PHYSICS

BOOKS - MAXIMUM PUBLICATION

THERMODYNAMICS

Example

1. What is the importance of reversibility in thermodynamics?

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Exercise

1. If the pressure and the volume of certain quantity of ideal gas are halved, then its temperature.

A. is doubled

B. becomes one-fourth

C. remains constant

D. is halved

Answer: B

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2. Give the ideal gas equation and explain the terms .

A. $PV = \frac{k_B N}{T}$

B. $P = \frac{k_B N}{V} T$

C. $PV = k_B NT$

D. $P = \frac{k_B NV}{T}$

Answer: C

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3. Which of the following laws of thermodynamics forms the basis for the definition of temperature?

A. First law

B. Zeroth law

C. Second law

D. Third law

Answer: B

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4. Which of the following is a true statement?

A. The total entropy of thermally interacting systems is conserved

B. Carnot engine has 100%` efficiency

C. Total entropy does not change in a reversible process.

D. Total entropy in an irreversible process can either increase or decrease.

Answer: C

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5. In a given process of 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: A

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6. An electric fan is switched on in a closed room. Will the air of the room be cooled?

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7. When an iron nail is hammered, it becomes hot. Why?

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8. Identify the thermodynamics process in which temperature of system may increase even when no heat is supplied to the system.

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9. Which thermodynamics variable is defined by first law of thermodynamics?

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10. The door of an operating refrigerator kept open in a closed room. Will it make the room cool?

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11. A carnot engine working between $300k$ and $600k$ has a work output of $800J$ per cycle. Find the amount of energy consumed per cycle.

A. $800J$

B. $400J$

C. $1600J$

D. $1200J$

Answer: B

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12. A carnote's engine is made to work between 200°C $\text{and } 0^{\circ}C$ first and then between 0°C` and minus 200°C. Compare the values of efficiencies in the two cases.

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13. Match the following:

1. (a) Work done by a gas, (A) Heat and work inter changes

2. (b) First law of thermodynamics , (B)

$1 - \left(\frac{Q_2}{Q_1}\right)$ B)

3. (c) Second law of thermodynamics, (C) $P\Delta V$

B)

4. (d) Efficiency , (D)$\Delta Q = \Delta U + \Delta W$

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14. What is the value of specific heat capacity of gas in Isothermal process

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15. What is the value of specific heat capacity of gas in Adiabatic process

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16. Is the function of refrigerator against the second law of thermodynamics? Explain.

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17. Heat is supplied to a system, but its internal energy does not increase Which process is the involved in this case?

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18. Heat is supplied to a system, but its internal energy does not increase Obtain an expression for the work done in the above process.

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19. A heat engine is a device which effectively converts heat energy into mechanical energy. State the law which describe this principle.

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20. Explain briefly, the operations of a Carnot's engine, draw the Carnot's cycle and deduce the expression for its efficiency.

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21. A thermo flask contains coffee it is violently shaken. considering the coffee as a system: does its temperature rise?

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22. A thermos flask contains coffee it is violently shaken. considering the coffee as a system: has heat been added to it?

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23. A thermo flask contains coffee it is violently shaken. considering the coffee as a system: has internal energy changed

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24. It is predicted by the meteorologists that global warming will result in the flooding of oceans due to the melting of ice caps on the earth. Name the thermodynamic process involved in the melting of ice.

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25. Determine the heat energy required to melt 5 kg of ice completely at 0°C.Latent heat of fusion of water is $3336 \times 10^3 JKg^{-1}$

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26. It is predicted by the meteorologists that global warming will result in the flooding of oceans due to the melting of ice caps on the

earth . During the melting process what changes will occur to its internal energy.

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27. Water is heated in an open vessel. This process is

A. Iso Thermal

B. Iso baric

C. Ico choric

D. adiabatic

Answer:

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28. Water is heated in an open vessel. Draw the heat temperature graph of ice below $0^{\circ}C$ heated up to the steam above $100^{\circ}C$.

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29. The molar heat capacity of oxygen at constant volume is $20Jmol^{-1}K^{-1}$. What do

you mean by molar heat capacity at constant volume (C)?

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30. The difference between C_p and C_v is always a constant. Give the mathematical proof.

