is no change in the internal energy of the gas

C. The work done by the gas is equal to the heat supplied to the gas

D. The work done by the gas is equal to the change in its internal energy

Answer:

Watch Video Solution

3. Heating of water under atmospheric pressure is an:

A. Isothermal process

B. Isobaric process

C. Adiabatic process

D. Isochoric process

Answer:

Watch Video Solution

4. Suppose a gas obeys pV^2= constant in addition to the gas equation pV = RT. If on heating temperature is doubled, what will be the percentage change in volume ?

A. Decreases by 50%

B. Increases by 50%

C. Decreases by 100%

D. Increases by 100%

Answer:

Watch Video Solution

5. In which of the following processes the system always returns to the original thermodynamic state ?

A. Adiabatic

B. Isobaric

C. Cyclic

D. Reversible

Answer:

Watch Video Solution

6. For an ideal gas, the heat capacity at constant pressure is larger than that at constant volume because

A. Work is done during expansion of the gas by the external pressure

B. Work is done during expansion by the gas against external pressure

C. Work is done during expansion by the gas against intermolecular forces at attraction

D. More collisions occur per unit time when volume is kept constant.

Answer:

Watch Video Solution

7. A gas has :

A. One specific heat only

B. Two specific heats only

C. Infinite number of specific heats

D. No specific heat

Answer:

Watch Video Solution

8. A gas kept in a container of finite conductivity is suddenly compressed . The process

A. Must be very nearly adiabatic

B. Must be very nearly isothermal

C. May be very nearly adiabatic

D. May be very nearly isothermal

Answer:

Watch Video Solution

9. An ideal gas (whose $\dfrac{C_p}{C_v} = \lambda$, and internal energy U at absolute zero temp. is equal to zero) undergoes a reversible adiabatic compression. If U,p,V,T Represent the internal energy, pressure, volume and temperature respectively of the ideal gas, then

A. UV^{λ} =const

B. Up^{λ} =const

C. $VU^{\frac{1}{\lambda-1}}$ =const

D. $TV^{\lambda-1}$ =const

Answer:

Watch Video Solution

10. For an adiabatic compression the quantity pV

A. increases

B. decreases

C. remains constant

D. depends on γ

Answer:

Watch Video Solution

11. When an ideal gas undergoes an adiabatic change causing a temperature change ΔT

(i) there is no heat ganied or lost by the gas

(ii) the work done by the gas is equal to change in internal eenrgy

(iii) the change in internal energy per mole of the gas is $C_V \Delta T$, where C_V is the molar heat capacity at constant volume.

A. (i),(ii) & (iii) are correct

B. (i)&(ii) are correct

C. (i)&(iii) are correct

D. only (i) is correct

Answer:

Watch Video Solution

12. The relation between the slope of isothemal curve and slope of adiabatic curve

A. Slope of isothermal curve = slope of adiabatic curve

B. Slope of isothermal curve = γ x slope of adiabatic curve

C. Slope of adiabatic curve = γ x slope of isothermal curve

D. Slope of adiabatic curve = $\frac{1}{2}$ x slope of isothermal curve

Answer:

Watch Video Solution

13. An ideal gas is allowed to expand in vacuum in rigid insulator container. Choose the correct alternative (s).

A. An increase in its internal energy

B. A decrease in its internal energy

C. Neither an increase or decrease in temperature or internal energy

D. An increase in temperature

Answer:

Watch Video Solution

14. The value of $(C_p - C_v)$ is $1.00R$ for a gas sample in state A and is $1.08R$ in state B. Let (p_A, p_B)denote the pressures and $(T_A \text{ and } T_B)$ denote the temperatures of the states A and B respectively . Most likely

A. $p_A < p_B$ and $T_A > T_B$

B. $p_A > p_B$ and $T_A < T_B$

C. $p_A = p_B$ and $T_A < T_B$

D. $p_A > p_B$ and $T_A = T_B$

Answer:

Watch Video Solution

15. A gas undergoes a process in which its pressure P and volume V are related as $VP^n =$ constant. The bulk modulus of the gas in the process is:

A. nP

B. $P^{t/n}$

C. P/n

D. P^n

Answer:

Watch Video Solution

16. During free expansion of an ideal gas which of the following remains constant ?

A. Pressure

B. Temperature

C. Both pressure and temperature

D. Neither pressure nor temperature

Answer:

Watch Video Solution

17. The internal energy of a gas is given by $U = 2pV$. It expands from V_0 to $2V_0$ against a constant pressure p_0. The heat absorbed by the gas in the process is

A. $2P_0V_0$

B. $4P_0V_0$

C. $3P_0V_0$

D. P_0V_0

Answer:

Watch Video Solution

18. An amount Q of heat is added to a monoatomic ideal gas in a process in which the gas performs work $\frac{Q}{2}$ on its surrounding. Find the molar heat capacity for the process.

A. 2R

B. $\frac{5R}{3}$

C. 3R

D. none of these

Answer:

Watch Video Solution

19. A gas is found to be obeyed the law $p^2V = cons\tan t$. The initial temperature and volume are T_0 and V_0. If the gas expands to a volume $3V_0$, then the final temperature becomes.

A. $\sqrt{3}T_0$

B. $\sqrt{2}T_0$

C. $\frac{T_0}{\sqrt{3}}$

D. $\frac{T_0}{\sqrt{2}}$

Answer:

Watch Video Solution

20. An ideal gas has initial volume V and pressure p. In doubling its volume the minimum work done will be in the process (of the given processes)

A. Isobaric process

B. Isothermal process

C. Adiabatic process

D. None of the above

Answer:

Watch Video Solution

21. A gas of adiabatic exponent γ is supplied heat at a constant pressure. Show that in such a process $\Delta Q : \Delta W = \gamma : 1 : (\gamma - 1)$.

A. $\gamma : \gamma - 1 : \frac{1}{\gamma}$

B. $1 : 1 : \gamma - 1$

C. $\gamma : \gamma - 1 : 1$

D. $\gamma : 1 : \gamma - 1$

Answer:

Watch Video Solution

Numerical Mcqs Single Options Correct

1. An ideal gas is expanded adiabatically at an initial temperature of 300 K so that its volume is doubled. The final temperature of the hydrogen gas is $\lambda = 1.40)$

A. 227.3 K

B. 500.30 K

C. 454.76 K

D. $-47^{\circ} C$

Answer:

Watch Video Solution

2. Three samples of the same gas A,B and C $(\gamma = 3/2)$ have initially equal volume. Now the volume of each sample is doubled. The process is adiabatic for A. Isobaric for B and isothermal for C. If the final pressures are equal for all three samples, find the ratio of their initial pressures

A. $2\sqrt{2}:2:1$

B. $2\sqrt{2}:1:2$

C. $\sqrt{2}:1:2$

D. $2:1:\sqrt{2}$

Answer:

Watch Video Solution

3. An ideal gas at $27^{\circ} C$ is compressed adiabatically to $8/27$ of its original volume. If $\gamma = 5/3$, then the rise in temperature is

A. $450^{\circ} C$

B. $375^{\circ} C$

C. $225^{\circ} C$

D. $405^{\circ} C$

Answer:

Watch Video Solution

4. One mole of an ideal gas at temperature T was cooled isochorically till the gas pressure fell from P to $\frac{P}{n}$. Then, by an isobaric process, the gas was restored to the initial temperature. The net amount of heat absorbed by the gas in the process is

A. nRT

B. $\frac{RT}{n}$

C. $RT\left(1 - n^{-1}\right)$

D. $RT(n - 1)$

Answer:

