PHYSICS

BOOKS - KUMAR PRAKASHAN KENDRA

PHYSICS (GUJRATI ENGLISH)

THERMAL PROPERTIES OF MATTER

Section A Questions Answer

1. Write experienced idea for heat and temperature.

Watch Video Solution

2. Explain the study of thermal properties of matter by giving definitions of temperature and heat.

Watch Video Solution

3. What type of changes occur in a object by heating it ?

Watch Video Solution

4. Explain which property of liquid is used with temperature to measure it thermometer and how thermometer represent it ?

Watch Video Solution

5. Write the relation between Celsius and Fahrenheit scales with graph.

Watch Video Solution

6. Explain constant volume gas thermometer and absolute zero temperature.

Watch Video Solution

7. By explaining different scales of temperature write the equation of their relation.

Watch Video Solution

8. Give one example for solid, liquid and gaseous for expansion with increase in temperature and compression with decreases in temperature.

Watch Video Solution

9. What is thermal expansion ? Write only its types.

Watch Video Solution

10. Explain linear expansion .

Watch Video Solution

11. Anomalous expansion of water is blessing for living organisms in water". Explain this statement.

Watch Video Solution

12. Explain Anomalous expansion of water.

Watch Video Solution

13. Obtain coefficient of volume expansion from ideal gas equation.

Watch Video Solution

14. Obtain relation between coefficient of volume expansion (α_V) and coefficient of linear expansion (α_l).

Watch Video Solution

15. What will happen of a rod is tied with fixed supports rigidly at both ends and temperature is

increased ?

Watch Video Solution

16. Explain heat capacity of substance and write its equation and unit.

Watch Video Solution

17. On which factor does the required amount of heat depend to increase temperature in substance ?

Watch Video Solution

18. What is specific heat ? Give its unit and on which factors does specific heat depends upon ?

Watch Video Solution

19. What is molar specific heat capacity of a substance ? Write its unit.

Watch Video Solution

20. What is calorimeter ? What is Calorimeter ? Explain its principle and construction.

Watch Video Solution

21. Explain three states and change in states for matter.

Watch Video Solution

22. Explain the process of change in state of matter by heating or cooling it.

Watch Video Solution

23. Explain the process of melting of ice with explanation of freezing, melting and melting point.

Watch Video Solution

24. What are vapourization and boiling point ? Explain the process of boiling of water.

Watch Video Solution

25. Why is difficult to cook on hills ?

Watch Video Solution

26. Why does food cook faster in a pressure cooker ?

Watch Video Solution

27. Define normal boiling point.

Watch Video Solution

28. What is sublimation ? Give name of sublimation substances.

Watch Video Solution

29. What is latent heat ? Explain with example.

Watch Video Solution

30. What is heat transfer ? Give its types.

Watch Video Solution

31. Write definition of thermal conduction and explain thermal conduction in solid bodies.

Watch Video Solution

32. How thermal conduction is represented for given temperature difference for any material by rate of heat conduction ?

Watch Video Solution

33. Some vessels of cooking have copper coating at bottom why ?

Watch Video Solution

34. Why do people prefer to give a layer sand or foam insulation on ceiling made up of concrete ?

Watch Video Solution

35. Explain an example in which heat transfer is necessary.

Watch Video Solution

36. Explain heat convection.

Watch Video Solution

37. Explain sea breeze and ground waves.

Watch Video Solution

38. Define the term : Trade wind.

Watch Video Solution

39. Differentiate clearly between Thermal conduction and Thermal convection.

Watch Video Solution

40. Define thermal radiation and radiant energy and explain Provost theory

Watch Video Solution

41. Write difference of conduction, convection and radiation.

Watch Video Solution

42. Why do we wear white or light colour clothes in summer and dark colour clothes in winter ?

Watch Video Solution

43. Why the bottom layers are kept of black colour of cooling vessels ?

Watch Video Solution

44. Write note on flask of two walls or on thermos.

Watch Video Solution

45. State and explain Wien's displacement law.

Watch Video Solution

46. Write and explain Stefan - Boltzmann's law.

Watch Video Solution

47. Find the emissive power from $0.3\,\mathrm{cm}^2$ surface of filament of bulb of tungsten at 3000 K temperature. Take $e = 0.4$ for tungsten bulb.

Watch Video Solution

48. Obtain the equation rate of emission of heat for perfect black body by using Stefan Boltzmaan law.

Watch Video Solution

49. Area of surface of a person is $1.9\ \mathrm{m}^2$ and its body temp. is $37^\circ C$ and room temp. is $22^\circ C$. Temperature of skin is $28^\circ C$, then find the rate of emission of heat. Emissivity of skin is 0.97.

Watch Video Solution

50. Write short note on Green House Effect.

Watch Video Solution

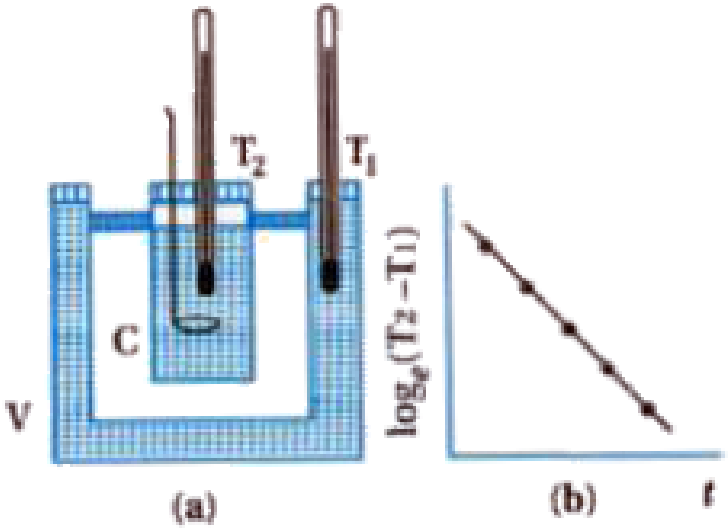
51. Write the procedure which explains that the rate of loss of heat for hot body directly depends on difference of its temperature and surroundings temperature.

Watch Video Solution

52. Write Newton's law of cooling.

Watch Video Solution

53. Discuss the experiment verifying Newton's law of cooling.



Watch Video Solution

Try Yourself Vsqs

1. "Amount of heat is greater in hot body than cold body". Check correctness of this statement.

