PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

THERMODYNAMICS

One Mark Questions And Answers

1. What is thermodynamics ?

2. What is a thermodynamic system ?

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3. What is a thermodynamic surrounding ?

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4. State the condition for thermodynamic equilibrium between two conducting bodies.

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5. Explain thermodynamic equilibrium between two radiating bodies.

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6. State Zeroth law of thermodynamics.

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7. What is a diathermic wall ?

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8. What is an adiabatic wall ?

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9. What is meant by internal energy transfer.

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10. Mention any one mode of energy transfer.

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11. Given any one difference between heat and work in terms of energy transfer.

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12. Given the mathematical form of the law of thermodynamics with the explanation of

symbols used.

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13. Name of law of coservation on which the first law of thermodynamics to based ?

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14. Give the expression for work doen by a system.

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15. What is an isothermaol thermodynamci process ?

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16. In an isothermal process, the quantity to heat supplied is wholly converted into external work on the surroundings. Justify the statement.

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17. What will be the amount of heat distributed among the molecules per degree of freedom and per molecule ?

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18. What will be the energy associated with a molecule of gas having 'f' degree of freedom ?

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19. What will be the energy associated with Avogadro number of molecules. (1 mole) ?

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20. Give the expression for energy associated with the monoatomic gas in terms of universal gas constant for 1 mole of gas.

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21. Give the expression for total energy supllied at a constant pressure for 1 mole of gas.

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22. Express degrees of freedom in terms of ratio of specific heat of a gas.

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23. What is the number of degrees of freedom associated with a diatomic gas ?

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24. Give the formula to calculate the number of degrees of freedom of a polyatomic gas.

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25. For a penta atomic system of a molecule which forms non-collinear arrangement, calculate the degrees of freedom (Assume pyramid structure)

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26. Define the unit calorie.

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27. Relate on calorie of heat in terms of joule.

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28. Convert 5 cal in terms of J.

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29. What is a PV indicator diagram (Isotherm)

?

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30. Given example for intensive thermodynamic state variables.

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31. Give example for extensive thermodynamic state variable.

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32. Say whether the product $P\Delta V'$ is extensive or intensive.

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33. What is an ideal quasi-static process ?

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34. Write the isothermal relation between pressure and volume of an ideal gas.

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35. Write adiabatic relation between pressure and volume of an ideal gas.

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36. Write adiabatic relation between pressure and temperature of an ideal gas adiabatic pressure.

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37. Write the relation between volume and temperature of an ideal gas undergoing an adiabatic process.

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38. What is the change in the internal energy of an ideal gas,at constant temperature (isothermal process) ?

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39. Name the parameter which remains constants during an adiatbatic process.

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40. What is an isochoric process ?

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41. Represent an isochoric process graphically.

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42. What is an isobaric process ?

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43. Represent an isobaric process graphically.

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44. What is meant by a cyclic thermodynamic process ?

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45. Represent PV indicator diagram for a cyclic process.

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46. Give the expression for work doen in an isobaric process.

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47. Explain why are pressue in a car tyre increases during driving ?

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48. What is a heat engine ?

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49. Write the expression for efficiency of Carnot's heat engine.

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Two Mark Questions And Answers

1. Write the expression for work done in an isothermal expansion and give the meanings of the sympbols.

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2. Write the expression for work done in an adiabatic expansion and give the meaninigs of

the symbols.

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3. Explain why the climate of a barbor two in more temperate than that of a town in a desert at the same latitude. (NCERT)

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4. The coolant in a chemical or a nuclear plant should have high specifice heat. Why ?

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5. Two bodies at different temperatures T_1 and T_2, if brought in thermal contact do not necessarily settle to the mean temperature $(T_1 - T_2)/2$. Why ?