Watch Video Solution

5. 14 g of nitrogen is contained in a vessel at 300 K. How much heat should be taken out of the gas to half the rms speed cf its molecules ? R=2 cal/mol K:

A. 500 cal

B. 562.5 cal

C. 2000 cal

D. 2250 cal

Answer:

Watch Video Solution

6. Certain amount of an ideal gas is contained in a closed vessel. The vessel is moving with a constant velcity v. The molecular mass of gas is M. The rise in temperature of the gas when the vessel is suddenly stopped is $(\gamma C_P / C_V)$

A. $\frac{Mv^2}{2R(\gamma+1)}$

B. $\dfrac{Mv^2(\gamma - 1)}{2R}$

C. $\dfrac{Mv^2}{2R\gamma}$

D. $\dfrac{Mv^2\gamma}{2R(\gamma - 1)}$

Answer:

Watch Video Solution

7. The molar heat capacity in a process of a diatomic gas if it does a work of $\dfrac{Q}{4}$ when a heat of Q is supplied to it is

A. $\frac{2}{5}R$

B. $\frac{5}{2}R$

C. $\frac{10}{3}R$

D. $\frac{6}{7}R$

Answer:

Watch Video Solution

8. If R = universal gas constant, the amount of heat needed to raise the temperature of 2 mole of an ideal monoatomic gas from 273 K to 373 K when no work is done

A. 150R

B. 250R

C. 300R

D. 500R

Answer:

Watch Video Solution

9. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is

A. $\frac{2}{5}$

B. $\frac{3}{5}$

C. $\frac{3}{7}$

D. $\frac{3}{4}$

Answer:

Watch Video Solution

Watch Video Solution

10. A geyser heats water flowing at the rate of 3.0 litre per minute from $27^\circ C$ to $77^\circ C$. If the geyser operates on a gas burner and its heat of combustion is $4.0 \times 10^4 J/g$, then what is the rate of combusion of fuel (approx.)?

A. 15.25

B. 15.5

C. 15.75

D. 16

Answer:

Watch Video Solution

11. The ratio of adiabatic bulk modulus and isothermal bulk modulus of a gas is $\left(\gamma = \frac{C_p}{C_v}\right)$:

A. 1

B. γ

C. $\frac{\gamma}{\gamma - 1}$

D. $\frac{\gamma - 1}{\gamma}$

Answer:

Watch Video Solution

12. When 20J of work was done on a gas, 40J of heat energy was released. If the initial internal enrgy of the gas was 70J, what is the final internal energy?

A. 50 J

B. 60 J

C. 90 J

D. 110 J

Answer:

Watch Video Solution

13. P-V diagram of a diatomic gas is a straight line passing through origin. The molar heat capacity of the gas in the process will be

A. 4R

B. 2.5R

C. 3R

D. $\frac{4R}{3}$

Answer:

Watch Video Solution

14. An ideal gs at pressure P is adiabatically compressed so that its density becomes n times the initial vlaue The final pressure of the gas will be $\left(\gamma = \frac{C_P}{C_V}\right)$

A. $n^{\lambda}P$

B. $n^{-\lambda}P$

C. $n^{\gamma-1}P$

D. $n^{1-\gamma}P$

Answer:

Watch Video Solution

15. For an ideal monoatomic gas, the universal gas constant R is n times the molar heat capacity a constant pressure C_p.Here n is

A. 0.67

B. 1.4

C. 0.4

D. 1.67

Answer:

Watch Video Solution

16. Unit mass of liquid of volume V_1 completely turns into a gas of volume V_2 at constant atmospheric pressure P and temperature T. The latent heat of vaporization is "L". Then the change in internal energy of the gas is

A. L

B. $L + P_0(V_2 - V_1)$

C. $L - P_0(V_2 - V_1)$

D. Zero

Answer:

Watch Video Solution

17. The height of a waterfall is 84 metre . Assuming that the entire kinetic energy of falling water is converted into heat, the rise in temperature of the water will be ($g = 9.8m / s^2, J = 4.2$ joule / cal)

A. $0.2^\circ C$

B. $1.960^\circ C$

C. $0.96^\circ C$

D. $0.0196^{\circ} C$

Answer:

Watch Video Solution

18. One mole of an ideal gas requires 207 J heat to raise its temperature by 10 K when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by the same 10 K, the heat required will be (R, the gas constant = $8.3 JK^{-1} mol^{-1}$):

A. 198.7 J

B. 29 J

C. 215.3 J

D. 124 J

Answer:

Watch Video Solution

19. A gas is expanded to double its volume by two different processes. One is isobaric and the other is isothermal. Let W_1 and W_2 be the respective work done, then find W_1 and W_2

A. $W_2 = W_1 \ln(2)$

B. $W_2 = \frac{W_1}{\ln(2)}$

C. $W_2 = \frac{W_1}{2}$

D. Data is insufficient

Answer:

Watch Video Solution

Watch Video Solution

20. One mole of monoatomic gas and one mole of diatomic gas are mixed together. What is the molar specific heat at constant volume for the mixture ?

A. $\frac{3}{2}R$

B. $2R$

C. $\frac{5}{2}R$

D. 3R

Answer:

Watch Video Solution

21. The equation of state for n moles of an ideal gas is PV=nRT, where R is a constant. The SI unit for R is:

A. JK^{-1} per molecule

B. $Jkg^{-1}K^{-1}$

C. $JK^{-1}mol^{-1}$

D. $JK^{-1}g^{-1}$

Answer:

Watch Video Solution

22. The temperature of an air bubble while rising from bottom to surface of a lake remains constant but its diameter is doubled if the pressure on the surface is equal to h meter of mercury column and relative density of mercury is then the depth of lake in metre is -

A. $8\rho h$

B. $4\rho h$

C. $7\rho h$

D. $2\rho h$

Answer:

Watch Video Solution

23. Heat is supplied to a diatomic gas at constant pressure. The ratio of $\Delta Q : \Delta U : \Delta W$ is :

A. $5:3:2$

B. $5:2:3$

C. $7:5:2$

D. $7:2:5$

Answer:

Watch Video Solution

24. A vessel contains $0.5m^3$ of hydrogen gas at 300 K and pressure 10^5 Pa. How much heat should be added to it to raise the temperature to 500 K ? Molar specific heat of hydrogen is 5 cal/mol K:

A. 20kcal

B. 10kcal

C. 5kcal

D. 2.5kcal

Answer:

Watch Video Solution

25. Given that the interatomic distance between the molecules of a diatomic gas remains constant, what is the value of molar specific heat of the gas?

A. 3R/2

B. 5R/2

C. 3R

D. 5R

Answer:

Watch Video Solution

Watch Video Solution

26. The triatomic gas is heated isothermally. What percentage of the heat energy is used to increase the internal energy?