Watch Video Solution

2. On which does the heat in a substance depend ?

Watch Video Solution

3. What does temperature measure ?

Watch Video Solution

4. What is heat ?

Watch Video Solution

5. Write SI and CGS unit of heat and give their relation.

Watch Video Solution

6. Write SI unit temperature.

Watch Video Solution

7. Give name of instrument that measures temperature.

Watch Video Solution

8. Write freezing and boiling points of water in $^{\circ}C$, $^{\circ}F$ and K.

Watch Video Solution

9. Write equation which gives relation between t_F° and t_C°.

Watch Video Solution

10. What is the difference between $^{\circ}C$ and $^{\circ}F$ thermometer values for freezing and boiling points of water ?

Watch Video Solution

11. What is thermometer ?

Watch Video Solution

12. What is gas thermometer ? Write its characteristics.

Watch Video Solution

13. Write law of Robert Boyle.

Watch Video Solution

14. Write law of Jacques Charles.

Watch Video Solution

15. What is ideal gas ?

Watch Video Solution

16. Write ideal gas equation.

Watch Video Solution

17. Write base of absolute temperature scale.

Watch Video Solution

18. Is negative value on Kelvin scale possible ? Why ?

Watch Video Solution

19. What is the value of absolute zero temperature on Fahrenheit scale ?

Watch Video Solution

20. What is thermal expansion ? Write only its types.

Watch Video Solution

21. Explain linear expansion .

Watch Video Solution

22. What is areal expansion ? Give definition and unit of coefficient of areal expansion.

Watch Video Solution

23. What is volume expansion ? Give definition and unit of coefficient of volume expansion.

Watch Video Solution

24. On what value of α_l depends ? Write its unit.

Watch Video Solution

25. On what value of α_V depends ? Write its unit.

Watch Video Solution

26. Write relation between α_l, α_A and α_V.

Watch Video Solution

27. Draw graph of $\alpha_V \rightarrow$ temperature.

Watch Video Solution

28. Where α_V is greater among alcohol and mercury ?

Watch Video Solution

29. Give temperature $^{\circ}C$, $^{\circ}F$ and K when density of water is maximum.

Watch Video Solution

30. Obtain relation between coefficient of volume expansion (α_V) and coefficient of linear expansion (α_l).

Watch Video Solution

31. On which factor does the required amount of heat depend to increase temperature in substance ?

Watch Video Solution

32. What is heat capacity of a substance ?

Watch Video Solution

33. What is specific heat ? Give its unit and on which factors does specific heat depends upon ?

Watch Video Solution

34. On what the value of heat capacity depends ?

Watch Video Solution

35. Give SI unit of heat capacity.

Watch Video Solution

36. Write dimensional formula of heat capacity.

Watch Video Solution

37. Write definition unit of molar specific heat.

Watch Video Solution

38. Write definitions of molar specific heat at constant pressure and constant volume.

Watch Video Solution

39. Why water is used as coolant in automobile radiator ?

Watch Video Solution

40. Why the winds coming from sea are cool in summer ?

Watch Video Solution

41. Whose specific heat is high ? Sand or water ?

Watch Video Solution

42. What is specific heat of a gas in an isothermal process ?

Watch Video Solution

43. What is calorimetry ?

Watch Video Solution

44. What is calorimeter ? What is Calorimeter ? Explain its principle and construction.

Watch Video Solution

45. Write principle of calorimeter.

Watch Video Solution

46. What is isolated system ?

Watch Video Solution

47. What are the states of matter ? Which ?

Watch Video Solution

48. What is called change of state of matter ?

Watch Video Solution

49. What are fusion and melting point ?

Watch Video Solution

50. What are freezing and freezing point ?

Watch Video Solution

51. On what does the value of melting point depend ?

Watch Video Solution

52. Why skating is possible on ice ?

Watch Video Solution

53. What are vapourization and boiling point ? Explain the process of boiling of water.

Watch Video Solution

54. Define normal boiling point.

Watch Video Solution

55. What is sublimation ? Give name of sublimation substances.

Watch Video Solution

56. What is latent heat ? Write its unit and dimensional formula.

Watch Video Solution

57. On what does the value of latent heat depend ?

Watch Video Solution

58. What is latent heat of fusion ? Give its value for water.

Watch Video Solution

59. What is latent heat of vaporization ?

Watch Video Solution

60. What is heat transfer ? Write its modes.

Watch Video Solution

61. Give definition of heat transfer in solids.

Watch Video Solution

62. The unit of thermal conductivity is:

Watch Video Solution

63. When thermal conductivity is said to be constant ?

Watch Video Solution

64. What is thermal steady state ?

Watch Video Solution

65. Give mode of heat transfer due to density difference.

Watch Video Solution

66. Give mode of heat transfer due to temperature difference.

Watch Video Solution

67. In which mode, medium is not required ?

Watch Video Solution

68. In which mode, gravitation is required ?

Watch Video Solution

69. Write types of convection.

Watch Video Solution

70. Which type of convection does the human, blood circulation system represent ?

Watch Video Solution

71. Define the term : Trade wind.

Watch Video Solution

72. Define thermal radiation and radiant energy and explain Provost theory

Watch Video Solution

73. What is perfect black body ? Give examples.

Watch Video Solution

74. State and explain Wien's displacement law.

Watch Video Solution

75. Give values of Wien's constant is IS and CGS unit.

Watch Video Solution

76. Write the temperature of surfaces of Moon and Sun according to Wien's law.

Watch Video Solution

77. Define emissivity and absorptivity and give their values for perfect black body.

Watch Video Solution

78. Write and explain Stefan - Boltzmann's law.

Watch Video Solution

79. What are heat rays ?

Watch Video Solution

80. What would happen if green house effect is not there ?

Watch Video Solution

81. Draw the graph that represents the cooling of hot water with time.

Watch Video Solution

82. Write Newton's law of cooling.

Watch Video Solution

83. On what does the proportionality constant depends given in Newton's law of cooling.

Watch Video Solution

84. For which method of convection Newton's law of cooling can be used ?

Watch Video Solution

Information Higher Order Thinking Skills Hots

1. What is the triple point ?

Watch Video Solution

2. Derive equation for heat flow rate in rectangular block of solid.

Watch Video Solution

3. Discuss the factors on which amount of thermal energy passing perpendicularly between two nearby cross-section depends. Hence obtain expression for heat current.

