THE GURUKUL INSTITUTE

PLOT 5C, 2ND FLOOR, COMPLEX, SEC-13, OPP. JAIPURIA SCHOOL,
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PHYSICS

HEAT & THERMODYNAMICS

HEAT/ THERMAL EXPANSION

1.What is the unit of heat?

2.(i) Take a metallic cylindrical vessel of steel of Internal volume V0 and a solid cylinder of steel of similar shape and volume V0.The temperature of both is raised up to ΔT. Can we put the solid inside the vessel?

(ii) A silver ring is tightly fitted on a silver rod.Can we remove the ring from the rod by raising or lowering the temperature?

3. A steel glass is half filled with a liquid.The coefficients of volume expansion of steel and liquid are same. When temperature is increased, the volume of empty glass Increases or decreases. If temperature is decreased, what will happen to the empty glass volume.

4. A sphere of silver is floating in a mercury bath. If temperature is increased, will the sphere sink deeper or rise? It is given $\gamma_{Silver} > \gamma_{Mercurry}$.

5.A sphere of diameter 7 cm and mass 266.5 gm floats in a bath of liquid. As the temperature is raised, the sphere just sinks at a temperature of 35^0C.If the density of the liquid at 0^0C is 1.527 gm/cm^3, find the co-efficient of cubical expansion of the liquid.(γ of sphere is negligible)

6.A cubical block is floating inside a bath. The temperature of system is increases by small temperature ΔT. It was found that the depth of submerged portion of cube does not change. Find the relation between coefficient of linear expansion (α) of the cube and volume expansion of liquid (γ).

7.A light steel wire of length L and area of cross- section A is hanging vertically downward from a ceiling. It cools to the room temperature (30^0C) from the initial temperature 100^0C. Calculate the weight which should be attached at its lower and such that its length remains same. Young's modulus of steel is Y and coefficient of linear expansion is α.

CALORIMETRY: Principle of Calorimetry

8. Find the molar heat capacity of the process P= a/T for a monatomic gas, 'a' being positive constant.

9. A gaseous mixture enclosed in a vessel consists of one gm mole of a gass A with γ= (5/3) and some amount of gas B with γ= 7/5 at a temperature T. The gases A and B do not react with each other and are assumed to be ideal. Find the number of gm moles of the gas B if γ for the gaseous mixture is (19/13).

10.An air bubble starts rising from the bottom of a lake. Its diameter is 3.6 mm at the bottom and 4mm at the surface. The depth of the lake is 250 cm and the temperature at the surface is 40^0C. What is the temperature at the bottom of the lake? Given atmospheric pressure= 76cm of Hg and g= 980cm/sec^2. (Specific gravity of mercury=13.6)

11. Can an ideal gas be liquefied?

12. Two different gases have exactly the same temperature. Does this mean that their molecules have the same rms speed?

13. Given: Avogadro's number N= 6.02×10^{23} and Boltzmann's constant k= 1.38×10^{-23}J/K.

(i) Calculate the average kinetic energy of translation of the molecules of an ideal gas at 0^0C and at 100^0C.

(ii) Also calculate the corresponding energies per mole of the gas.

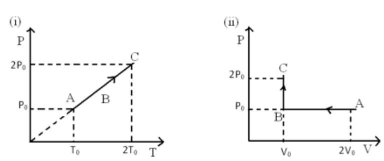
DEGREES OF FREEDOM

14. How many degrees of freedom does the gas molecule have if under standard conditions the gas density is 1.3kg/m^3 and the velocity of sound in it is v=330 m/s.

15. One mole of an ideal monatomic gas is taken at a temperature of 300 K. Its volume is doubled keeping its pressure constant. Find the change in internal energy.

16.Two moles of a diatomic ideal gas is taken through the process PT= const, Its temperature is increased from T_0K to $2T_0$K. Find the work done by the system?

17. Three moles of a diatomic gas is taken through the process A-B-C as shown in the figure. Find work done by the system in the process A-B-C.