A. Zero

B. $14\ \%$

C. $60\ \%$

D. 100

Answer:

Watch Video Solution

27. A quantity of heat Q is supplied to a monoatomic ideal gas which expands at constant pressure. The fraction of heat that goes into work done by the gas $\left(\frac{W}{Q}\right)$ is

A. 1

B. $\frac{2}{3}$

C. $\frac{3}{5}$

D. $\frac{2}{5}$

Answer:

Watch Video Solution

28. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is

A. $\frac{2}{5}$

B. $\frac{3}{5}$

C. $\frac{3}{7}$

D. $\frac{5}{7}$

Answer:

Watch Video Solution

29. In One mole of a monoatomic gas $\left(\gamma = \frac{5}{3}\right)$ is mixed with one mole of a triatomic gas $\left(\gamma = \frac{4}{3}\right)$, the value of γ for the mixture is :

A. 1.4

B. 1.44

C. 1.53

D. 3.07

Answer:

Watch Video Solution

30. One mole of an ideal gas $(C_p / C_v = \gamma)$ at absolute temperature T_1 is adiabatically compressed from an initial pressure P_1 to a final pressure P_2. The resulting temperature T_2, of the gas is given by:

A. $T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{\gamma}{\gamma-1}}$

B. $T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}}$

C. $T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\gamma}$

D. $T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\gamma-1}$

Answer:

Watch Video Solution

31. The pressure of the air inside the motor tyre is 2 atmosphere and the temperature is $27^\circ C$. If it suddenly bursts, the final temperature will be $(\gamma = 1.4)$:

A. 27 K

B. $-150^\circ C$

C. $-81^\circ C$

D. $-27^\circ C$

Answer:

Watch Video Solution

Watch Video Solution

32. A certain mass of an ideal gas at pressure P_1 is adiabatically expanded from an initial volume V_1 to a final volume V_2. The resulting pressure P_2 of the gas is given by:

A. $P_2 = P_1\left(\frac{V_1}{V_2}\right)^{\gamma}$

B. $P_2 = P_1\left(\frac{V_1}{V_2}\right)^{1/\gamma}$

C. $P_2 = P_1\left(\frac{V_1}{V_2}\right)^{\frac{\gamma-1}{\gamma}}$

D. $P_2 = P_1\left(\frac{V_1}{V_2}\right)^{\frac{\gamma}{\gamma-1}}$

Answer:

Watch Video Solution

33. The molar specific heat of oxygen at constant pressure $C_P = 7.03 cal / mol.^{\circ} C$ and $R = 8.31 J / mol.^{\circ} C$. The amount of heat taken by 5 mol of oxygen when heated at constant volume from $10^{\circ} C$ to $20^{\circ} C$ will be approximately.

A. 100cal

B. 200cal

C. 300cal

D. 400cal

Answer:

Watch Video Solution

34. 5 mole of oxygen are heated at constant volume from $10^\circ C \text{to} 20^\circ C$. What will be the change in internal energy of the gas? Gram molar specific heat of gas at constant pressure

$= 8cal. \text{Mole}^{-1}.^{\circ} C^{-1}$ and

$R = 8.36J\text{mole}^{-1}.^{\circ} C^{-1}.$

A. 100 cal

B. 200 cal

C. 300cal

D. 400cal

Answer:

Watch Video Solution

35. A gas at pressure P is abiabatically compressed so that its density becomes twice that of initial value. Given that $\gamma = C_p / C_v = (7/5)$, What will be the final pressure of the gas ?

A. P

B. 2P

C. 2.6P

D. $\frac{7P}{5}$

Answer:

Watch Video Solution

36. A monoatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a friction less piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the length of the gas column before expansion respectively, then $\frac{T_1}{T_2}$ is given by

A. $\left(\frac{L_1}{L_2}\right)^{2/3}$

B. $\left(\frac{L_1}{L_2}\right)$

C. $\left(\frac{L_2}{L_1}\right)$

D. $\left(\frac{L_2}{L_1}\right)^{2/3}$

Answer:

Watch Video Solution

37. During the adiabatic expansion of 2 moles of a gas, the internal energy was found to have decreased by 100 J . The work done by the gas in this process is

A. zero

B. -100J

C. 200J

D. 100J

Answer:

Watch Video Solution

38. In thermodynamic process, pressure of a fixed mass of a gas is changes in such a manner that the gas molecules gives out 20 J of heat and 10 J of work is done in the gas. If the initial internal energy of the gas was 40 J, then the final internal energy will be

A. 0

B. 80 J

C. 20 J

D. -20 J

Answer:

Watch Video Solution

39. A freezer has coefficient of performance 5. When 3.6×10^6 J work is done on the freezer, what mass of water at $0^\circ C$ is converted into ice cubes at $0^\circ C$:

A. $\approx$ 5 kg

B. $\approx$ 3.6 kg

C. $\approx$ 54 kg

D. $\approx$ 107 kg

Answer:

Watch Video Solution

40. In a thermodynamic process helium gas obeys the law $TP^{-2/5}$ = constant. The heat given to the gas when the temperature of 2 moles of the gas is raised from T to 4T (R is the universal gas constant) is :

A. 9RT

B. 18RT

C. Zero

D. Data insufficient

Answer:

Watch Video Solution

41. For adiabatic expansion of a monoatomic perfect gas, the volume increases by 2.4%. What is the percentage decrease in pressure ?

A. 2.4%

B. 4.0%

C. 4.8%

D. 7.1%

Answer:

Watch Video Solution

42. 5 moles of gas were heated from $100^{\circ}C$ to $120^{\circ}C$ at constant volume. The internal energy was changed by 200 J. what is the specific heat capacity of the gas?

A. $5 \text{ J mole}^{-1}K^{-1}$

B. $4 \text{ J mole}^{-1}K^{-1}$

C. $2 \text{ J mole}^{-1}K^{-1}$

D. $1 \text{ J mole}^{-1} K^{-1}$

Answer:

Watch Video Solution

Advance Mcqs With One Or More Options Correct

1. The pressure p and volume V of an ideal gas both increase in a process.

A. Such a process is not possible

B. The work done by the system is positive

C. The temperature of the system will increase

D. Heat supplied to the gas is equal to the change in internal energy

Answer:

Watch Video Solution

2. In a process on a system in closed container, the initial pressure and volume are equal to the final pressure and volume :

A. The initial temperature must be equal to the final temperature

B. The initial internal energy must be equal to the final internal energy

C. The net heat given to the system in the process must be zero

D. The net work done by the system in the process must be zero

Answer:

Watch Video Solution

3. The internal enegy of an ideal gas decreases by the same amount as the work done by the system.

A. The process must be adiabatic

B. The process must be isothermal

C. The process must be isobaric

D. The temperature must decrease

Answer:

Watch Video Solution

4. Three identical adiabatic containers A, B and C Contain helium, neon and oxygen respectively at equal pressure. The gases are pushed to half their original volumes.

A. The final temperature in the three containers will be the same

B. The final pressures in the three containers will be the same

C. The pressure of helium and neon will be the same but that of oxygen will be different

D. The temperature of helium and neon will be the same but that of oxygen will be different

Answer:

Watch Video Solution

5. For an ideal gas :

A. The change in internal energy in a constant pressure process from temperature T_1 to T_2 is equal to $nC_v(T_2 - T_1)$, where C_v is the molar specific heat at constant volume and n the number of moles of the gas.

B. The change in internal energy of the gas and the work done by the gas are equal in magnitude in an adiabatic process.

C. The internal energy does not change in an isothermal process

D. No heat is added or removed in an adiabatic process.

Answer:

Watch Video Solution

6. A sample of gas follow process represented by PV^2 = constant . Bulk modulus for this process is B, then which of the following graph is correct ?

A.

B.

C.

D.

Answer:

Watch Video Solution

7. An ideal gas undergoes a process such that $P \propto \frac{1}{T}$. If molar heat capacity for this process is $C = 33.24 \text{ J}/\text{mole-K}$, then calculate A. Where $A = 2\gamma$ and γ is adiabatic index of gas.

$(R = 8.31 \mathrm{J} / \mathrm{mole\text{-}K})$

A. The work done by the gas is $2R\Delta T$

B. Degree of freedom of the gas is 4

C. Degree of freedom of the gas is 3

D. $Y\left(\frac{C_P}{C_V}\right)$

Answer:

Watch Video Solution

8. A rigid container of negligible heat capacity contains one mole of an ideal gas. The temperatures of the gas increases by $1^\circ C$ if 3.0 cal of heat is added to it. The gas may be

A. Helium

B. Argon

C. Oxygen

D. Carbon dioxide

Answer:

Watch Video Solution

9. At ordinary temperatures, the molecules of an ideal gas have only translational and rotational kinetic energies. At high temperatures they may also have vibrational energy.