Watch Video Solution

4. Derive equation for heat flow rate in rectangular block of solid.

Watch Video Solution

5. Explain thermal resistance.

Watch Video Solution

6. What is perfect black body ? Give examples.

Watch Video Solution

7. Explain cavity and cavity radiation.

Watch Video Solution

8. Why Sun is considered as perfect black body ? Explain and also Explain the importance of study of black body radiation.

Watch Video Solution

Section B Numericals Numerical From Textual Illustration

1. Show that the coefficient of area expansions, $(\Delta A / A) / \Delta T$, of a rectangular sheet of the solid is twice its linear expansively, α_l. $\left(\alpha_l = 10^{-5} K^{-1}\right)$

Watch Video Solution

2. A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and the iron ring are 5.243m and 5.231 m respectively at $27 \quad ^{\circ}C$. To what temperature should the ring be heated so as to fit the rim of the wheel ? $\left(\alpha_1 = 1.20 \times 10^{-5} K^{-1}\right)$

Watch Video Solution

3. A sphere of aluminium of 0.047 kg placed for sufficient time in a vessel containing boiling water, so that sphere is at $100 \quad ^{\circ}C$. It is then immediately transferred to 0.14 kg copper calorimeter containing 0.25 kg of water at $20 \quad ^{\circ}C$. The temperature of water

rises and attains a steady state at $23 \quad ^{\circ}C$. Calculate the specific heat capacity of aluminium.

Watch Video Solution

4. When 0.15 kg of ice of $0 \quad ^{\circ}C$ mixed with 0.30 kg of water at $50 \quad ^{\circ}C$ in a container, the resulting temperature is $6.7 \quad ^{\circ}C$. Calculate the heat of fusion of ice. $\left(s_{\text{water}} = 4186 \quad \text{J Kg}^{-1}K^{-1}\right)$

Watch Video Solution

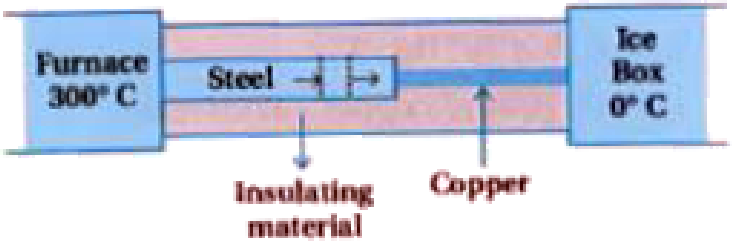
5. Calculate the heat required to convert 3 kg of ice at $-12 \quad ^{\circ}C$ kept in a calorimeter to steam at $100 \quad ^{\circ}C$

at atmospheric pressure. Given specific heat capacity of ice $= 2100\ \text{J kg}^{-1}K^{-1}$, specific heat capacity of water $= 4186\ \text{J kg}^{-1}K^{-1}$, latent heat of fusionn of ice $= 3.35 \times 10^5\ \text{J kg}^{-1}$ and latent heat of steam $= 2.256 \times 10^6\ \text{J kg}^{-1}$.

Watch Video Solution

6. What is the temperature of the steel-copper junction is the steady state of the system shown in figure. Length of the steel rod = 15.0 cm, length of the copper rod = 10.0 cm, temperature of the furnace $= 300^\circ C$, temperature of the other end $= 0^\circ C$. The area of cross section of the steel rod is twice that of

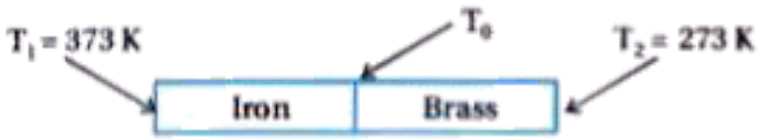
the copper rod. (Thermal conductivity of steel $= 50.2 \ \mathrm{Js}^{-1}m^{-1}K^{-1}$, and copper $= 385 \ \mathrm{Js}^{-1}m^{-1}KJ^{-1}$).



Watch Video Solution

7. An iron bar $\left(L_1 = 0.1 \ \mathrm{m}, A_1 = 0.02 \ \mathrm{m}^2, K_1 = 97 \ \mathrm{Wm}^{-1}K^{-1}\right)$ and a brass bar $\left(L_2 = 0.1 \ \mathrm{m}, A_2 = 0.02 \ \mathrm{m}^2, K_2 = 109 \ \mathrm{W\,m}^{-1}K^{-1}\right)$ are soldered end to end as shown in figure. The free

ends of the iron bar and brass bar are maintained at 373 K and 273 K respectively. Obtain expressions for and hence compute (i) the temperature of the junction of the two bars, (ii) the equivalent thermal conductivity of the compound bar, and (iii) the heat current through the compound bar.



Watch Video Solution

8. A pan filled with hot food cools from $94^\circ C$ to $86^\circ C$ in 2 minutes when th room temperature is at $20^\circ C$. How long will it take to cook from $71^\circ C$ to $69^\circ C$?

Watch Video Solution

Section B

1. Show that the coefficient of area expansions, $(\Delta A / A) / \Delta T$, of a rectangular sheet of the solid is twice its linear expansively, α_l. $\left(\alpha_l = 10^{-5} K^{-1}\right)$

Watch Video Solution

2. A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and the iron ring are 5.243m and 5.231 m

respectively at $27 \quad ^{\circ}C$. To what temperature should the ring be heated so as to fit the rim of the wheel ? $\left(\alpha_1 = 1.20 \times 10^{-5} K^{-1}\right)$

Watch Video Solution

3. A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and the iron ring are 5.243m and 5.231 m respectively at $27 \quad ^{\circ}C$. To what temperature should the ring be heated so as to fit the rim of the wheel ? $\left(\alpha_1 = 1.20 \times 10^{-5} K^{-1}\right)$

Watch Video Solution

4. A sphere of aluminium of 0.047 kg placed for sufficient time in a vessel containing boiling water, so that sphere is at $100 \ ^{\circ}C$. It is then immediately transferred to 0.14 kg copper calorimeter containing 0.25 kg of water at $20 \ ^{\circ}C$. The temperature of water rises and attains a steady state at $23 \ ^{\circ}C$. Calculate the specific heat capacity of aluminium.

