PHYSICS

BOOKS - MBD

THERMODYNAMICS

Example

1. State first law of thermodynamics.

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2. What do you mean by "internal energy"?

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3. What is the value of specific heat of water in S.I. units?

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4. Which is greater : C_p or C_v?

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5. Does the internal energy of an ideal gas change in an isothermal process

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6. Does the internal energy of an ideal gas change in an adiable process?

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7. Can the temperature of an isolated system change?

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8. Why does a gas gets heated on compression?

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9. Why cooling takes place when a gas suffer adiabatic expansion?

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10. Can two isothermal curves intersect each other? Why?

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11. What is heat engine?

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12. What is heat pump?

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13. How is heat engine differ from refrigerator?

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14. Under what conditions can the efficiency of a Carnot engine be 100%?

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15. Is it possible to convert internal energy into work?

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16. Can whole of work be converted into heat? Is the reverse true?

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17. Is rusting of iron a reversible process?

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18. Is Carnot's engine a practical engine?

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19. How is the efficiency of a Carnot engine affected by the nature of the working substance?

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20. Can the temperature of a gas be increased by keeping its pressure and volume constant?

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21. 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 $4.0 \times 10^{4} J/g$?

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22. 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 $N_2 = 28, R = 8.3 Jmol^{-1} K^{-1}$.)

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23. 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 $(T_1 + T_2)/2$.

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24. 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.

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

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26. A cylinder with a movable piston contains3moles of hydrogen atstandard temperature and pressure. The walls of the cylinder are made of a heat insulator, and the piston

is insulated by having a pile of sand on it. By what factor does the pressure of the gas increase if the gas is compressed to half its original volume ?

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27. In changing the state of a gas adiabatically from an equilibrium state A to another equilibrium state B, an amount of work equal to 22.3 Jis done on the system. If the gas is taken from state A to B via a process in which the net heat absorbed by the system is 9.35 cal, how much is the net work done by the system in the latter case ? (Take 1 cal = 4.19 J)

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28. 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 ?

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29. 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 ?

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30. 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 ?

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31. 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 ?

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32. A steam engine delivers $5.4 \times 10^8 J$ of work per minute and services $3.6 \times 10^9 J$ of heat per minute from its boiler. What is the efficiency of the engine? flow much heat is wasted per minute?

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33. An electric heater supplies heat to a system at a rate of 100W. If system performs work at a rate of 75 joules per second. At what rate isthe internal energy increasing?

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

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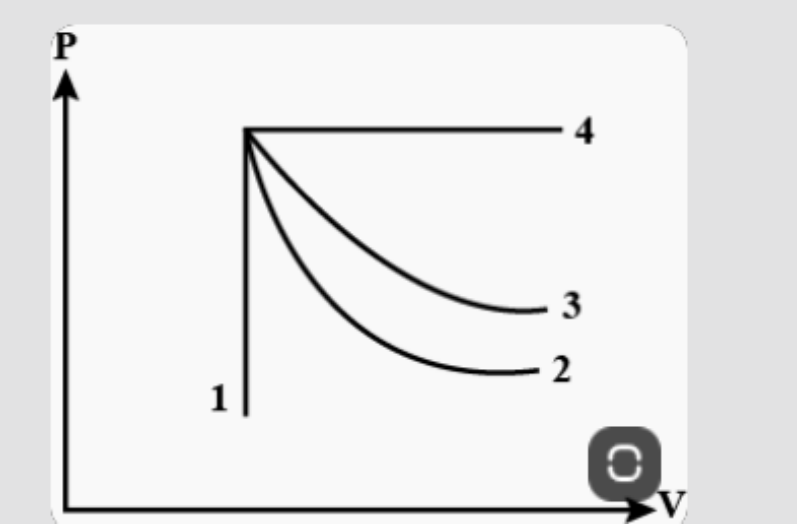
35. An ideal gas undergoes four different processes from the same initial state (Figure Four processes are adiabatic,

isothermal, isobaric and isochoric. Out of 1,2,3 and 4, which one is adiabatic?