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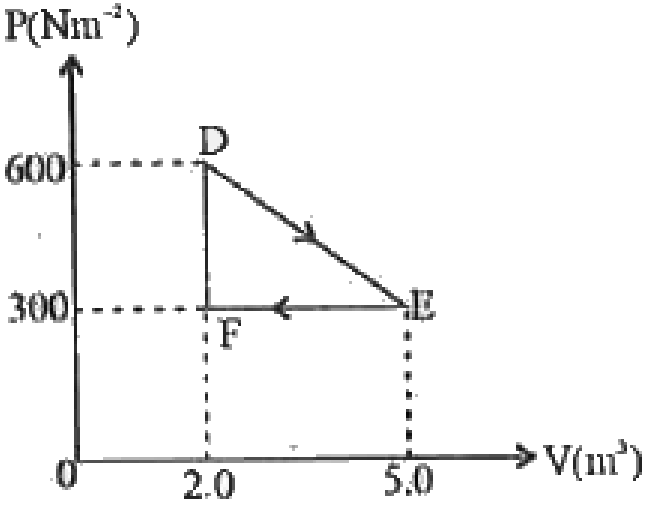
6. Calculate the work done by the gas is moving from D to E to F and to D. Refer the

following diagram.



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7. State law of equipartition of energy.

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8. What is a refrigerator ? Why the expression for coefficient of performance.

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9. Can the coefficient of performance be infinity ?

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10. State Clausius and Kelvin Plank's statements of II law of thermodynamics.

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11. Source and sink used in Carnot's heat engine have infinite thermal capacity. What does it mean ?

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12. Can the internal energy of system be completely converted into work ? Give examples in support to your answer.

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13. What are the values of specific heat of a gas in isothermal and adiabatic processes?

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Three Mark Questions And Answers

1. Apply the first law of thermodynamics to an isochoric process explain.

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2. Apply first law of thermodynamics to an adiabatic process.

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3. Write the four important parts of Carnot's ideal heat engine.

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Five Marks Questions With Answers

1. Derive Mayer's equation from the I law of thermodynamics.

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2. Show that for an isotheremal process, work $W = \mu RT \log_e \left(\frac{V_2}{V_1} \right)$ where symbols have their usual meaning.

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3. Distinguish between isothermal and adiabatic processes.

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4. Obtain an expression for the work done in a adiabatic process.

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5. Show that efficiency of Caront's ideal heat engine is $\eta = \left(1 - \frac{T_2}{T_1}\right)$.

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6. Explain the working of Carnot's heat engine with the help of graph.

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Numericals With Solutions

1. A refrigerator is used to mainatain eatables kept inside it at $9^{\circ}C$. If the room temperature is $35^{\circ}C$, then calculate the coefficient to

performance. Calculate the amount of heat rejected to the surrounding.

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2. The triple points of Ne and CO_2 are 24.57K and 216.55K respectively. Express these temperatures in the Celsius and Fahrenheit scales.

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3. A constant volume gas theremometer using helium, records a pressure of $20.0kPa$ at the triple point of water and pressure of $14.3kPa$ at the temperature of dry ice. What is the temperature of dry ice.?

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4. The electrical resistance in ohms of a cerbain thermomter varies with temperature according to

$R = R_0\{1 + 5 \times 10^{-3}(T - T_0)\}$. The resistance is 101.6Ω at the triple point of water, and 185.5Ω at the normal melting point of lead (600.5K). What is the temperature when the resistance is 123.4Ω?

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5. A steel tape 1 m long is correctly cailbrated for temperature of $27.0^\circ C$. The length of a steel rod measured by this tape is found to be 63.0 cm on a hot day when the termperature is

$45.0^\circ C$. What is the actual length of the steel rod on that day? What is the length of the same steel rood on a day when the temperature is $27.0^\circ C$? α of steel is $1.20 \times 10^{-5} \circ C^{-1}$?

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6. A hole is drilled in a copper sheet. The diameter of the hole is 4.24cm at $27.0^\circ C$. What is the change in the diameter of the when the sheet is heated to $227^\circ C$?

Coefficient of linear expansion of copper $= 1.70 \times 10^{-5} {}^{\circ} C^{-1}$?

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7. A brass wire 1.8 m long at $27^{\circ} C$ is held taut with a little tension b/w two rigid supports. If the wire is cooled to a temperature of $-39^{\circ} C$, what is the tension developed in the wire, if its diameter is 2.0 mm ? $a = 2.0 \times 10^{-5} {}^{\circ} C^{-1}$ and $Y = 0.91 \times 10^{11} Pa$?

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8. A 10 kW drilling machine is used to drill a bore in a small aluminium block of mass 8.0 kg. How much is the rise in temperature of the block in 2.5 minutes assuming 50% of power is used up in heating the machine itself or lost to the surroundings? Specific heat of aluminum $= 910 Jkg^{-1}K^{-1}$.