Watch Video Solution

5. When 0.15 kg of ice of $0 \ ^{\circ}C$ mixed with 0.30 kg of water at $50 \ ^{\circ}C$ in a container, the resulting temperature is $7.6 \ ^{\circ}C$. Calculate the heat of fusion of ice. $\left(S_{\text{water}} = 4186 \ \text{J kg}^{-1}K^{-1}\right)$

Watch Video Solution

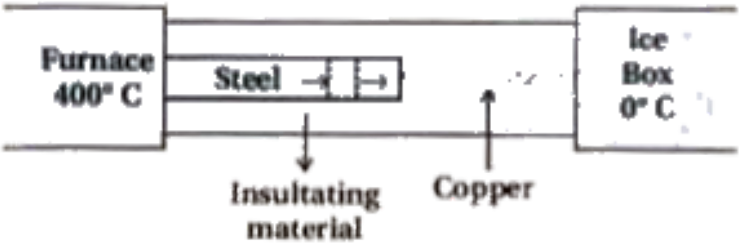
6. (a) How much heat should be provided to ice of 720 g mass, lying at -$10^\circ C$ to melt it to water at $0^\circ C$? (b) How much heat should be provided to water at $0^\circ C$ to increase its temperature to $100^\circ C$?(c) How much heat should be given to water at $100^\circ C$ to transform it completely into water ?

(d) Totally, how much heat should be given to ice of 720 g at $-10^\circ C$ to convert it completely into vapour ? (C"ice"=2220 "J kg"^(-1) K^(-1), C"water"=4190 "J kg"^(-1) K^(-1) , LF=333 "kJ"/"kg", LV=2256 "kJ"/"kg"`)

Watch Video Solution

7. What is the temperature of the steel - copper junction in the steady state of the system shown in Fig. Length of the steel rod = 15.0 cm, length of the copper rod = 10.0 cm, temperature of the furnace $= 400 \quad ^{\circ}C$, temperature of the other end $= 0 \quad ^{\circ}C$. The area of cross section of the steel rod is twice that of the copper rod.

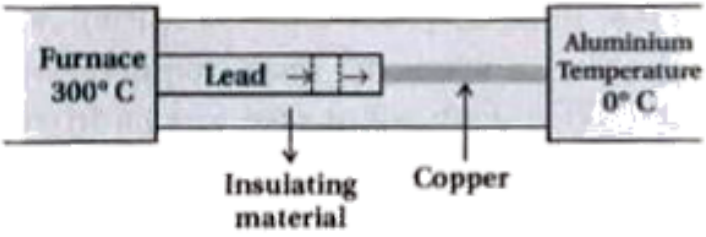
(Thermal conductivity of steel $= 50.2 \ \mathrm{J\,s^{-1}} m^{-1} K^{-1}$, and of copper $= 385 \ \mathrm{J\,s^{-1}} m - 1 \quad K^{-1}$).



Watch Video Solution

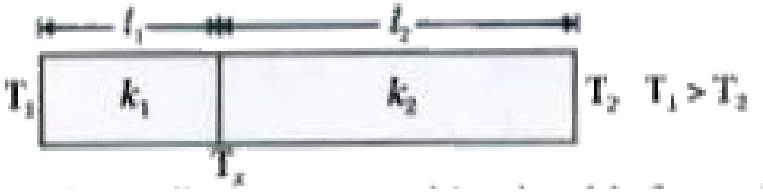
8. What is the temperature of the aluminium junction in the steady state of the system shown in Fig. Length of the load $= 15.0$ cm, length of the aluminium rod $= 10.0$ cm temperature of the furnace = $400 \quad ^\circ C$, temperature of the other end $= 0 \quad ^\circ C$. The area of cross section of the lead rod is twice that of the aluminium rod.

(Thermal conductivity of steel $= 34.9 \quad \mathrm{J\,s^{-1}} m^{-1} K^{-1}$, and copper $= 205 \quad \mathrm{J\,s^{-1}} m - 1 \quad K^{-1}$)



Watch Video Solution

9.



In above diagram, a combined rod is formed by connecting two rods of length l_1 and l_2 respectively and thermal conductivity k_1 and k_2 respectively. Temperature of ends of rods are T_1 and T_2 constant, then find the temperature of their contact surface ?

Watch Video Solution

10. A pan filled with hot food cools from $50^{\circ}C$ to $48^{\circ}C$ in 5 s when the room temperature is at $30^{\circ}C$. How long will it take to cool from $40^{\circ}C$ to $39^{\circ}C$?

Watch Video Solution

Section B Numericals Numerical From Textual Exercise

1. The triple points of neon and carbon dioxide are 24.57 K and 216.55 respectively. Express these temperatures on the Celsius and Fahrenheit scales.

Watch Video Solution

2. Two absolute scales A and B have triple points of water defined to be 200 A and 350 B. What is the relation between T_A and T_B ?

Watch Video Solution

3. The electrical resistance in ohms of a certain thermometer varies with temperature according to the approximate law :

$$R = R_0[1 + \alpha(T - T_0)]$$

The resitance is $101.6 \quad \Omega$ at the triple-point of water 273.16 K, and $165.5 \quad \Omega$ at the normal melting point of lead (600.5 K). What is the temperature when the resistance is $123.4 \quad \Omega$?

Watch Video Solution

4. Two ideal gas thermometers A and B use oxygen and hydrogen respectively. The following observations are made :

Temperature	Pressure thermometer A	Pressure thermometer B
Triple-point of water	1.250×10^5 Pa	0.200×10^5 Pa
Normal melting point of sulphur	1.797×10^5 Pa	0.287×10^5 Pa

What is the absolute temperature of normal melting point sulphur as read by thermometers A and B ?

Watch Video Solution

5. Two ideal gas thermometers A and B use oxygen and hydrogen respectively. The following observations are made :

Temperature	Pressure thermometer A	Pressure thermometer B
Triple-point of water	1.250×10^5 Pa	0.200×10^5 Pa
Normal melting point of sulphur	1.797×10^5 Pa	0.287×10^5 Pa

What do you think is the reason behind the slight difference in answers of thermometers A and B ? (The thermometers are not faulty). What further procedure is needed in the experiment to reduce the discrepancy between the two readings ?