As a result of this, at higher temperature

A. $C_v = 3R/2$ for monatomic gas

B. $C_v > R/2$ for monoatomic gas

C. $C_v < 5R/2$ for diatomic gas

D. $C_v > 5R/2$ for diatomic gas

Answer:

Watch Video Solution

10. When an enclosed perfect gas is subjected to an adiabatic process :

A. Its total internal energy does not change

B. Its temperature does not change

C. Its pressure varies inversely as a certain power of its volume

D. The product of its pressure and volume is directly proportional to its absolute temperature.

Answer:

Watch Video Solution

Unsolved Numerical Problems

1. An ideal gas $(\gamma = 1.5)$ is expanded adiabatically. How many times has the gas to be expanded to reduce the roo-mean-square velocity of molecules becomes half ?

Watch Video Solution

2. Two diatomic gases are mixed in mole ratio 1:2. Find the value of adiabatic exponent for this mixture of gases.

Watch Video Solution

3. A gas (γ=1.5) is enclosed in a container of volume $150 cm^3$. The initial pressure and the initial temperature are 1.5×10^5 Pa and 300K respectively. Of The gas is adiabatically compressed to $50 cm^3$, find the final pressure and temperature and the work done by the gas in the process. Also find the total change in internal energy of the gas in the process.

Watch Video Solution

4. One mole of an ideal gas is heated at constant pressure so that its temperature rises by ΔT= 72 K. In The heat supplied is Q=1.6 kJ, find the change in its internal energy and the work done by the gas.

Watch Video Solution

5. What work has to be done isobarically on a mole of diatomic gas to increase its rms speed η = 3 times from T_0=300 K ?

Watch Video Solution

6. An engine that operates at half its theoretical (Carnot) efficiency, operates between $545^\circ C$ and $310^\circ C$ while producing work at the rate of 1000 kW. How much heat is discharged per hour?

Watch Video Solution

7. A gas at $20^\circ C$ and atmospheric pressure is compressed to a volume one-fifteenth as large as its original volume and an absolute pressure of 3000 kPa. What is the new temperature of the gas?

View Text Solution

8. A closed vessel 10L in volume contains a diatomic gas under a pressure of $10^5 N/m^2$. What amount of heat should be imparted to the gas to increase the pressure in the vessel five times?

Watch Video Solution

9. One cubic metre of air at $27^{\circ} C$ and $10^5 Nm^{-2}$ pressure weighs $1.18 kg$. Calculate the value of the gas constant for $1 kg$ of the gas and calculate c_p of air if $168 cal kg^{-1} K^{-1}$ and $J = 4.2 J cal^{-1}$

Watch Video Solution

10. As a result of heating a mole of an ideal gas at constant pressure by $72^{\circ} C$, a heat flow by an amount 1600 joules takes place. Find the

work performed by the gas, ther increment of its internal energy, and the value of γ.

Watch Video Solution

11. A gas at constant pressure $P_1, volume V_1$ and temperture T_1 is suddenly compressed to $\frac{V_1}{2}$ and then slowly expanded to V_1 again.Find the final temperature and pressure.

Watch Video Solution

12. A cubic metre of dry air at NTP is allowed to expand to 5 cubic metres (i) isothermally, (ii) adiabatically. Calculate in each cae, the pressure, temperature and work done. ($\gamma = 1.4$ and $1atm = 1.013 \times 10^5 Nm^{-2}$)

Watch Video Solution

13. A thermally insulated vessel with gaseous nitrogen at a temperature of $27^\circ C$ moves with velocity $100m / s^{-1}$. How much (in percentage) and in what way will the gas pressrue change if the vessel is brought to rest suddenly ?

Watch Video Solution

14. As a result of the isobaric heating by ΔT =72 K one mole of a certain ideal gas obtains an amount of heat Q = 1.60 kJ. Find the work performed by the gas, the increment of its internal energy, and the value of $\gamma = C_p / C_v$

Watch Video Solution

15. What amount of heat is to be transferred to nitrogen in an isobaric heating process so that the gas may perform 2 J work?

Watch Video Solution

16. Five moles of neon gas (molecular weight=20) at 2 atm and $27^\circ C$ is adiabatically compressed to one-third its initial volume. Find the final pressure, the temperature and the work done on the gas.

Watch Video Solution

17. Calculate the change in temperature when a gas (γ= 1.4) is suddenly allowed to expand to one hundredth of its original pressure, its original temperature being $37^\circ C$.

Watch Video Solution

18. One mole of oxygen being initially at a temperature $T_0 = 290K$ is adiabatically compressed to increase its pressure $\eta = 10.0$ times. Find :

(a) the gas temperature after the compression

,

(b) the work that has been performed on the gas.

Watch Video Solution

19. One mole of oxygen being initially at a temperature $T_0 = 290K$ is adiabatically compressed to increase its pressure $\eta = 10.0$

times. Find :

(a) the gas temperature after the compression

,

(b) the work that has been performed on the gas.

Watch Video Solution

20. Find the ratio of number of moles of a monoatomic and a diatomic gas whose mixture has a value of adiabatic exponent γa =3/2.

Watch Video Solution

21. A gas is enclosed in a cylindrical vessel fitted with a frictionless piston. The gas is slowly heated for some time. During the process, 10 J of heat is supplied and the piston is found to move out 10 cm. The area of cross-section of the cylinder $= 4cm^2$ and the atmospheric pressure $= 100kPa$.

Watch Video Solution

22. One cubic metre of hydrogen at $0^{\circ}C$ and $76cm$ and of Hg weighs $0.0896kg$. The specific heat capacities of hydrogen at constant pressure volume are 3409 and 2411 cal per kg per kelvin, respectively. Calculate the value of $J.$ $(g = 9.81, ms^{-2}$ density of mercury $= 13.6 \times 10^3$ kg per cubic metre)

Watch Video Solution

23. A gass of given mass at a pressure of $10^5 Nm^{-2}$ expands isothermally until its volume is doubled and then adiabatically until volume is again double. Find the final pressure of the gas. $(\gamma = 1.4)$

Watch Video Solution

24. A vessel containing one gram-mole of oxygen is enclosed in a thermally insulated vessel. The vessel is than moved with a constant speed v_0 and then suddenly stopped. The process results in a rise in the temperature of the gas by $1^{\circ} C$. Calculate the speed v_0.

Watch Video Solution

25. An ideal gas with the adiabatic exponent γ undergoes a process in which its internal energy relates to the volume as $U = aV^{\alpha}$, where a and α are constants. Find the work performed by the gas and the amount of heat to be transferred to this gas to increase its internal energy by ΔU

Watch Video Solution

26. An ideal gas with the adiabatic exponent γ undergoes a process in which its internal energy relates to the volume as $u = aV^{\alpha}$. Where a and α are constants. Find :

(a) the work performed by the gas and the amount of heat to be transferred to this gas to increase its internal energy by ΔU ,

(b) the molar heat capacity of the gas in this process.