18.At 1 atmospheric pressure, 1.000 gm of water having a volume of 1.000 cm^3 becomes 1.091 cm^3 of ice on freezing. The heat of fusion of water at 1 atmosphere is 80.0 cal/gm. What is the change in internal energy during the process?

19.An ideal monatomic gas at temperature 27^0C and pressure 10^6 N/m^2 occupies 10 litre volume. 10,000 cal of heat is added to the system without changing the volume. Calculate the final temperature of the gas. Given: R=8.31 J/(mol-K) and J= 4.18 J/ cal.

HEAT TRANSFER

20. (i) Pieces of copper and glass are heated to the same temperature. Why do the pieces of copper feel hotter on touching? At what common temperature do the pieces of copper and glass feel equally hot when touched?

(ii) Thermal conductivity of air is less than of felt, but felt is a better heat insulator in comparison to air, why?

21. Two plates each of area A, thicknesses L_1 and L_2 and thermal conductivities K_1 and K_2 are joined to form a single plate of thickness (L_1+L_2).If the temperatures of the free surfaces are T_1 and T_2, calculate

(a) rate of flow of heat;

(b) temperature of interface; and

(c) equivalent thermal conductivity.

22. A cylinder of radius R made of a material of thermal conductivity K_1 is surrounded by a cylindrical shell of inner radius R and outer radius 2R made of a material of thermal conductivity K_2. The two ends of the combined system are maintained at two different temperatures.
There is no loss of heat across the cylindrical surface and the system is in steady state. What is the effective thermal conductivity of the system?

23. Find the rate of heat flow and temperature as a function of radius r in case of a cylindrical shell whose inner surface temperature and outer surface temperature are θ_1 and θ_2.The inner and the outer radii of the cylindrical shell are r_1 and r_2.

24. On a winter night you feel warmer when clouds cover the sky than when the sky is clear. Why?

25. A metallic ball has a black spot. The ball is heated to 1000^0C and is then taken into a dark room. It is found that black spot looks brighter than rest of the ball. How can you understand this?

26.Two bodies A and B have thermal emissivities of 0.01 and 0.81. The outer surface areas of the two bodies are same. The two bodies emit total radiant power at the same rate. The wavelength λ_B corresponding to maximum spectral radiancy in the radiation from B is shifted from the wavelength corresponding to maximum spectral radiancy in the radiation from A by 1.00μm. If the temperature of A is 5802 K, calculate:
(a) the temperature of B and (b) wavelength λ_B.

PROBLEMS

1.A bar of length L_0 is heated from temperature t_1 to t_2. Find the final length of bar if its coefficient of linear expansion of linear expansion varies according to equation α= aL, where a is constant and L is the length of bar.

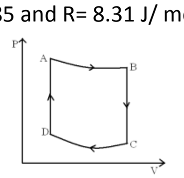
2. Two glass bulbs of volumes 500 cm^3 and 100cm^3 are connected by a narrow tube whose volume is negligible. When the apparatus is sealed off, the pressure of the air inside is 70 cm of mercury and its temperature is 20^0C and the other is heated to 100^0C.

3.One mole of an ideal gas whose pressure changes with volume as P= αV, where α is a constant, is expanded so that its volume increases n times. Find the work done and change in internal energy.[Adiabatic exponent=γ]

4.An ideal gas is taken through a cyclic thermodynamic process through four steps.The amounts of heat involved in these steps are Q_1=5960 J; Q_2=-5585 J; Q_3= -2980 J; and Q_4= 3645 J. The corresponding work involved are W_1=2200 J; W_2= -825 J; W_3= -1100 J and W_4, respectively.
(a) Find the value of W_4.
(b) What is the efficiency of the cycle?