A. 4

B. 3

C. 2

D. 1

Answer:

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36. If an average person jogs, he produces 14.5×10^3 cal/min. This is removed by the evaporation of sweat. The amount of sweat evaporated per minute (assuming 1 kg requires 580×10^3 cal for evaporation) is

A. 0.25 kg

B. 2.25 kg

C. 0.05 kg

D. 0.20 kg

Answer:

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37. Consider two containers A and B containing identical gases at the same pressure, volume and temperature. The gas in container A is compressed to half of its original volume isothermally while the gas in container B is compressed to half of its original value adiabatically. The ratio of final pressure of gas in B to that of gas in A is

A. $2^{\gamma-1}$

B. $\left(\frac{1}{2}\right)^{\gamma-1}$

C. $\left(\frac{1}{1-\gamma}\right)^{2}$

D. $\left(\frac{1}{\gamma-1}\right)^{2}$

Answer:

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38. Three copper blocks of masses M_1, M_2 and M_3 kg respectively are brought into thermal contact till they reach equilibrium. Before contact, they were at $T_1, T_2, T_3 (T_1 > T_2 > T_3$). Assuming there is no heat loss to the surroundings, the equilibrium temperature T is (s is specific heat of copper)

A. $T = \frac{T_1 + T_2 + T_3}{3}$

B. $T = \frac{M_1T_1 + M_2T_2 + M_3T_3}{M_1 + M_2 + M_3}$

C. $T = \frac{M_1T_1 + M_2T_2 + M_3T_3}{3(M_1 + M_2 + M_3)}$

D.

$$T = (M_1s + T_1 + M_2T_2s + M_3T_3)\frac{s}{3(M_1 + M_2 + M_3)}$$

Answer:

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39. Which of the process described below are irreversible?

A. The increase in temperature of an iron rod by hammering it.

B. A gas in a small contianer at a temprture T_1 is brought in contact with a big reservoir at a higher temperature T_2 which increases the temperature of the gas.

C. A quasi-static isothermal expansion of an ideal gas in cylinder fitted with a frictionless piston.

D. an ideal gas is enclosed in a piston cylinder arrangement with adiabatic walls. A weight W is added to the piston, resulting in compression of gas.

Answer:

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40. An ideal gas undergoes isothermal process from some initial state I to final state f. choose the correct alternatives

A. $dU = 0$

B. $dQ = 0$

C. $dQ = du$

D. $dQ = dW$

Answer:

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41. Can a system be heated and its temperature remain constant?

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42. A system goes from P to Q by two different paths in the P–V diagram as shown in Figure. Heat given to the system in path 1 is 1000 J. The work done by the system along path

1 is more than path 2 by 100 J. What is the heat exchanged by the system in path 2?

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43. If the door of a refrigerator is kept open, the room in which the refrigerator is kept

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44. Is it possible to increase the temperature of the gas without adding heat to it? Explain.

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

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46. Consier a Carnot's cycle operating between $T_1 = 500K$ and $T_2 = 300K$ producing 1 k J of mechanical work per cycle. Find the heat transferred to the engine by the reservoirs.

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47. A person of mass 60 kg wants to lose 5 kg by going up and down a 10 m high stairs. Assume he burns twice as much fat while going up than coming down. If 1 kg of fat is

burnt on expending 7000 kilo calories, how many times must he go up and down to reduce his weight by 5 kg?

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48. Consider a cycle tyre being filled with air by a pump. Let V be the volume of the tyre (fixed) and at each stroke of the pump $\Delta V(<< V)$ of air is transferred to the tube adiabatically. What is the work done when the pressure in the tube is increased from P_1 to P_2.

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49. In a refrigerator, one removes heat from a lower temperature and deposits to the surroundings at a higher

temperature. In this process, mechanical work has to be done, which is provided by an electric motor. If the motor is of 1kW power, and heat is transferred from $-3^{\circ}C \rightarrow 27^{\circ}C$, find the heat taken out of the refrigerator per second assuming its efficiency is 50% of a perfect engine.

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50. If the co-efficient of perormance of a refrigerator is 5 and operates at the room temperature $(27^{\circ}C)$, find the temperature inside the refrigerator.

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51. 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.

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52. 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.