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9. A copper block of mass 2.5 kg is heated in a furance to temperature of $500^{\circ}C$ and then placed on a large ice block. What is the maximum amount of ice that can melt? (Specific heat of copper $= 380 Jkg^{-1}K^{-1}$, latetn heat of fusion of ice $= 3.36 \times 10^{5} Jkg^{-1}$).

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

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11. What amount of heat must be supplied to $2.0 \times 10^{-2} kg$ of N_2 (at room temperature) to raise its temperature by $45^\circ C$ at constant

pressure? Molecular mass of $N_2 = 28, R = 8.3 J \text{mole}^{-1} K^{-1}$

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12. A tyre pumped at a pressure of 3.375 atm and at $27^\circ C$ suddenly bursts. What is the final temperature? $(\gamma = 1.5)$

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13. The volume of 1 kg water is reduced by $91 cm^3$ on melting. Calculate the change in the internal energy when 2 kg ice melts at NTP.

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14. A gas expands from 75 litre to 125 litre at a constant pressure of 4 atm. Calculate the work done by the gas during this expansion.

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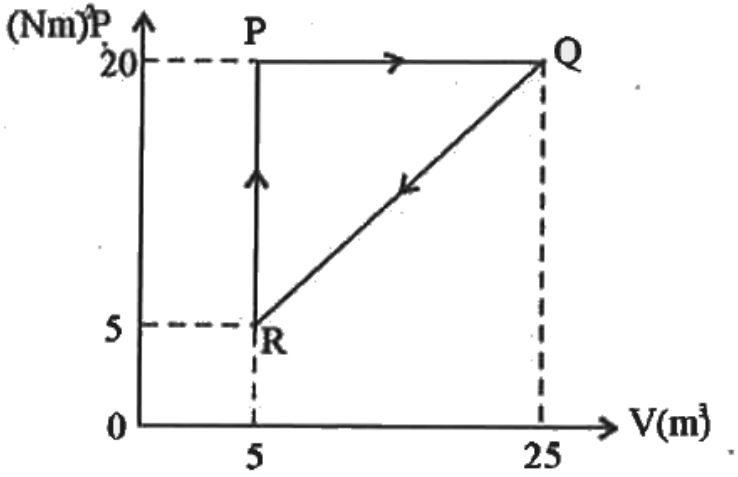
15. Calculate the amount of work done in taking the gas from the state (i) P to Q (ii) Q to R (iii) R to P (iv) the entire cycle,



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16. $1g$ of water at atmospheric pressure and at $100^\circ C$, $1671cm^3$ of water vapour is converted into cm^3 water. Calculate (i) work doen against the surroundigs and (ii) increases in the internal energy.

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17. The efficiency of a Carbot's heat engine is 0.25. If on reducing the temperature of the sink by $50^\circ C$, the efficiency increase, 0.35,

then calculate the temperature of the source and sink.

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18. The volume of N_2 gas increases from $1cm^3$ "to" $100cm^3$ at a constant temperature of 300K. If there are 10 moles of gas present, then calculate the amount of work done by N_2 on the surroundings.

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19. The ratio of specific heats of a gas in 1.40. There are 200 moles of gas initially present. The gas undergoes adiabatic expansion and as a result which, the temperature of the gas falls from 400 K to 100 K. Give $R = 8.312 J \text{mole}^{-1} K^{-1}$. Calculate the amount or work done by the gas on the surroundings.

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20. The working substance in a Carnot's heat engine absorbs $5 \times 10^6 J$ of heat from the source and reject $2 \times 10^6 J$ of heat of the sink. Calculate the (i) heat converted into work and (ii) efficiency of the engine.

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21. Caclulate the change in entropy of a 1000 kg of water converted into steam. Latent heat of steam $= 2.268 \times 10^6 Jkg^{-1}$

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22. Under an increase of pressure of atmosphere, the volume of $1m^3$ of ice is decreased to $0.986m^3$. Calculate the fall in the freezing point of water.

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23. A refrigerator is driven by a 1HP motor having an efficiency of 80%. The refrigerator works between $0^\circ C$ and $38^\circ C$. Calculate the

time required by the refrigerator to freeze 1 litre of water, heat of fusion of ice is $2.26 \times 10^5 Jkg^{-1}$.

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24. A Carnot heat engine absorbs 600J of heat from source of temperature 800K and rejects 300J of heat to the sink. Calculate efficiency and temperature of the sink.

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