5. At 27^0C, two moles of an ideal monoatomic gas occupy a volume V. The gas expands adiabatically to a volume 2V. Calcuate:
(a) final temperature of the gas;
(b) change in its internal energy; and
(c) the work done by the gas during the process.[R= 8.31 J/ mol K]

6.One mole of a monoatomic ideal gas is taken through the cycle shown in figure.
A → B Adiabatic expansion;
B → C Cooling at constant volume;
C → D Adiabatic compression;
D→ A Heating at constant volume
The pressure and temperature at A, B; etc. are denoted by P_A, T_A; P_B, T_B; etc., respectively.
Given T_A= 1000K, P_B=(2/3)P_A and P_C= (1/3)P_A. Calculate(a) The work done by the gas in the process A→B; (b) the heat lost by the gas in the process B→C; and (c) temperature T_D.
[Given;$(2/3)^{2/5}$= 0.85 and R= 8.31 J/ mol K.]



7. A fixed mass of a gas is taken through a process A→ B →C →A. Here A →B is isobaric, B→ C is adiabatic and C →A is isothermal.

Find: (a) pressure and a volume at C;

(b) work done in the process (take γ=1.5)

8. Find temperature as a function of radius r in case of hollow sphere having inner and outer radii r_1 and r_2, maintained at temperature θ_1 and θ_2, respectivey.

9.One end of a rod of length 20 cm is inserted in a furnance at 800 K. The sides of the rod are covered with an insulating material and the other end emits radiation like a blackbody. The temperature of this end is 750 K in the steady state. The temperature of the surrounding air is 300 K. Assumng radiation to be the only important mode of energy transfer between the surrounding and the open end of the rod, find the thermal conductivity of the rod. [Stefan's constant σ= 6.0× 10^{-8} W/m^2-K^4]

10.A cylindrical block of length 0.4 m and area of cross- section 0.04 m^2 is placed coaxially on a thin metal disc of mass 0.4 kg and same cross-section. The upper face of the cylinder is maintained at a constant temperature of 400 K and the initial temperature of the disc is 300K. If the thermal conductivity of the material of the cylinder is 10 W/mK and the specific heat of the material of the disc is 600 J/kg K, how long will it take for the temperature of the disc to increase to 350 K? Assume for purpose of calculation the thermal conductivity of the disc to be very high and the system to be thermally insulated except for the upper and lower face of the cylinder.

OBJECTIVE

1. Two rods of length L_1 and L_2 are made of materials whose coefficients of linear expansion are α_1 and α_2. If the difference between the two lengths is independent of temperature, then

a) $L_1/L_2= \alpha_1/\alpha_2$ b) $L_1/L_2= \alpha_2/\alpha_1$ c) $L^2{}_2\alpha_1= L^2{}_1\alpha_2$

d) $\alpha^2{}_1/L_1=\alpha^2{}_2/L_2$

2.Water of volume 2 litre in a container is heated with a coil of 1kW at 27^0C. The lid of the container is open and energy is dissipated at the rate of 160J/s. In how much time temperature will rise from 27^0C to 77^0C? (Given C_{water}= 4.2kJ/kg)

a) 8min 20s b) 6min 2s c) 2s d) 14 min

3. A monoatomic gas (γ= 5/3) is suddenly compressed to $(1/8)^{th}$ its volume adiabatically the pressure of the gas will change to

a) 24/5 b)8 c)40/3 d) 32

4.At room temperature the rms speed of the molecules of a certain diatomic gas is found to be 1930 m/s. The gas is

a) H_2 b)F_2 c) O_2 d) Cl_2

5.The average translation energy and the rms speed of molecules in a sample of oxygen at 300K are 6.21×10^{-21} J and 484 m/s respectively. The corresponding values at 600 K are nearly (assuming ideal gas behavior).

a) 12.42×10^{-21}J, 968 m/s. c) 6.21×10^{-21}J,968 m/s

b) 8.78 ×10^{-21}J,684 m/s d) 12.42× 10^{-21} J,684 m/s

6. Two identical containers A and B with frictionless pistons contains the same ideal gas at the same temperature and the same volume V. The mass of gas contained 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 change in the pressure in A and B are found to be ΔP and 1.5ΔP, respectively, then

a) $4m_A= 9m_B$ b) $2m_A= 3m_B$ c) $3m_A=2m_B$ d) $9m_A= 4m_B$

7.Two insulating cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at temperature 300K. The piston A is free to move, while that of 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