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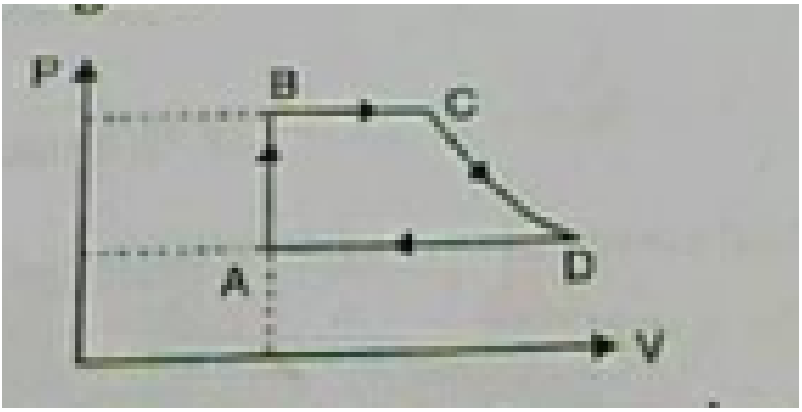
53. A cycle followed by an engine (made of one mole of an ideal gas in a cylinder with a piston) is shown in the figure. Find heat exchanged by the engine, with the surroundings at constant volume of the cycle. `(C_v = (3/2) R)



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54. Consider that an ideal gas (n moles) is expanding in a process given by P = f (V), which passes through a point

(V_0, P_0). Show that the gas is absorbing heat at (P_0, V_0) if the slope of the curve P = f (V) is larger than the slope of the adiabat passing through (P_0, V_0)

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55. First law of thermodynamics can be explained on the basis of

A. Boyle's law

B. Maxwell's law

C. Charle's law

D. Law of conservation of energy

Answer:

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56. A given system undergoes a change in which work done by the system equals decrease in its internal energy. The system must have undergone an

A. Isothermal change

B. Adiabatic change

C. Isochroic change

D.

Answer:

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57. Heat capacity of a susbtance 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:

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58. Air in a cylinder is suddenly compressed by a piston, which is then maintained at the same position. With hpassage of time

A. The pressure increases

B. The pressure may increase or decrease

C. The pressure remains the same

D. The pressure decreases.

Answer:

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59. The specific heat of a gas in an isothermal process is

A. Infinite

B. Zero

C. Negative

D. Remains constant.

Answer:

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60. Which of the following is not true about the processes?

A. For isothermal process dT = 0

B. For isobaric process DP = 0

C. For isochoric process D E = 0

D. For adiabatic process dQ = 0

Answer:

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61. Which of the following is not a state function

A. Temperature

B. Entropy

C. Pressure

D. Work

Answer:

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62. Which of the following parameters done not characterize the thermodynamic state of matter?

A. Temperature

B. Pressure

C. Work

D. volume

Answer:

Watch Video Solution

63. Which of the following is incorrect regarding the first law of thermodynamics?

A. It introduces the concept of the internal energy

B. It introduces the concept of the entropy

C. It is not applicable to any cyclic process

D. It is a restatement of the principle of conservation of energy.

Answer:

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64. "Heat cannot itself flow from a body at lower temperature to a body at higiher temperature" is the statement or consequence of

A. Second law of Thermodynamics

B. Conservation of momentum

C. Conservation of mass

D. First law of thermodynamics.

Answer:

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65. Which one of the following statemetns is true in respect of usual quantities represented by ΔQ, ΔU and ΔW

A. ΔU and ΔW are path dependent

B. ΔQ and ΔU are path dependent

C. ΔU does not depend on path

D. ΔQ does not depend upon path.

Answer:

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66. Which law of the thermodyamics leads us to conclude that it is not possible to convert whole of heat into work continuously

A. Third law

B. Second law

C. First law

D. Zeroth law

Answer:

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67. What is the temperature of the source in Carnot cycle of 10% efficiency when heat exhaussts at 270 K

A. 400 K

B. 500 K

C. 300 K

D. 600 K

Answer:

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68. For 100% effiiency of Carnot engine, temperature of the sink should be

A. $0^\circ C$

B. 0 K

C. 273 K

D. $0^\circ F$

Answer:

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69. Four engine are working between

Which one has maximum efficiency?