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31. A heat engine is a device which converts heat energy into work. What is the working substance in an ideal heat engine.

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32. Camot engine is considered as an ideal heat engine. Calculate the efficiency of a heat engine working between ice point and stream point.

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33. A gas is taken in a cylinder. The walls of the cylinder is insulated from the surroundings. The gas in a cylinder is suddenly compressed. Which thermodynamic process is involved in this statement. Explain the thermodynamic process.

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34. A gas is taken in a cylinder. The walls of the cylinder is insulated from the surroundings. If

a gas is suddenly compressed 1/4^th of its original volume. Calculate the rise in temperature. The initial temperature was 27°C and $\gamma = 1.5$

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35. Raju brought a motor pump from shop. The efficiency of the motor pump is printed on its label as $60\ \%$. What is meant by this ?

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36. Can you design a heat engine of $100\,\%$ efficiency. Justify your answer.

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37. Categorise in to reversible and irreversible process. (i) Water fall, (ii) rusting of iron, (iii) electrolysis, (iv) diffusion of gas. (v) melting of ice, (vi) dissolving NaCl in water, (vii) flow of heat from hot body to cool body

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38. 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 it its heat of combustion is $4.0 \cdot 10^{4} Jg^{-1}$

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39. 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°C

at constant pressure? (molecular mass of $N_2 = 28, R = 8.3 Jmol^{-1}K^{-1}$)

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40. A cylinder with a movable piston constant moles of hydrogen air standard 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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41. 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?How much heat is wasted per minute?

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42. An electric heater supplies heat to a system at a rate of $100W$.If system performs work at a rate of 75 joule per second ,at what rate is the internal energy increasing?

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

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44. Molar volume is the vloume occupied by $1mol$ of any (idea) gas at standard temperature and pressure.(STP : 1 atmospheric pressure,$0^{\circ}C$),Show that it is $22.4litres$

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45. Match the following:

(Equation of continuity,$F = ma$

Hydraulic lift),(Pascal's law,$A_1V_1 = A_2V_2$

,Rocket propulsion),(Newton's law of motion, $P_1V_1 = P_2V_2$,Quill tube),(Boyle's law, $\frac{F_1}{A_1} = \frac{F_2}{A_2}$,Venturimeter).

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46. A heat engine is a device which effectively converts heat energy into mechanical energy. State the law which describe this principle.

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47. Thermodynamics deals with the concept of heat and the exchange of heat energy.

What are the sink,source,and working substances of a domestic refrigerator?

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48. Write the expression for the efficiency of a Carnot engine.

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49. Thermodynamics deals with the concept of heat and the exchange of heat energy.

Which thermodynamic process is also called an isoentropic process?

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50. Thermodynamics deals with the concept of heat and the exchange of heat energy.

The efficiency of a Carnot engine is $\frac{1}{6}$.If on reducing the temperature of sink by $65^{\circ}C$.Its

efficiency becomes $\frac{1}{3}$.Find the temperature of the sink and the source.

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51. Thermodynamics deals with the concept of heat and the exchange of heat energy.

Obtain the expression for the work done during an adiabatic process.

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52. The coefficient of themal expansion in solids an mainly (I)Coefficient of Linear Expansion (α) (ii) Coefficient of superficial Expansion (β)iii) Coefficient of cubical expansion (γ). What is the ratio of (α),β and (γ).

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53. The increase in dimensions of a body due to increase in temperature is called thermal

expansion.

Railway lines are laid with gaps to allow for expansion.If the gap between steel rails $60m$ long is $3.63cm$ at $10^{\circ}C$,then at what temperature will the line just touch? Coefficient of linear expansion for steel is $11 \times \frac{10^{-6}}{o} C$

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54. The property of material bodies to regain its original size on the remaoval of deforming

force is called elasticity. What is the value of Young's modulus for a perfectly rigid body?

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55. Modulus of elasticity of a material is the ratio of stress and strain.

One end of a rope of length $4.5m$ and diameter $6mm$ is fixed to the branch of a tree.A monkey weighing $100N$ jumps to catch the free end and stays there.Find the

elongation of the rope.(Young's modulus= $4.8 \times 10^{11} \frac{N}{m^2}$).