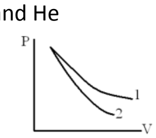
a) 30K b) 18K c) 50K d) 42K

8. The volume of a gas at constant pressure of 10^3 N/m^2 expands by 0.25 m^3. The work done by the gas is equal to

a) 2.3 erg b) 250J c) 250 W d)250N

9. P-V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should correspond, respectively to

a) He and O_2 b) O_2 and He c) He and Ar d) O_2 and N_2



10. A rigid container with thermally insulated walls contains a coil of resistance 100Ω carrying current 1 A. Change in internal energy after 5 minute will be

a) 0 kJ b) 10kJ c) 20kJ d) 30kJ

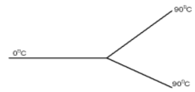
11.An ideal gas expands isothermally from a volume V_1 to V_2 and is then compressed to original volume V_1 adiabatically. Initial pressure was P_1 and final pressure is P_3.The total work done is W. Then

a) $P_3>P_1$, W> 0 b) $P_3<P_1$, W<0 c) $P_3 >P_1$, W<0

d) $P_3= P_1$, W=0

12. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at 0^0C and 90^0C respectively. The temperature of the junction of the three rods will be

a) 45^0C b) 60^0C c) 30^0C d) 20^0C



13. Two identical conducting rods are first connected independently to two vessel, one containing water at 100^0C and the other containing ice at 0^0C. In the second case, the rods are joined end to end and connected to the same vessels. Let q_1 and q_2 be the rate of melting of ice in two cases, respectively. The ratio q_1/q_2 is

a) 1/2 b) 2/1 c) 4/1 d) 1/4

14.Three discs A, B and C having radii 2m, 4m and 6m, respectively, are coated with carbon black on their outer surfaces. The wavelengths corresponding to maximum intensity are 300 nm, 400 nm and 500 nm, respectively. The powers radiated by them are Q_A, Q_B and Q_C respectively. Then

a) Q_A is maximum b) Q_B is maximum c) Q_C is maximum

d) $Q_A=Q_B=Q_C$

15.In a room where the temperature is 30^0C, a body cools from 61^0C to 59^0C in 4 minutes. The time taken by the body to cool from 51^0C to 49^0C will be:

a) 4 minutes b) 6 minutes c) 5 minutes d)8 minutes

ASSIGNMENTS

SECTION- I

PART-A

LEVEL-I

1. The volume of a thin brass vessel and the volume of a solid cube are both equal to 1 it. What will be change in volumes of vessel and the cube on being heated to 25^0C? Given α for brass= $1.9\times10^{-5}/^0$C.

2.One mole of a monoatomic gas is mixed with 3 moles of a diatomic gas. What is the molecular specific heat of the mixture at constant pressure?

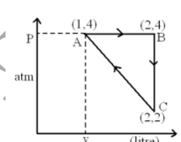
3. 30 gm of ice at -14^0C is added to 200 gm of water at 25^0C. Find the equilibrium temperature. [Take specific heat of ice=0.5 cal/g. C^0, and latent heat of ice=80 cal/g]

4. At what temperature the rms velocity is equal to escape velocity from the surface of earth for hydrogen and for oxygen? Given radius of earth

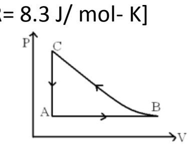
$= 6.4\times10^6$m, g=9.8m/s^2; k= 1.38×10^{-23} J/k

5.A cylinder containing one mole of a monoatomic gas at 127^0C expand isothermally until its volume is doubled, and then compressed adiabatically until its temperature rise from 127^0C to 227^0C. Calculate total work done and heat absorbed.

6. A P-V diagram for a cyclic process is a triangle ABC.Calculate work done during the process AB, BC and CA. Also calculate the work done in the complete cycle.