Watch Video Solution

6. A steel tape 1 m long is correctly calibrated for a 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 temperature 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 rod on a day when the temperature is $27.0^{\circ}C$? Coefficient of linear expansion of steel $= 1.20 \times 10^{-5}K^{-1}$.

Watch Video Solution

7. A large steel wheel is to be fitted on to a shaft of the same material. At $27^{\circ}C$, the outer diameter of the shaft is 0.70 cm and the diameter of the central hole

in the wheel is 8.69 cm. The shaft is cooled using 'dry ice'. At what temperature of the shaft does the wheel slip on the shaft ? Assume coefficient of linear expansion of the steel to be constant over the required temperature range :

$\alpha_{\text{steel}} = 1.20 \times 10^{-5} K^{-1}$.

Watch Video Solution

8. A hole is drilled in a copper sheet. The diameter of the hole is 4.24 cm at $27.0^{\circ} C$. What is the change in the diameter of the hole when the sheet is heated to $227^{\circ} C$? Coefficient of linear expansion of copper $= 1.70 \times 10^{-5} K^{-1}$.

Watch Video Solution

9. A steel wire 0.72 m long has a mass of $5.0 \times 10^{-3} kg$. If the wire is under a tension of 60 N, what is the speed of transvers waves on the wire ?

Watch Video Solution

10. A brass rod of length 50 cm and diameter 3.0 mm is joined to a steel rod of the same length and diameter. What is the change in length of the combined rod at $250^{\circ} C$, if the original lengths are at $40.0^{\circ} C$? there a 'thermal stress' developed at the junction ? The ends of the rod are free to expand

(Coefficient of linear expansion of brass $= 2.0 \times 10^{-5} K^{-1}$, steel $= 1.2 \times 10^{-5} K^{-1}$).

Watch Video Solution

11. The coefficient of volume expansion of glycerin is $49 \times 10^{-5} K^{-1}$. What is the fractional change in its density for a $30^{\circ} C$ rise in temperature ?

Watch Video Solution

12. 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 aluminium $= 0.91\ \ \mathrm{Jg}^{-1}K^{-1}$.

Watch Video Solution

13. A copper block of mass 2.5 kg is heated in a furnace to a 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 $= 0.39\ \ \mathrm{Jg}^{-1}K^{-1}$, heat of fusion of water $= 335\ \ \mathrm{Jg}^{-1}$).

Watch Video Solution

14. In an experiment on the specific heat of a metal, a 0.20 kg block of the metal at $150^{\circ}C$ is dropped in a copper calorimeter (of water equivalent 0.025 kg) containing $150\ \mathrm{cm}^3$ of water at $27^{\circ}C$. The final temperature is $40^{\circ}C$. Compute the specific heat of the metal. If heat losses to the surroundings are not negligible, is your answer greater or smaller than the actual value for specific heat of the metal ?

Watch Video Solution

15. Given below are observations on molar specific heats at room temperature of some common gases.

Gas	Molar specific heat (C_v) (cal $mol^{-1}K^{-1}$)
Hydrogen	4.87
Nitrogen	4.97
Oxygen	5.02
Nitric oxide	4.99
Carbon monoxide	5.01
Chlorine	6.17

The measured molar specific heats of these gases are markedly different from those for monatomic gases. Typically, molar specific heat of a monatomic gas is 2.92 cal/mol K. Explain this difference. What can you infer from the somewhat larger (than the rest) value for chlorine ?

Watch Video Solution

16. Answer the following questions based on the P-T phase diagram of carbon dioxide :

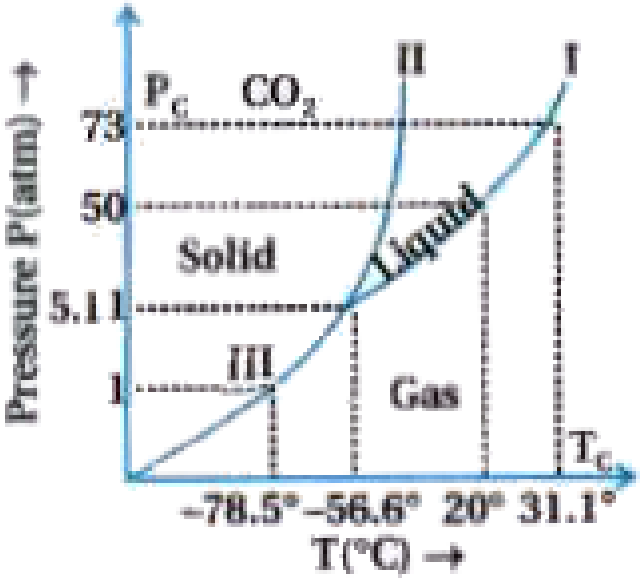
(a) At what temperature and pressure can the solid, liquid and vapour phases of CO_2 coexist in equilibrium ?

(b) What is the effect of decrease of pressure on the fusion and boiling point of CO_2 ?

(c) What are the critical temperature and pressure for CO_2 ? What is their significance ?

(d) Is CO_2 solid, liquid or gas at (a) $-70^\circ C$ under 1 atm, (b) $-60^\circ C$ under 10 atm, (c) $16^\circ C$ under 56 atm

?



Watch Video Solution

17. Answer the following questions based on the P - T phase diagram of CO_2 :

(a) CO_2 at 1 atm pressure and temperature $-60^\circ C$ is compressed isothermally. Does it go through a liquid

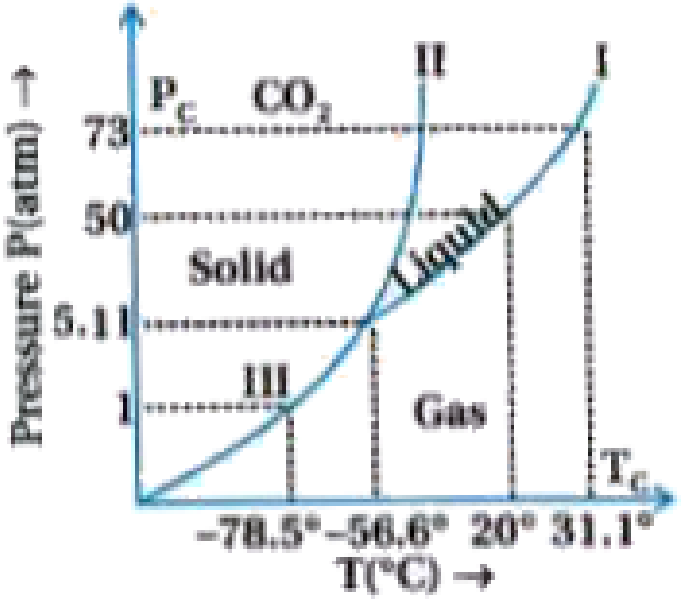
phase ?