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56. Camot engine is considered as an ideal heat engine. Draw the P-V graph of Camot's cycle.

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57. A Carnot engine working between $527^{\circ}C$ and $127^{\circ}C$ has a work output of $800J$ per cycle.How much heat is supplied to the engine from the source per cycle?

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58. Isothermal, isobaric, isochoric and adiabatic processes are some special thermodynamic processes. In which of these

processes, the work done is maximum, when a gas expands from V_1 to V_2?

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59. Which law of thermodynamics implies that no heat engine can be $100\,\%$ efficient?

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60. A heat engine is a device that converts heat energy into mechanical energy.

A refrigerator is a reverse heat engine. Can we decrease the temperature of a room by keeping the door of a refrigerator open? Explain.

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61. A heat engine is a device which converts heat energy into work. What is the working substance in an ideal heat engine.

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62. Explain briefly, the operations of a Carnot's engine, draw the Carnot's cycle and deduce the expression for its efficiency.

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63. Can you design a heat engine of 100% efficiency. Justify your answer.

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64. Three moles of an ideal gas kept at a constant temperature of $300K$ are compressed from the volume of 10litre to5 litre.

Which thermodynamic process is involved in this process?

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65. Three moles of an ideal gas kept at a constant temperature of 300K are compressed

from the volume of 10 litre to 5 litre.

Calculate the work done required to compress this gas.

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66. A Carnot engine is working between temperatures of $27^{\circ}C$ and $327^{\circ}C$. Find its efficiency

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67. A refrigerator takes a quantity of heat 'Q' from the cold body, with work done'W' on it, transfer heat to the hot body.

What does the ratio Q/W represent?

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68. A refrigerator takes a quantity of heat 'Q' from the cold body, with work done 'W' on it, transfer heat to the hot body.

The value of Q/W cannot be infinity. State the

law of thermodynamics that explains this statement.

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69. A heat engine is a device that converts heat energy into mechanical energy.

A refrigerator is a reverse heat engine. Can we decrease the temperature of a room by keeping the door of a refrigerator open? Explain.

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70. Heat is supplied to a system, but its internal energy does not increase Obtain an expression for the work done in the above process.

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71. Name the gas law which gives the relationship between the pressure and temperature of a fixed amount of gas at a constant volume.

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72. Camot engine is considered as an ideal heat engine. Draw the P-V graph of Camot's cycle.

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73. The variables which determines the thermodynamic behaviour of a system are called thermodynamic variables.

Pick out the one which is NOT a thermodynamic variable.(temparature, pressure, work, volume)

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74. The variables which determines the thermodynamic behaviour of a system are called thermodynamic variables.

What happens to the internal energy of a gas during isothermal expasion?

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75. The variables which determines the thermodynamic behaviour of a system are called thermodynamic variables.

what happens to the internal energy of a gas during an adiabatic expansion?

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76. The variables which determines the thermodynamic behaviour of a system are called thermodynamic variables.

Gases have two specific heat capacities,$C_p$and C_v. Why?

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77. The variables which determines the thermodynamic behaviour of a system are called thermodynamic variables.

Laplace pointed out that when sound is propagating through a gaseous medium, the change in adiabatic. Show that adiabatic bulk modulus is $-\gamma_P$?

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78. Explain isobaric process and isothermal process.

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79. Heat engine is a device used to convert .....energy into.....energy.

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80. A thermodynamic process is characterized by pressure,volume and temperature.

Name the four processes in a Carnot's cycle.

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81. A hole is drilled in a copper sheet. The diameter of the hole is $4.24cm$ at $27^{\circ}C$. What is the change in diameter of the hole when the sheet is heated to $227^{\circ}C$? (Coefficient of linear expansion of copper=$1.7 \times \frac{10^{-5}}{K}$)

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82. Thermodynamics deals with the concept of heat and the exchange of heat energy.

Obtain the expression for the work done during an adiabatic process.

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83. Explain briefly, the operations of a Carnot's engine, draw the Carnot's cycle and deduce the expression for its efficiency.

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84. Write the expression for the efficiency of a Carnot engine.

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85. Two systems in thermal equilibrium with a third system, are in thermal equilibrium with each other'. Identify the law given by the above statement.

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