Watch Video Solution

27. Two moles of an ideal gas at temperature $T_0 = 300K$ was cooled isochorically so that the pressure was reduced to half. Then, in an isobaric process, the gas expanded till its temperature got back to the initial value. Find the total amount of heat absorbed by the gas in the processs

Watch Video Solution

28. Suppose that 5 g of helium gas is heated from $-30^{\circ}C$ to $120^{\circ}C$. Find its change in internal energy and the work it does if the heating occurs (a) at constant volume and (b) at constant pressure. For helium, C_v=0.75 cal/g. C° and C_p =1.25 cal/g . C°

Watch Video Solution

29. 10 gm of oxygen at a pressure $3 \times 10^5 N/m^2$ and temperature $10^\circ C$ is heated at constant pressure and after heating it occupies a volume of 10 litres. (a) Find the amount of heat received by the gas and (b) the energy of thermal motion of gas molecules before heating.

Watch Video Solution

30. A gas expands adiabatically and its volume doubles while its absolute temperature drops 1.32 times. What number of degrees of freedom do the gas molecules have ?

Watch Video Solution

31. A system undergoes a change of state during which 100 kJ of heat is transferred to it and it does 50 kJ of fwork. The system is brought back to its original state through a process during which 120 kJ of heat is transferred to it. Find the work done by the system in the second process.

Watch Video Solution

32. A certain volume of a gas (diatomic) expands isothermally at $20^\circ C$ until its volume is doubled and then adiabatically until its volume is again doubled. Find the final temperature of the gas, given γ= 1.4 and that there is 0.1 mole of the gas. Also calculate the work done in the two cases.

$R = 8.3J\text{mole}^{-1}K^{-1}$

Watch Video Solution

33. In a cyclic process initially a gas is at 10^5 Pa pressure and its volume is $2m^3$. First it undergoes an isobaric expansion to increase its volume to $2.5m^3$. The in an isochoric process its pressure is doubled. Now the gas is brought back to its initial state by changing the pressure of gas linearly with its volume.

Find the total amount of heat supplied to the gas in the process.

Watch Video Solution

34. A certain volume of dry air at $20^{\circ}C$ is expanded to there times its volume (i) slowly, (ii) suddenly. Calculate the final pressure and temperature in eachh case. Atmospheric pressure $= 10^5 Nm^{-2}$, γ of air $= 1.4$

Watch Video Solution

35. A closed vessel impermeable to heat contains ozone (O_3) at a temperature of $t_1 = 527^\circ C$. After some time the ozone is completely converted into oxygen (O_2). Find the increase of the pressure in the vessel ifq=34 kcal have to be spent to form one g-mole of ozone from oxygen. M_1= Molecular weight of ozone = 48 and M_2 = molecular weight of oxygen 32, $C_v$of oxygen = 5 cal/deg. mole.

View Text Solution

36. A gas occupying one litre at 80 cm pressure is expanded adiabatically to $1190cm^3$. If the pressure falls to 60 cm in the process, deduce the value of γ.

Watch Video Solution

37. A certain mass of a gas is taken at $0^\circ C$ in a cylinder whose walls are perfect insulators. The gas is compressed (a) slowly, (b) suddenly till its pressure is increased to 20 times the initial pressure ($\gamma = 1.4$). Calculate the final temperature in each case.

Watch Video Solution

38. In a polytropic process an ideal gas (y= 1.40) was compressed from volume $V_1 = 10 litres \rightarrow v_2 = 5 litres$. The pressure increased from $p_1 = 10^5 Pa \rightarrow p_2 = 5 \times 10^5$ Pa.Determine: (a) the polytropic expoment n, (b) the molar heat capacity of the gas for the process.

Watch Video Solution

39. A diatomic ideal gas is heated at constant volume until its pressure becomes three times. It is again heated at constant pressure until its volume is doubled. Find the molar heat capacity for the whole process.

Watch Video Solution

40. One mole an ideal gas whose adiabatic exponent equals γ undergoes a process

$p = p_0 + \alpha / V$, where p_0 and α are positive constants. Find :

(a) heat capacity of the gas as a function of its volume ,

(b) the internal energy of heat transferred to the gas, of its volume increased from V_1 to V_2.

Watch Video Solution

41. One mole an ideal gas whose adiabatic exponent equals γ undergoes a process $p = p_0 + \alpha / V$, where p_0 and α are positive constants. Find :

(a) heat capacity of the gas as a function of its volume ,

(b) the internal energy of heat transferred to the gas, of its volume increased from V_1 to V_2.

Watch Video Solution

42. One mole of argon is expanded according to process equation $PV^{1.5} =$ constant and its temperature falls by 26 K, then

Watch Video Solution

43. On mole of argon expands polytropically, the polytropic constant being 1.5, that is, the process proceeds according to the law $pV^{1.5}$ = constant. In the process, its temperature change by $\Delta T = -26K$. Find

a. the amount of heat obatined by the gas.

b. the work performed by the gas.

Watch Video Solution

44. Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and the same velocity V. The mass of the gas in A is m_A, and that in B is m_B. The gas in each cylinder is now allowed to expand isothermally to the same final volume 2V. The changes in the pressure in A and B are found to be ΔP and $1.5\Delta P$ respectively. Then

Watch Video Solution

45. Suppose that 30 g of highly compressed air $(C = 0.177 cal / g. C^{\circ})$ is confined to a cylinder by a piston. Its volume is 2400 cm^3 its pressure is 10×10^5 Pa, and its temperature is $35^{\circ} C$. The air is expanded adiabatically until its volume is 24,000 cm^3. During the process, 4100 J of work is done by the air. What is its final temperature ?

Watch Video Solution

46. A mole of a monatimic perfect gas is adiabatically composressed when its temperature rises from 27° to $127^\circ C$. Calculate the work done.

[Hint: Work done $= R\frac{T - T'}{\gamma} - 1$, for monatomic gas $= \frac{5}{3}$]

Watch Video Solution

47. In a certain polytropic process the volume of argon was increased $\alpha = 4.0$ times.

Simultaneously, the pressure decreased $\beta = 8.0$ times. Find the molar heat capacity of argon in this process. Assuming the gas to be ideal.

Watch Video Solution

48. Gaseous hydrogen contained initially under standard conditions in a sealed vessel of volume V = 5.01 L was cooled by $\Delta T = 50K$. Find how much the internal energy of the gas will change and what amount of heat will be lost by the gas.

Watch Video Solution

49. A cylinder contains 3 moles of oxygen at a temperature of $27^\circ C$. The cylinder is provided with a frictionless piston which maintains a constant pressure of 1 atm on the gas. The gas is heated until its temperature rises to $127^\circ C$.

a. How much work is done by the gas in the process ?

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

c. How much heat was supplied to the gas ?

For oxygen $C_P = 7.03 cal mol^{-1} . ^{\circ} C^{-1}$.

Watch Video Solution

50. A cylinder contains 3 moles of oxygen at a temperature of $27^{\circ} C$. The cylinder is provided with a frictionless piston which maintains a constant pressure of 1 atm on the gas. The gas is heated until its temperature rises to $127^{\circ} C$.

a. How much work is done by the gas in the process ?

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

c. How much heat was supplied to the gas ?

For oxygen $C_P = 7.03 cal mol^{-1} . ^{\circ} C^{-1}$.

Watch Video Solution

51. A cylinder contains 3 moles of oxygen at a temperature of $27^{\circ} C$. The cylinder is provided with a frictionless piston which maintains a constant pressure of 1 atm on the gas. The gas is heated until its temperature rises to $127^\circ C$.

a. How much work is done by the gas in the process ?

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

c. How much heat was supplied to the gas ?

For oxygen $C_P = 7.03 cal mol^{-1} . ^\circ C^{-1}$.