(b) What happens when CO_2 at 4 atm pressure is cooled from room temperature at constant pressure ?

(c) Describe qualitatively the changes in a given mass of solid CO_2 at 10 atm pressure and temperature $-65^\circ C$ as it is heated up to room temperature at constant pressure.

(d) CO_2 is heated to a temperature $70^\circ C$ and compressed isothermally. What changes in its

properties do you expect to observe ?



Watch Video Solution

18. A child running a temperature if $101^\circ F$ is given an antipyrine (i.e. a medicine that lowers fever) which causes an increase in the rate of evaporation of sweat from his body. If the fever is brought down to $98^\circ F$ in

20 min, what is the average rate of extra evaporation caused, by the drug. Assume the evaporation mechanism to be the only way by which heat is lost The mass of the child is 30 kg. The specific heat of human body water, and latent heat of evaporation of water at that temperature is about $580\ \mathrm{cal\ g^{-1}}$.

Watch Video Solution

19. A 'thermacole' icebox is cheap and efficient method for storing small quantities of cooked food in summer in particular. A cubical icebox of side 30 cm has a thickness of 5.0 cam if 4.0 kg of ice is put in the box, estimate the amount of ice remaining after 6 h. The

outside temperature is $45^{\circ}C$, and coefficient of thermal conductivity of thermacole is $0.01\ \mathrm{Js}^{-1}m^{-1}K^{-1}$. [Heat of fusion of water $= 335 \times 10^{3}\ \mathrm{Jkg}^{-1}$]

Watch Video Solution

20. A brass boiler has a base of $0.15m^{2}$ and thickness 1.0 cm. It boils water at the rate of 6.0 kg/min when placed on a gas stove. Estimate the temperature of the part of the flame in contact with the boiler. Thermal conductivity of brass $= 109\ \mathrm{Js}^{-1}m^{-1}K^{-1}$, Heat of vaporization of water $= 2256 \times 10^{3}\ \mathrm{Jkg}^{-1}$.

Watch Video Solution

21. Explain why,

a body with large reflectivity is a poor emitter.

Watch Video Solution

22. Explain why,

a brass tumbler feels much colder than a wooden tray on a chilly day.

Watch Video Solution

23. Explain why,

an optical pyrometer (for measuring high temperatures) calibrated for an ideal black body radiation gives too low a value for the temperature of a red hot iron piece in the open, but gives a correct value for the temperature when the same piece is in the temperature when the same piece is in the furnace.

Watch Video Solution

24. Explain why,

the earth without its atmosphere would be

inhospitably cold.

Watch Video Solution

25. Explain why,

heating systems based on circulation of steam are more efficient in warming a building than those based on circulation of hot water.

Watch Video Solution

26. A body cools from $80^\circ C$ to $50^\circ C$ in 5 minutes Calculate the time it takes to cool from $60^\circ C$ to $30^\circ C$. The temperature of the surroundings is $20^\circ C$.

Watch Video Solution

Section B Numericals Numerical From Textual Exercise Answer The Following

1. The triple - point of water is a standard fixed point in modern thermometry. Why ? What is wrong in taking the melting point of ice and the boiling point of water as standard fixed points (as was originally done in the Celsius scale) ?

Watch Video Solution

2. There were two fixed points in the original Celsius scale which were assigned the number $0^{\circ}C$ and $100^{\circ}C$ respectively. On the absolute scale, one of the fixed point is the triple - point of water, which on the Kelvin absolute scale is assigned the number 273.16 K. What is the other fixed point on this (Kelvin) scale ?

Watch Video Solution

3. The absolute temperature (Kelvin scale) T is related to the temperature t_c on the Celsius scale by $t_c = T - 273.15$

Why do we have 273.15 in this relation, and not 273.16 ?

Watch Video Solution

4. What is the temperature of the triple - point of water on an absolute scale whose unit interval size is equal to that of the Fahrenheit scale ?

Watch Video Solution

Section B Numerical From Darpan Based On Textbook

1. How much heat should be given to an Aluminium sphere of 200 g to carry it from $26^{\circ}C$ to $66^{\circ}C$ temperature ? What will be the heat capacity of the Aluminium sphere ?

$C = 0.215 \ \ \text{cal g}^{-1}C^{0-1}$

Watch Video Solution

2. Two rods, one of iron and another of aluminium of equal length and equal cross-sections are connected with each other. The free end of the iron rod is kept at $100 \ \ ^{\circ}C$ and the free end of aluminium rod is kept at $0 \ \ ^{\circ}C$. If thermal conductivity of aluminium is four

times that of iron, find the temperature of their contact surface in the thermal steady state.

Watch Video Solution

3. A body at $80 \ ^\circ C$ cools down to $64 \ ^\circ C$ in 5 minutes, and in 10 minutes it cools down to $52 \ ^\circ C$. What will be its temperature after 20 minutes ? What is the temperature of the environment ?

Watch Video Solution

4. What should be the lengths of a brass and an aluminium rod at 0°. if the difference between their

lengths is to be maintained equal to 5 cm at any temperature ?

(For brass $\alpha = 18 \times 10^{-6} {}^{\circ}C^{-1}$ and for aluminium $\alpha = 24 \times 10^{-6} \quad {}^{\circ}C^{-1}$)

Watch Video Solution

5. What value of temperature in farenheit scale becomes double than value in celcius scale ?

Watch Video Solution

6. What value of temperature in farenheit scale Becomes half than value in celcius scale ?

View Text Solution

7. Average temperature of the Earth was 300 K when the Earth came into existence. At present its average temperature is 3000 K (This is due to the heat evolving from the disintegration of radioactive substances at the core of the Earth) What would be the radius of the Earth at the toime of its birth ? For the material of the Earth $\gamma = 3 \times 10^{-5} K^{-1}$. At present, radius of the Earth = 6400 km.