A. 100 K, 80 K

B. 40 K, 20 K

C. 60 K, 40 K

D. 120 K, 100 K.

Answer:

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70. A carnot engine works between 600 K and 300 K. In each cycle of operation, the engine draws 1000 J of heat energy from source. The efficiency of the engine is

A. 0.5

B. 0.7

C. 0.2

D. 0.8

Answer:

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

A. Both T_1 and T_2 should be low

B. Both T_1 and T_2 should be high

C. T_1 should be high and T_2 should be low

D. T_1 should be high and T_2 should be high.

Answer:

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72. In a given process on an ideal gas dW = 0 and dQ < 0. Then for the gas

A. The temperature will decrease

B. The volume will increase

C. The pressure will remain constant

D. The temperature will increase

Answer:

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73. The efficiency of a Carnot engine working between the steam point and ice pint is

A. 0.288

B. 0.278

C. 0.268

D. 0.238

Answer:

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74. If the door of a refrigerator is kept open, the room in which the refrigerator is kept

A. Decreases

B. Increases

C. Remains constant

D. Cannot say

Answer:

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75. Fill in the Blanks:

A relation between pressure, volume and temperature of a system is called _____ state.

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76. Fill in the Blanks:

Increase in internal energy is taken as ___.

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77. Fill in the Blanks:

Air escaping from a cycle-tube becomes _____.

Watch Video Solution

78. Fill in the Blanks:

If a system is thermally insulated, there is ____ in internal energy of the system.

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79. Fill in the Blanks:

complete reversible process is _____ possible.

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80. Fill in the Blanks:

Carnot engine is an _____ engine .

Watch Video Solution

81. Fill in the Blanks:

Complete ____ of heat into work is _____ possible.

Watch Video Solution

82. Fill in the Blanks:

Ideal engine have _____ eficiency.

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83. Fill in the Blanks:

Efficiency of Carnot engine depends on _____ of source and ____ sink.

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84. Fill in the Blanks:

Efficiency of Carnot engine to independent of _____ substance.

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85. Give two examples of isothermal changes

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86. Give two examples of adiabatic changes.

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87. Do the internal energy of ideal gas depend upon volume?

Watch Video Solution

88. What is zeroth law of thermodynamics?

Watch Video Solution

89. State first law of thermodynamics.

Watch Video Solution

90. How does the internal energy of an ideal gas differ from real gas?

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91. Why is a match stick lighted on rubbing it on the rough surface provided on the side of the match box?

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92. An ideal gas is compressed at a contant temperature. Will its internal energy increase or decrease?

Watch Video Solution

93. How is the heat absorbed used by a system in a cyclic process?

Watch Video Solution

94. Write adiabatic gas equation

Watch Video Solution

95. What thermodynamical variable is defined by Zeroth law

Watch Video Solution

96. What thermodynamical variable is defined by First law?

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97. If an inflated tyre bursts, the air escaping out is cooled. Why?

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98. Can the temperature of a gas be increased by keeping its pressure and volume constant?

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99. Explain why it is impossible to design a heat energy with 100% efficiency?

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100. In a Carnot engine, the temperature of sink is increased. What will happen to it efficiency?

Watch Video Solution

101. An engine working under isothermal conditions can produce no useful work. Explain.

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102. What is Carnot's theorem?

Watch Video Solution

103. Can a system be heated and its temperature remain constant?

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104. A system goes from P to Q by two different paths in the P–V diagram as shown in Figure. Heat given to the system in path 1 is 1000 J. The work done by the system along path 1 is more than path 2 by 100 J. What is the heat exchanged by the system in path 2?

Watch Video Solution

105. If the door of a refrigerator is kept open, the room in which the refrigerator is kept

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106. Is it possible to increase the temperature of the gas without adding heat to it? Explain.

Watch Video Solution

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

Watch Video Solution

108. Can specific heat of a gas be infinity?

Watch Video Solution

109. What is the relation between C_P and C_v?

Watch Video Solution

110. Explain why it is impossible to design a heat energy with 100% efficiency?

Watch Video Solution

111. Is the internal energy of an ideal gas a function of its pressure?

Watch Video Solution

112. Is Carnot's cycle a cyclic process?

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113. Two systems are said to be in thermal equilibrium with each other, if they are at the same_____.

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114. The work done by a gas is said to be ____.

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115. Specific heat of a gas can have any value ranging from _____ to _____ depending upon the mode of heating.

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116. First law of thermodynamics_____ indicate the direction of heat transfer.

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117. A rerigerator is a _____ working in reverse direction.

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118. Second law of thermodynamics implie that no heat engine can have _____.