Watch Video Solution

52. One mole of an ideal monoatomic gas at temperature T_0 expands slowly according to the law $\frac{p}{V}$ = constant. If the final temperature is $2T_0$, heat supplied to the gas is

Watch Video Solution

53. An insulator container contains 4 moles of an ideal diatomic gas at temperature T. Heat Q is supplied to this gas, due to which 2 moles of the gas are dissociated into atoms but temperature of the gas remains constant. Then

Watch Video Solution

54. Two moles of an ideal monoatomic gas, initially at pressure p_1 and volume V_1, undergo an adiabatic compression until its volume is V_2. Then the gas is given heat Q at constant volume V_2.

(i) Sketch the complete process on a p-V diagram.

(b) Find the total work done by the gas, the total change in its internal energy and the final temperature of the gas. [Give your answer in terms of p_1, V_1, V_2, Q and R]

Watch Video Solution

55. Two moles of an ideal monoatomic gas, initially at pressure p_1 and volume V_1, undergo an adiabatic compression until its volume is V_2. Then the gas is given heat Q at constant volume V_2.

(i) Sketch the complete process on a p-V diagram.

(b) Find the total work done by the gas, the total change in its internal energy and the final temperature of the gas. [Give your answer in terms of p_1, V_1, V_2, Q and R]

Watch Video Solution

56. A mole of an ideal gas initially at a temperature $T_1 = 290K$ expands isobarically until its volume increases 2 times. Next the gas is cooled isochorically to its initial temperature T_1.Find (a) the incement ΔU in the internal energy of the gas, (b) the work A done by the gas (c) the amount of the heat Q received by the gas.

Watch Video Solution

57. A cylinder contains an ideal gas at a pressure of two atmospheres, the volume being 5 litres at a temperature of 250 K. The gas is heated at constant volume to a pressure of 4 atmospheres and then at constant pressure to a temperature of 650 K. Calculate the total heat input during these processes. For the gas $C_v = 21 J \mathrm{mole}^{-1} degree^{-1}$, The gas is then cooled at constant volume to its original pressure and then at constant pressure to its original volume. Find the total heat output during these processes and the total work done by the gas in the whole cyclic process.

View Text Solution

58. Two moles of helium gas$(\lambda = 5/3)$ are initially at temperature $27^{\circ}C$ and occupy a volume of 20 litres. The gas is first expanded at constant pressure until the volume is doubled. Then it undergoes an adiabatic change until the temperature returns to its initial value.

(i) Sketch the process on a p-V diagram.

(ii) What are the final volume and pressure of the gas?

(iii) What is the work done by the gas ?

Watch Video Solution

59. A gram mole of a gas at $27^{\circ}C$ expands isothermally until its volume is doubled. Calculate the amount of work done. $(R = 8 J mol^{-1} K^{-1})$

Watch Video Solution

60. The temperature of 3 kg of nitrogen is raised form $10^{\circ}C$ to $100^{\circ}C$, Compute the heat added, the work done, and the change in internal energy if (a) this is done at constant volume and (b) if the heating is at constant pressure. For nitrogen

$C_p = 1400 J kg^{-1} K^{-1}$ and

$C_v = 740 J kg^{-1} K^{-1}$.

Watch Video Solution

61. The temperature of 3 kg of nitrogen is raised form $10^{\circ} C$ to $100^{\circ} C$, Compute the heat added, the work done, and the change in internal energy if (a) this is done at constant volume and (b) if the heating is at constant pressure. For nitrogen

$C_p = 1400 J kg^{-1} K^{-1}$ and

$C_v = 740 J kg^{-1} K^{-1}$.

Watch Video Solution

62. A heat-conducting piston can freely move inside a closed thermally insulated cylinder with an ideal gas. In equilibrium the piston divides the cylinder into two equal parts, the gas temperature being equal to T_0. The piston is slowly displaced. Find the gas temperature as a function of the ratio η of the volumes of the greater and smaller sections. The adiabatic exponent of the gas is equal to γ.

Watch Video Solution

63. A heat conducting piston can move freely inside a closed, thermally insulated cylinder with an ideal gas (γ= 5/3). At equilibrium, the piston divides the cylinder into two equal parts, the gas temperature being equal to 300 K. The piston is slowly displaced by an external agent. Find the gas temperature when the volume of the greater section is seven times the volume of the smaller section.

View Text Solution

64. The atomic mass of iodine is $127g/mol$. A standing wave in iodine vapour at $400k$ has nodes that are $6:77cm$ apart when the frequency is $1000H_Z$. At this temperature, is iodine vapour monatomic or daiatomic.

Watch Video Solution

65. A cubical vessel of side 1 metre contains one gram molecule of nitrogen at pressure of 2 atmospheres and 300 K. If the molecules are assumed to move with their rms velocity find the number of collisions per second which he molecules can make with the wall of vessel. Further if the vessel now thermally isolated moved with a constant speed V and then suddenly results in a rise of temperature $2^\circ C$. Find V.

View Text Solution

66. A gas consisting of rigid diatomic molecules (degrees of freedom r = 5) under standard conditions $\left(P_0 = 10^5\right.$ Pa and $\left.T_0 = 273K\right)$ was compressed adiabatically $\eta = 5$ times. Find the mean kinetic energy of a rotating molecule in the final state.

Watch Video Solution

67. A Gas is enclosed in a metallic container of volume Vand its initial pressure is p. It is slowly

compressed to a volume V/2 and then suddenly compressed to V/4. Find the final pressure of the gas. From the initial state the gas is suddenly compressed to V/2 and then slowly compressed to V/4, what will be the final pressure now.

Watch Video Solution

68. One gram mole of oxygen at $27^{\circ}C$ and one atmospheric pressure is enclosed in a vessel. Assuming the molecules to be moving with

v_{rms}, find the number of collisions per second which the molecules make against one square metre of the vessel wall.

Watch Video Solution

69. An ideal gas expands at a constant pressure of 7.0 atm from 280 mL to 630 mL. Heat then flows out of the gas, at constant volume, and the pressure and temperature are allowed to drop until the temperature reaches its original value. Calculate the total work done by the gas in the process

Watch Video Solution

70. An ideal gas expands at a constant pressure of 7.0 atm from 280 mL to 630 mL. Heat then flows out of the gas, at constant volume, and the pressure and temperature are allowed to drop until the temperature reaches its original value. Calculate the total heat flow into the gas.

Watch Video Solution

71. Find the specific heat of a polyatomic gas at constant volume if the density of this gas in standard conditions is $7.95 \times 10^{-4} gm / cm^3$. Express your result in cal/gm degree.

Watch Video Solution

72. An ideal gas expands according to the law $pV^2 =$ constant (a) Is it heated or cooled ?

(b) What is the molar heat capacity in this process?

Watch Video Solution

73. An ideal gas expands according to the laq $PV^{\frac{3}{2}} = cons\tan t$. Then find molar heat capcity of this gas for the given process.

Watch Video Solution

74. The molar heat capacity of an ideal gas (γ =1.40) varies during a process according to the law $C = 20.0 + \frac{500}{T}$.

Is the process polytropic ?

View Text Solution

75. The molar heat capacity of an ideal gas (γ =1.40) varies during a process according to the law $C = 20.0 + \frac{500}{T}$.

Find the work done by a mole of the gas when heated from T_1=200 K to T_2=544 K .

View Text Solution

76. One cubic metre of argon at $27^\circ C$ is adiabatically compressed so that the final temperature is $127^\circ C$. Calculate the new volume of the gas $(\gamma = 5/3)$.

Watch Video Solution

77. Two moles of a certain gas at a temperature $T_0 = 300K$ were cooled isochorically so that the pressure of the gas got reduced 2 times. Then as a result of isobaric process, the gas is allowed to expand till its temperature got back to the initial value. Find the total amount of heat absorbed by gas in this process.