View Text Solution

Section C Objective Questions Vsqs

1. Is negative temperature possible on Kelvin scale ? Why ?

View Text Solution

2. Why the coefficient of volume expansion is zero for water at $4^{\circ} C$?

Watch Video Solution

3. What will be the difference in volume of water when it is heated from $0^{\circ} C$ to $10^{\circ} C$?

Watch Video Solution

4. What is the heat capacity of copper of 40 g and specific heat $0.3\ \text{erg g}^{-1}(^{\circ}C)^{-1}$?

Watch Video Solution

5. Give name of substance that contract with increase in temperature.

Watch Video Solution

6. Why snow particles are good insulators of heat than ice ?

Watch Video Solution

7. Whose specific heat is high ? Sand or water ?

Watch Video Solution

8. Why the density is changed of solid substances by increase in temperature ?

Watch Video Solution

9. What is sublimation ? Give name of sublimation substances.

Watch Video Solution

10. Give the values of some definite points on standard (Kelvin) scale.

Watch Video Solution

11. Write principle of calorimeter.

Watch Video Solution

12. Is the value of temperature coefficient is always positive ?

Watch Video Solution

13. Write SI and CGS unit of heat and give their relation.

Watch Video Solution

14. What is temperature gradient ?

Watch Video Solution

15. When temperature gradient is considered as positive and negative ?

Watch Video Solution

16. Value of temperature gradient is 80° C/m on a rod of 0.5 m length. Temperature of hot end is $30^\circ C$, then what is the temperature of cold end ?

Watch Video Solution

17. Are rate of heat emission and rate of cooling same ? Explain this.

Watch Video Solution

18. What power is gained by a man when he eats 100 g ice in one minute ? Latent heat of fusion of ice is 80 cal/gm.

Watch Video Solution

19. In day of summer the glass of water of ice becomes hot on table with respect to time and the cup of heat tea becomes cold on table with respect to time. Write its reason.

Watch Video Solution

20. What is called absolute zero temp ?

Watch Video Solution

21. On what does the value of coefficient of linear expansion depend ?

Watch Video Solution

22. Give the value of coefficient of volume expansion at $0^{\circ} C$ for ideal gas.

Watch Video Solution

23. Give value of coefficient of volume expansion at room temperature for ideal gas.

Watch Video Solution

24. On what value of α_V depends ? Write its unit.

Watch Video Solution

25. On which fcator does the thermal conductivity depend ?

Watch Video Solution

26. On what the value of heat capacity depends ?

Watch Video Solution

27. On which factor does the required amount of heat depend to increase temperature in substance ?

Watch Video Solution

28. Write dimensional formula of heat capacity.

Watch Video Solution

29. By what the temperature difference can be determined if the state of substance is not charged for the absorption of given heat ?

Watch Video Solution

30. Why water is used as coolant in automobile radiator ?

Watch Video Solution

31. Why the water is used in the rubber bag for the fomentation on body ?

Watch Video Solution

32. Why the winds coming from sea are cool in summer ?

Watch Video Solution

33. Why the land of desert gets hotter in day time and colder in night time quickly ?

Watch Video Solution

34. What is the effect of pressures on boiling point of water ?

Watch Video Solution

35. Why we get burnt more by steam than boiling water ?

Watch Video Solution

36. What is called forced convection ?

Watch Video Solution

37. What is called natural convection ?

Watch Video Solution

38. "Perfect black body is black in colour". Is this statement true or false ?

Watch Video Solution

39. Why Sun is considered as perfect black body ? Explain and also Explain the importance of study of black body radiation.

Watch Video Solution

40. Write the value and dimensional formula of Stefan - Boltzmaan constant.

View Text Solution

41. It substance of T temperature is kept in surrounding of T temperature, then give the net rate of loss of radlation energy.

View Text Solution

Section C Objective Questions Vsqs Fill In The Blank

1. $0.49 \frac{\text{cal}}{cm \times K \times s} = \ldots . \frac{J}{m \times K \times s}$

Watch Video Solution

2. If the rate of emission of heat of a substance is less than its rate of absorption, then its temperature . . ..

Watch Video Solution

3. The rate of emission of heat of a substance is directly proportional to . . . . . of temperature of it and surroundings.

Watch Video Solution

4. SI unit of Stefan-Boltzmaan constant is . . ..

Watch Video Solution

5. In thermal steady state of rod, temperature gradient is 5° C/cm and temperature of its hot end is $100^\circ C$, then at . . . . . cm distance from hot end its temperature becomes $60^\circ C$.

Watch Video Solution

6. At . . . . temperature coefficient of volume expansion will be zero.

Watch Video Solution

Section C Objective Questions Vsqs Match Type Questions

1. Match the followings :

Column-I		Column-II	
(a)	Combined existence of liquid-gaseous state of substance.	(i)	Sublimation curve
(b)	Combined existence of solid-gaseous state of substance.	(ii)	Fusion curve
		(iii)	Vapourization curve

Watch Video Solution

2. Match the following according to conversion by heat :

	Column-I		Column-II
(a)	Required heat to convert liquid into gaseous.	(i)	Latent heat of fusion
(b)	Required heat to convert solid into liquid.	(ii)	Latent heat of vapourization.

Watch Video Solution

3. Values for latent heat in Column - I and its values are given in Column - II. Match the followings

	Column-I		Column-II
(a)	Latent heat of vapourization L_V	(i)	22.6×10^5 J/kg
(b)	Latent heat of fusion L_f	(ii)	33.3×10^5 J/kg
		(iii)	3.33×10^5 J/kg

Watch Video Solution

4. Units for constants in Column-I and SI unit is given in Column-II. Match the followings :

Column-I		Column-II	
(a)	Wein's constant.	(i)	$Wm^{-2} K^{-4}$
(b)	Stefan-Boltzmaan's constant.	(ii)	$Wm^{-1} K^{4}$
		(iii)	mK

Watch Video Solution

5. In Column-I, system surroundings and in Column - II modes of heat transfer are given below. Match the

followings :

Column-I		Column-II	
(a)	Cup of hot tea in room	(i)	Forced convection
(b)	Substance kept near fire	(ii)	Natural convection
		(iii)	Conduction
		(iv)	Radiation

Watch Video Solution

Section C Objective Questions Vsqs Assertion And Reason Type Questions

1. Assertion : Good absorbers of radiation are weak emitters.

Reason : Ratoi of emissivity and absorptivity is

constant for all substances at any temperature for same wavelength radiation.