Watch Video Solution

119. Explain why the internal eneryg of a compressed gas is less than that of a rarefied gas at the same temperature.

Watch Video Solution

120. Why cooling takes place when a gas suffer adiabatic expansion?

Watch Video Solution

121. What is zeroth law of thermodynamics?

Watch Video Solution

122. Explain what do you understand by the term "Internal energy".

Watch Video Solution

123. State first law of thermodynamics.

Watch Video Solution

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

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125. What is an isothermal change? Apply first law of thermodynamics to an isothermal change.

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126. What do you mean by reversible and irreversible process? Give example.

A. Distinguish between reversible and irreversible process.

B.

C.

D.

Answer:

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127. What is heat engine?

Watch Video Solution

128. State second law of thermodynamics ?

Watch Video Solution

129. State second law of thermodynamics ?

Watch Video Solution

130. What are cyclic and non-cyclic processes?

Watch Video Solution

131. Show that adiabatics are steeper than isotherms.

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132. State first law of thermodynamics. Apply this to derive an expression for the change in internal energy during boiling process.

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133. Is the heat supplied to a system always equal to the increase in its internal energy?

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

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135. What are the limitationhs of first law of thermodynamics?

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136. Give two statements of second law of thermodnamics.

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137. Temperature of the source and sink of a Carnot's engine are increased by the same amount, how will the efficiency be affected?

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138. What is meant by a reversible engine? Explain as to why the efficiency of a reversible engine is maximum.

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139. Two reversible engines are working between same source and sink. Whether the two will be equally efficient or have different eficiencies, discuss.

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140. Is the efficieny of a heat engine more in hilly areas than in theh plains?

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141. Derive the relationship between C_p and C_v.

Watch Video Solution

142. Define thermodynamical variables, equation of state

Watch Video Solution

143. Define isothermal process, isochoric (isovolumetric) process, isobaric process and isotherms.

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144. Write adiabatic gas equation

Watch Video Solution

145. Calculate the external work done when an ideal gas is expanded isothermally

Watch Video Solution

146. Calculate the external work done when an ideal gas is expanded adiabatically.

Watch Video Solution

147. What is heat engine?

Watch Video Solution

148. What are the main essentials of Carnot's reversible heat engine? Explain its working and efficiency of the engine.

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149. What is a refrigerator? Calculate its coeficient of performance.

Watch Video Solution

150. Why is defrosting necessary?

Watch Video Solution

151. Calculate the difference between the two specific heats of Helium gas per gram. Given that molecular weight of He = 4, J = 4.18 joule/cal and R = $8.31 Jmo \leq^{-1} / K^{-1}$?

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152. The specific heats of a gas at a constant pressure and at constant volume are 0.20 and 0.15 cal/g/K respectively. Calculate its density at N.T.P.

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153. A gas occupying dm^3 at 80 cm pressure expands adiabaticlly to 1.190 cm^3. If the pressure falls to 60 cm in the process, determine the value of γ.

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Exercise

1. An ideal gas with pressure P, volume V and temperature T is expanded isothermally to a volume 2V and a final pressure P_i, If the same gas is expanded adiabatically to a volume 2V and a final pressure P_α find the value of ratio $\frac{P_\alpha}{P_i}$. The ratio of the specific heats for the gas is 1.67.

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2. A litre of hydrogen at $27^\circ C$ and $10^5 Nm^{-2}$ pressure expand isothermally until its volume is doubled and then adiabatically until its volume is redoubled. Find the final pressure of the gas. 1(gamma = 1.4)`

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

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4. The efficiency of an ideal engine is $\frac{1}{8}$. By lowering the temperature of the sink by 100 K, it increases to $\frac{1}{4}$. Find initial and final temperature of sink.

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5. What thermodynamical variable is defined by Zeroth law

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10. If the door of a refrigerator is kept open, the room in which the refrigerator is kept

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11. Why first law of thermodynamics does not forbid flow of heat from lower temperature to higher temperature?

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12. What do you mean by "internal energy"?

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13. Fill in the Blanks:

Air escaping from a cycle-tube becomes _____.

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14. Can two isothermal curves intersect each other? Why?

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15. What do you mean by reversible and irreversible process? Give example.

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16. Write two characterstics of a reversible process.

Watch Video Solution

17. State first law of thermodynamics.

Watch Video Solution

18. Show that PV^{γ} = constant for adiabatic process.

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