Watch Video Solution

78. Find the specific heat capacities c_v and c_p for a gaseous mixture consisting of $7.0g$ of nitrogen and $20g$ of argon. The gases are assumed to be ideal.

Watch Video Solution

79. A gas (γ = 1.5) is enclosed in a thermally insulated container of volume $4 \times 10^{-4} m^{-3}$ 1 atmospheric pressure and at a temperature of 300K. If the gas is suddenly compressed to a volume of $10^{-4} m^3$, what will be the final pressure and the temperature of the gas. What will be your answers for final pressure and temperature if gas is slowly compressed to the same final volume.

Watch Video Solution

80. The temperature of the sun's interior is estimated to be about 14×10^6K. Protons (m=1.67 x 10-27 kg) compose most of its mass. Compute the average speed of a proton by assuming that the protons act as particles in an ideal gas.

Watch Video Solution

81. A horizontal insulated cylinder is provided with frictionless non-conducting piston. On each side of the piston there is 50 litres of air at a pressure of 1 atmosphere and 273 K. Heat is slowly supplied to the air at the left hand side, until the piston has compressed the air on the right hand side to 2.5 atmosphere. Find

: Final temperature of air on the right hand side

View Text Solution

82. A horizontal insulated cylinder is provided with frictionless non-conducting piston. On each side of the piston there is 50 litres of air at a pressure of 1 atmosphere and 273 K. Heat is slowly supplied to the air at the left hand side, until the piston has compressed the air

on the right hand side to 2.5 atmosphere. Find Work done on the air on the right hand side

Watch Video Solution

83. A horizontal insulated cylinder is provided with frictionless non-conducting piston. On each side of the piston there is 50 litres of air at a pressure of 1 atmosphere and 273 K. Heat is slowly supplied to the air at the left hand side, until the piston has compressed the air

on the right hand side to 2.5 atmosphere. Find Final temperature of air on the left hand side

View Text Solution

84. A horizontal insulated cylinder is provided with frictionless non-conducting piston. On each side of the piston there is 50 litres of air at a pressure of 1 atmosphere and 273 K. Heat is slowly supplied to the air at the left hand side, until the piston has compressed the air

on the right hand side to 2.5 atmosphere. Find Heat added to air on the left hand side.

View Text Solution

85. What work has to be done adiabatically to increase the root mean square speed of a mole of a diatomic gas η=5 times from T_1 = 300 K?

Watch Video Solution

86. One mole of an ideal gas is contained in a vertical cylinder under a massless piston moving without friction. The piston is slowly raised so that the gas expands isothermally at temperature T_0 = 300 K. Find the amount of work done increasing the volume to η=2 times. The outside pressure is atmospheric.

Watch Video Solution

87. In an experiment with high energy beam, hydrogen ions each of 1.67×10^{-27} kg strike a stationary and thermally insulated target with a velocity of $2 \times 10^7 ms^{-1}$ at the rate of 10^{15} ions per second. If the mass of the target is 500 g and specific heat $0.09 kcal g^{-1} . ^\circ C^{-1}$, find the time taken for the temperature of the target to rise by $100^\circ C$, assuming the whole energy of the ions is converted to heat and absorbed by the target.

Watch Video Solution

88. Four moles of a certain ideal gas at $30^{\circ}C$ are expanded isothermally to three times its volume and then heated at this constant volume until the pressure is raised to its initial value. In the whole process the heat supplied is 72 KJ. Calculate the ratio C_p / C_v for the gas and state whether it is monoatomic, diatomic or polyatomic gas.

Watch Video Solution

89. One mole of a gas is put under a weightless piston of a vertical cylinder at temperature T. The space over the piston opens into atmosphere. Initially, piston was in equilibrium. How much work should be performed by some external force to increase isothermally the volume under the piston to twice the volume? (Neglect friction of piston).

Watch Video Solution

90. Two moles of a certain ideal gas at 300K is cooled at constant volume so that the pressure is reduced to half the original value. Now the gas is heated at constant pressure so that its temperature becomes equal to the initial temperature. Find the total amount of heat absorbed by the gas in the process.

Watch Video Solution

91. An ideal gas in a cylinder is slowly compressed to one third of its original volume. During this process, the temperature of the gas remains constant and the work done in compression is 75 J. How much does the internal energy of the gas change ?

Watch Video Solution

92. An ideal gas in a cylinder is slowly compressed to one third of its original volume. During this process, the temperature of the gas remains constant and the work done in compression is 75 J. How much heat flows into the gas ?

Watch Video Solution

93. A diatomic gas initially occupying a volume 3 litres at 300 K and one atmospheric pressure is adiabatically compressed to 1/3 of the initial volume. It is then isobarically expanded till its temperature becomes 300 K, and finally isothermally expanded to restore it to the initial P-V-T conditions. Find the work done during complete cycle of operations.

View Text Solution

94. For air, $C_V = 0.177 \text{cal/g.}^\circ C$. Suppose that air is confined to a cylinder by a movable piston under a constant pressure of 3.0 atm. How much heat must be added to the air if its temperature is to be changed from $27^\circ C$ to

400° C? The mass of air in the cylinder is 20 g, and its original volume is 5860 cm.

Watch Video Solution

95. A given mass of monoatomic gas occupies a volume of 4 litre at 1 atmosphere pressure and 300 K. It is compressed adiabatically to 1 litre. Find Final pressure and temperature

Watch Video Solution

96. A given mass of monoatomic gas occupies a volume of 4 litre at 1 atmosphere pressure and 300 K. It is compressed adiabatically to 1 litre. Find Increase in the internal energy

Watch Video Solution

97. Two vessels A and B of equal volume (V_0) are connected by a narrow tube which can be closed by a valve. The vessels are fitted with piston which can be moved to change the

volumes. Initially, the valve is open and the vessels contain an ideal gas $\left(\frac{C_p}{C_v} = \gamma\right)$ at atomospheric pressures(P_0) and atmospheric temperature (T_0). The walls of the vessels A are diathermic and those of B are adiabatic. The valve is now closed and the pistons are slowly pulled out to increase the volumes of the of the vessels to double the original value.

(a) Find the temperatures and pressures in the two vessels.

Watch Video Solution

98. The average degrees of freedom per molecule for a gas are 6. The gas performs $25J$ of work when it expands at constant pressure. The heat absorbed by gas is

Watch Video Solution

99. Two cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at 300K. The piston of A is free to move, while that B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30K, then the rise in temperature of the gas in B is

Watch Video Solution

100. A gas undergoes a change of state during which 100J of heat is supplied to it and it does 20J of work. The system is brough back to its original state through a process during which 20 J of heat is released by the gas. What is the work done by the gas in the second process?

Watch Video Solution

Practice Exercise 3 1

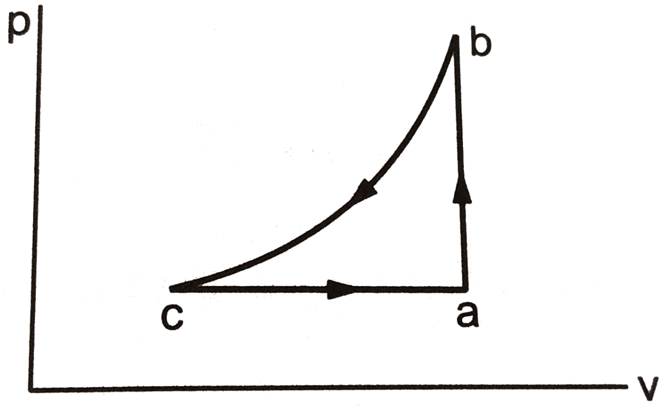
1. A gas undergoes a change of state during which 100J of heat is supplied to it and it does 20J of work. The system is brough back to its original state through a process during which 20 J of heat is released by the gas. What is the work done by the gas in the second process?