7. Consider the cyclic process ABCA on a sample of 2 mole of an ideal gas as shown in the figure.The temperature of the gas at A and B are 300 K and 500K, respectively. A total of 1200J heat is withdrawn from the sample inthe process. Find the work done by the gas in part BC. [Take R= 8.3 J/ mol- K]



8. A sphere, a cube and a thin circular plate all made of the same material and having the same mass are initially heated to 200^0C. Which of these objects will cool faster and which one slowest when left in air at room temperature?

9. A body which has a surface area of 5 cm^2 and temperature of 727^0C radiates 300 J of energy each minute. What is its emissivity? (σ= 5.67×10^{-8} W/m^2k^4)

10.A body cools in 7 minutes from 60^0C to 40^0C. What will be its temperature after the next 7 minutes? The temperature of surrounding is 10^0C.

LEVEL – II

1.A brass disc at 20^0C has a diameter of 30 cm and a hole (10 cm in diameter) is cut inside the disc. Calculate the diameter of hole when temperature of the disc is raised to 50^0C.[The coefficient of linear expansion of brass= $0.000018/^0$C.]

2.A steel wire of cross sectional area 0.5 mm^2 is held between two fixed supports. The tension in the wire is negliglible and it is just taut at a temperature of 20^0C. Determine the tension when the temperature of the wire falls to 0^0C. Assume that the distance between the supports remains constant. ($Y= 2.1\times10^{11}$ N/m^2, $\alpha= 12\times 10^{-6}/^0C$)

3. Ice of mass of 2kg at -20^0C and 5 kg water at 20^0C are mixed(specific heat of water= 1 Cal/g^0C, specific heat of ice= 0.5 cal/g^0C) Find the net amount of water in the container.

4. A vessel contains a mixture of 7 gm of nitrogen and 11 gm of carbon dioxide at room temperature T= 290 K. If the pressure of the mixture P=1 atm, calculate its density. (R= 8.31 J/ mol K)

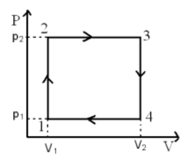
5.Find the average translation kinetic energy per molecule if one mole of the gas is contained in a volume $1.23\times 10^{-3}m^3$ at a pressure 2×10^5 N/m^2. Avogardo's number is 6.02×10^{23} molecules/mole.

6. The molar heat capacity of a process varies as $C= C_V+ \alpha V$, where α is constant. Find the equation of the process in the V-T variable.

7.A horizontal cylindrical tube of cross- sectional area A fitted with two frictionless pistosn.The pistons are connected to each other by an inextensible wire. Initially, the temperature of the gas is T_0 and its pressure is p_0 which equals the atmospheric pressure. Find the tension in the wire if the wire temperature is raised to $3T_0$.

8. A gas has been subjected to an isochoric- isobaric cycle 1-2-3-4-1.Plot the graph of this cycle in the P- p, V-T and P-T coordinates.

(p= density of the gas)

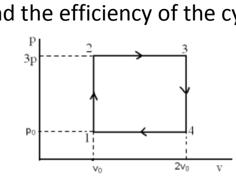


9. An ideal monoatomic gas undergoes a cyclic process as shown in the P-V diagram. For each process find

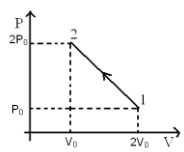
(a) the work done

(b) the change in internal energy and

(c) the heat transfer. Also find the efficiency of the cycle.



10.The ideal gas of mass m follows a process from state $(P_0, 2V_0)$ to $(2P_0,V_0)$. What maximum/ minimum temperature will the gas reach in this process, if it is depicted on the P-V diagram as a straight line as shown in the figure. The molecular weight of the gas is M



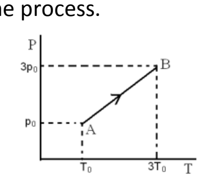
11. The volume of a moles of an ideal gas with the adiabatic exponent γ is varied according to the law V= a/T, where a is a constant. Find the amount of heat received by the gas in this process if the gas temperature is increased by ΔT.