Watch Video Solution

2. A sample of an ideal gas is taken through the cyclic process $abca$. It absorbs $50J$ of heat during the part ab, no heat during bc and rejects $70J$ of heat during ca. $40J$ of work is done on the gas during the part bc.

(a) Find the internal energy of the gas at b and c if it is $1500J$ at a.

(b) Calculate the work done by the gas during the part ca.



Watch Video Solution

3. In a gaseous system, a gas expands from $10^{-4}m^3$ to $2 \times 10^{-4}m^3$ while itspressure remains constant at $10^{-4}Nt/m^2$. Calculate

the amount of heat absorbed by the gas inthe expansion. $[\gamma = 1.67]$

Watch Video Solution

4. At 1 atmospheric pressure, 1.000 g of water having a volume of $1.000 cm^3$ becomes 1671 cm^3 of steam when boiled. The heat of vaporization of water at 1 atmosphere is $539 cal/g$. What is the change in internal energy during the process ?

Watch Video Solution

5. N_2 is confined in a cylindrical vessel with a movable piston exposed to open atmosphere. If 25 kcal of heat is added to it and the internal energy of the gas increases by 8 kcal, find the work done by the gas.

Watch Video Solution

6. A sample of an ideal diatomic gas is heated at constant pressure. If an amount of 100 J of heat is supplied to the gas, find the work done by the gas.

Watch Video Solution

Practice Exercise 3 3

1. One mole of an ideal gas undergoes a process $p = \frac{p_0}{1 + \left(\frac{V_0}{V}\right)^2}$. Here, p_0 and V_0 are constants. Change in temperature of the gas when volume is changed from $V = V_0$ to $V = 2V_0$ is

Watch Video Solution

2. For a thermodynamic system the pressure, volume and temperature are related as new gas law given as

$$P = \frac{\alpha T^2}{V}$$

Here α is a constant. Find the work done by the system in this process when pressure remains constant and its temperature changes from T_0 to $2T_0$.

Watch Video Solution

3. Temperature of 1 mole of an ideal gas is increased from 300K to 310K under isochoric process. Heat supplied to the gas in this process is Q=25R, where R=universal gas constant. What amount of work has to be done by the gas if temperature of the gas decreases from 310K to 300K adiabatically?

Watch Video Solution

4. During the adiabatic expansion of 2 moles of a gas, the internal energy was found to have decreased by 100 J . The work done by the gas in this process is

Watch Video Solution

5. 1 litre of an ideal gas $(\gamma = 1.5)$ at $300K$ is suddenly compressed to half its original volume.

(a) Find the ratio of the final pressure to the initial pressure.

(b) If the original pressure is $100 KPa$, find the work done by the gas in the process.

(c) What is the change in internal energy?

(d) What is the final temperature?

(e) the gas is now cooled to $300K$ keeping its pressure constant. Calculate the work done during the process .

(f) The gas is now expanded isothermally to achieve its original volume of 1 litres. Calculate the work done by the gas .

(g) Calculate the total work done in the cycle.

Watch Video Solution

6. Three identical diatomic gases (γ=1.5) are enclosed in three identical containers but at different pressures and same temperatures. These gases are expanded to double their volumes in first container the process is isothermal, in second container the process is adiabatic and in third container process is isobaric. Of The final pressures are equal in the three containers, find the ratio of the initial pressures in the three containers.

Watch Video Solution

7. Calculate the work done when 1 mole of a perfect gas is compressed adiabatically . The initial pressure and volume of the gas are $10^5 N/m^2$ and 6 litre respectively. The final volume of the gas is 2 litres. Molar specific heat of the gas at constant volume is $\frac{3R}{2}\left[(3)^{5/3}=6.19\right]$

Watch Video Solution

8. An ideal diatomic gas is heated at constant pressure such that it performs a work W=2.0 J . Find the amount of heat supplied.

Watch Video Solution

9. Two identical gases whose adiabatic exponent is γ are filled in two identical containers at equal pressures. In both the containers the volume of gas is doubled. In first container it is done by an isothermal process and in second container it is done by adiabatic process. Find the condition for which the work done by the gas in the two expansion process is same.

Watch Video Solution

10. One mole of oxygen being initially at a temperature $T_0 = 290K$ is adiabatically compressed to increase its pressure $\eta = 10.0$ times. Find :

(a) the gas temperature after the compression

,

(b) the work that has been performed on the gas.

Watch Video Solution

Practice Exercise 3 4

1. The volume of one mode of an ideal gas with adiabatic exponent γ is varied according to the law $V = a/T$, where a is constant . Find the amount of heat obtained by the gas in this process, if the temperature is increased by ΔT

.

Watch Video Solution

2. For the case of an ideal gas find the equation of the process (in the variables T, V) in which the molar heat capacity varies as :

(a) $C = C_V + \alpha T$,

(b) $C = C_V + \beta V$,

(c) $C = C_v + ap$,

where α, β and a are constants.

Watch Video Solution

3. For the case of an ideal gas find the equation of the process (in the variables T, V) in which the molar heat capacity varies as :

(a) $C = C_V + \alpha T$,

(b) $C = C_V + \beta V$,

(c) $C = C_v + ap$,

where α, β and a are constants.

Watch Video Solution

4. For the case of an ideal gas find the equation of the process (in the variables T, V) in which the molar heat capacity varies as :

(a) $C = C_V + \alpha T$,

(b) $C = C_V + \beta V$,

(c) $C = C_v + ap$,

where α, β and a are constants.

Watch Video Solution

5. A gas consisting of monatomic molecules (degrees of freedom = 3) was expanded in a polytropic process so that the rate of collisions of the molecules against the vessel's wall did not change. Find the molar heat capacity of the gas in the process.

View Text Solution

6. A gas consisting of rigid diatomic molecules was expanded in a polytropic process so that the rate of collisions of the molecules against the vessel's wall did not change. Find the molar heat capacity of the gas in this process.

Watch Video Solution

7. An ideal gas has an adiabatic exponent γ. In some process its molar heat capacity varies as $C = \alpha / T$,where α is a constant Find :

(a) the work performed by one mole of the gas during its heating from the temperature T_0 to the temperature η times higher ,

(b) the equation of the process in the variables p, V.

Watch Video Solution

8. An ideal gas has an adiabatic exponent γ. In some process its molar heat capacity varies as $C = \alpha / T$,where α is a constant Find :

(a) the work performed by one mole of the gas during its heating from the temperature T_0 to the temperature η times higher ,

(b) the equation of the process in the variables p, V.

Watch Video Solution

9. The volume of a diatomic gas $(\gamma = 7/5)$ is increased two times in a polytropic process with molar heat capacity $C = R$. How many times will the rate of collision of molecules against the wall of the vessel be reduced as a result of this process?

Watch Video Solution

10. One mole of an ideal gas whose adiabatic axponent equal γ undergoes a process in which the gas pressure relates to the temperature as $p = aT^{\alpha}$, where a and α are consists. Find :

(a) the work performed by the gas if its temperature gets an increment ΔT ,

(b) the molar heat capacity of the gas in the process , at what value of α will the heat capacity be negative ?

Watch Video Solution

11. One mole of an ideal gas whose adiabatic axponent equal γ undergoes a process in which the gas pressure relates to the temperature as $p = aT^{\alpha}$, where a and α are consists. Find :

(a) the work performed by the gas if its temperature gets an increment ΔT ,

(b) the molar heat capacity of the gas in the process , at what value of α will the heat capacity be negative ?

Watch Video Solution