12. A monoatomic gas undergoes a cycle consisting of two isothermal and two isobars.If the minimum and maximum temperature of the gas during the cycle are T_1= 400 K and T_2=800K, respectively, and the ratio of maximum to minimum volume is 4, calculate the efficiency of the cycle.

13. Two moles of a monoatomic ideal gas undergoes a process AB as shown in the figure. Find:

(a) the work done; and

(b) the heat transfer during the process.



PART- B OBJECTIVE

(MULTI CHOICE SINGLE CORRECT)

1.The radius of a ring is R and its coefficient of linear expansion is α. If the temperature of the ring increases by θ, then its circumference will increase by

a) $\pi R\alpha\theta$ b) $2\pi R\alpha\theta$ c) $\pi R\alpha\theta/2$ d) $\pi R\alpha\theta/4$

2. There are two spheres of same material and radius. One is solid and the other is hollow. If they are heated to the same temperature, the expansion of:

a) solid sphere is more b) hollow sphere is more

c) solid and hollow spheres are equal

d) solid is outward while that of hollow inwards

3.When a strip made of iron α_1 and copper α_2 ($>\alpha_1$) is heated:

a) its length does not change b) it gets twisted

c) it bends with iron on concave side

d) it bends with iron on convex side

4.Equal masses of three liquids A, B and C have temperatures 10^0C, 25^0C and 40^0C, respectively. If A and B are mixed, the mixture has a temperature of 15^0C. If B and C are mixed, the mixture has a temperature of 30^0C. If A and C are mixed, the mixture has a temperature of

a) 16^0C b) 20^0C c) 29^0C d) 25^0C

5. During an experiment, an ideal gas is found to obey the equation P^2V= constant. The gas is initially at temperature T and volume V. When it expands to a volume 2V, the temperature becomes

a) $\sqrt{2}T$ b) T/2 c) $\sqrt{3}T$ d) 2T

6. The bulk modulus of elasticity for a monoatomic ideal gas during an isothermal process is (P= pressure of the gas)

a) P b) 2P/3 c) 5P/3 d) 7P/5

7. The mass of hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} hydrogen molecules strike per seconds at 2 cm^2 area of rigid wall at an angle of 45^0 from the normal and rebound back with a speed of 1000 m/s, then the pressure exerted on the wall is

a) 2.34×10^3 pascal b) 0.23×10^3 pascal

c) 0.23×10^3 pascal d) 23.4×10^3 pascal

8. The number of molecules per unit volume of a gas is given by

a) P/ kT b) kT/ P c) P/RT d) RT/P

where R and k are universal gas constant and Boltzmann's constant, respectively.

9. A gas is filled in a container at pressure P_0. If the mass of molecules is halved and their rms speed is doubled, then the resultant pressure will be

a) P_0 b) $4P_0$ c) $2P_0$ d)$P_0/2$

10. When an ideal diatomic gas is heated at constant pressure, then the fraction of heat energy which is used to increase the internal energy of gas system, is

a) 3/7 b) 3/5 c) 5/7 d) 2/5

11. The velocities of three molecules are 3v, 4v and 5v. Their rms speed will

a) $\sqrt{50}/\sqrt{3}$ v b) $\sqrt{3}/\sqrt{50}$ v c) 50/3 v d) 3/50v

12. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at a temperature T. Neglecting all vibrational moles, the total internal energy of the system is

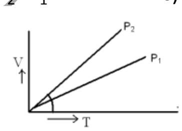
a) 4RT b) 15RT c) 9RT d) 11RT

13. For a certain gas, the ratio of specific heats is 3/2. What is the value of $C_{P?}$

a) R b) 2R c) 3R d) 5R

14. In the following V-T diagram, what is the relation between P_1 and P_2?

a) $P_2= P_1$ b) $P_2>P_1$ c) $P_2<P_1$ d) cannot be predicted



15.The average degree of freedom per molecule for a gas is 6. The gas performs 25J of work when it expands at constant pressure. The heat absorbed by the gas is

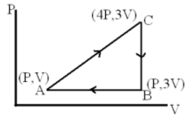
a) 75J b) 100J c) 150J d) 125J

16.When the state of a system is changed from A to B adiabatically, work done on the system is 322 joule. Then, the state of the system is changed from A to B by another method which requires 100J of heat. The work done on the system in this process will be

a) 222 joule b) 100 joule c) 422 joule d) 322 joule

17. An ideal gas is taken through a series of changes represented in figure. The total work done by the gas at the end of the cycle is equal to

a)zero b) 2PV c) 3PV d) 5PV



18.If one mole of a monoatomic gas is mixed with one mole of a diatomic gas, the value of γ for the mixture is

a) 1.40 b) 1.50 c) 1.53 d) 3.07

19. A bucket full of hot water is kept in a room and it cools from 75^0C to 70^0C in T_1 minutes, from 70^0C to 65^0C in T_2 minutes and from 65^0C to 60^0C in T_3 minutes. Then,

a) $T_1 = T_2 = T_3$ b)$T_1<T_2<T_3$ c)$T_1>T_2>T_3$ d)$T_1<T_2>T_3$

20. The formation of ice is started in a lake with water at 0^0C when at 0^0C when the atmospheric temperature is -10^0C. If time taken for 1 cm of ice to be formed is 7 hours, the time taken for the thickness of ice to increase from 1 cm to 2 cm is

a) less than 7 hours b) 7 hours c) more than 14 hours

d) more than 7 hours but less than 14 hours

21. Two stars S_1 and S_2 radiate maximum energy at 360 nm and 480 nm, respectively. Ratio of their absolute temperature is

a) 3/4 b) 4/3 c)9/16 d) 16/9

MULTI CHOICE MULTI CORRECT

1. A solid sphere and a hollow sphere of the same material and of equal radii are heated to the same temperature.

(a) Both will emit equal amount of radiation per unit time in the beginning.

(b) Both will absorb equal amount of radiation from the surrounding in the beginning.

(c) The initial rate of cooling (dT/dt) will be the same for the two spheres.

(d) The two spheres will have equal temperatures at any instant.

2.One gram of water becomes 1671 cm^3 of steam when boiled at atmospheric pressure. L_V= 540 cal/gm [1 atm = 1.01×10^5 N/m^2]

a) Then internal energy change is 499.7 cal

b) The work done 40.3 cal

c) Heat exchange is 540 cal

d)Volume change is not possible

3.The molar heat capacity for an ideal gas

a) is zero for an adiabatic process

b) is infinite for an isothermal process

c) depends only on the nature of the gas for a process in which either volume or pressure is constant

d) is equal to the product of the molecular weight and specific heat capacity for any process.

NUMERICAL BASED TYPE

1. A composite bar of length L= $L_A + L_B$ is made from a bar of metal A (coefficient of linear expansion is $1.4\times10^{-5}/{}^0C$) and length $L_A = L_0$, attached to a bar of metal B(coefficient of linear expansion is $0.2\times10^{-5}/{}^0C$) and $K\times10^{-6}/{}^0C$, then find the value of K.

2. In an insulated vessel, 0.05 kg steam at 373 K and 0.45 kg of ice at 253 K are mixed. Then find the final temperature of the mixture in ^{0}C. Given L_{fusion}= 80 cal/g= 336 J/g, $L_{vaporization}$= 540 cal/g= 2268 J/g, S_{ice}= 2100 J/kg K= 0.5 cal/ gK and S_{water}= 4200 J/ kg K= 1 cal/ gK

3. One mole of a gas (γ=5/3) is initially at temperature 27 = 5/3)is Initially at temperature 27C and occupy a volume V. The gas is first expanded at constant pressure until its volume double. Then it undergoes an adiabatic change until the temperature returns to its initial value. If the total work done in the process λ (150R) Joule, then find the value of λ. (R is the gas constant)

4.A metal ball of mass m is heated by means of a 18 watt heater in a room at 20^0C. The temperature of ball becomes steady at 50^0C. Assuming Newton's law of cooling, calculate the rate of loss of heat in watt to the surrounding when the ball is at 30^0.