A. Both are true and the reason is the correct explanation of the assertion.

B. Both are true but the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: A

 Watch Video Solution

2. Assertion : At same temperature among plastic body of pen and metal portion on cap, metal portion is cold.

Reason : Thermal conductivity of metal is more than plastic.

A. Both are true and the reason is the correct explanation of the assertion.

B. Both are true but the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: A

3. Assertion : If Earth doesn't have atmosphere, than there will be very much cold.

Reason : In convection, heat transfers through air.

A. Both are true and the reason is the correct explanation of the assertion.

B. Both are true but the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: C

4. Assertion : In radiation, heat transfers in form of electromagnetic waves.

Reason : For electromagnetic waves medium is not required.

A. Both are true and the reason is the correct explanation of the assertion.

B. Both are true but the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: B

 Watch Video Solution

5. Assertion : Vapourization is done from liquid surface.

Reason : The atoms on the surface apply less attraction as compared to atoms inside the surface.

A. Both are true and the reason is the correct explanation of the assertion.

B. Both are true but the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: B

Watch Video Solution

Section D Ncert Exemplar Solution Multiple Choice Questions Mcqs

1. A bimetallic strip is made of aluminium and steel $(\alpha_{Al} > \alpha_{\text{steel}})$. On heating, the strip will

A. remain straight.

B. get twisted.

C. will bend with aluminium on concave side.

D. will bend with steel on concave side.

Answer: D

Watch Video Solution

2. A uniform metallic rod rotates about its perpendicular bisector with constant angular speed. If

it is heated uniformly to raise its temperature slightly

A. its speed of rotation increases.

B. its speed of rotation decreases

C. its speed of rotation remains same.

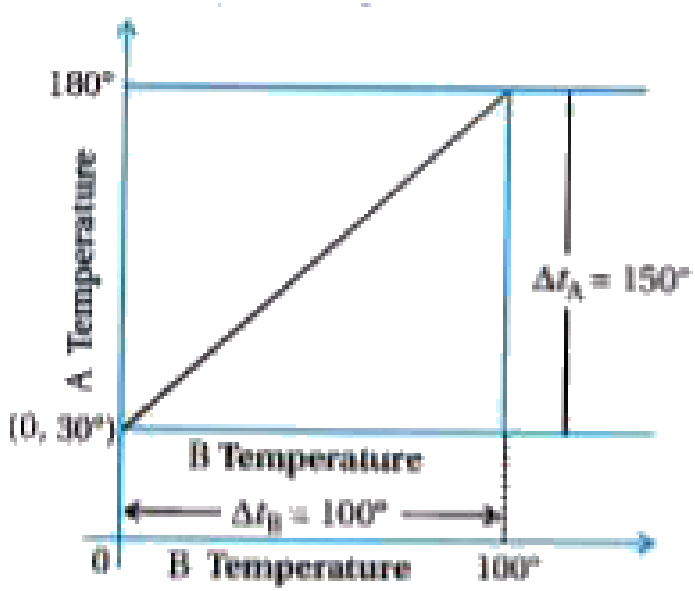
D. its speed increases because its moment of inertia increases.

Answer: B

Watch Video Solution

3. The graph between two temperature scales A and B is shown in figure. Between upper fixed point and

lower fixed point there are 150 equal division on A and 100 on scale B. The relationship for conversion between the two scales is given by



A. $\frac{t_A - 180}{100} = \frac{t_B}{150}$

B. $\frac{t_A - 30}{150} = \frac{t_B}{100}$

C. $\frac{T_B - 180}{150} = \frac{t_A}{100}$

D. $\frac{t_B - 40}{100} = \frac{t_A}{180}$

Answer: B

Watch Video Solution

4. An aluminium sphere is dipped into water which of the following is true ?

A. Buoyancy will be less in water at $0^\circ C$ than that in water at $4^\circ C$.

B. Buoyancy will be more in water at $0^\circ C$ than that in water at $4^\circ C$.

C. Buoyancy in water at $0^\circ C$ will be same as that in water at $4^\circ C$.

D. Buoyancy may be more or less in water at $4^{\circ}C$ depending on the radius of the sphere.

Answer: A

Watch Video Solution

5. As the temperature is increased, the time period of a pendulum

A. increases as its effective length increases even though its centre of mass still remains at the centre of the bob.

B. decreases as its effective length increases even though its centre of mass still remains at the centre of the bob.

C. increases as its effective length increases due to shifting of centre of mass below the centre of mass below the centre of the bob.

D. decreases as its effective length remains same but the centre of mass shifts above the centre of the bob.

Answer: A

 Watch Video Solution

6. With what heat is associated ?

A. Kinetic energy of molecules moving randomly.

B. Kinetic energy of molecules moving uniformly

C. Total of random and uniform kinetic energy.

D. Kinetic energy of random motion in some cases and uniform motion for other cases.

Answer: A

Watch Video Solution

7. The radius of a metal sphere at room temperature T is R, and the coefficient of linear expansion of the metal is α. The sphere is heated a little by a temperature ΔT so that its new temperature is $T + \Delta T$. The increase in the volume of the sphere is approsimately.

A. $2\pi \quad R\alpha \quad \Delta T$

B. $\pi R^2 \quad \alpha \quad \Delta T$

C. $\frac{4}{3}\pi \quad R^3 \quad \alpha \quad \Delta T$

D. $4\pi \quad R^3 \quad \alpha \quad \Delta T$

Answer: D

Watch Video Solution

8. A sphere , a cube and a thin circular plate, all of same material and same mass are initially heated to same high temperature.

A. Plate will cool fastest and cube the slowest

B. Sphere will cool fastest and cube the slowest

C. Plate will cool fastest and sphere the slowest.

D. Cube will cool fastest and plate the slowest.

Answer: C

Watch Video Solution

9. 'Gulab Jamuns' (assumed to be spherical) are to be heated in an oven. They are available in two sizes, one twice bigger (in radius) than the other. Pizzas (assumed to be discs) are also to be heated in oven. They are also in two sizes, one twice big (in radius) than the other. All four are put together to be heated to oven temperature. Choose the correct option from the following :

A. Both size gulab jamuns will get heated in the same time.

B. Smaller gulab jamuns are heated before bigger ones.

C. Smaller pizzas are heated before bigger ones.

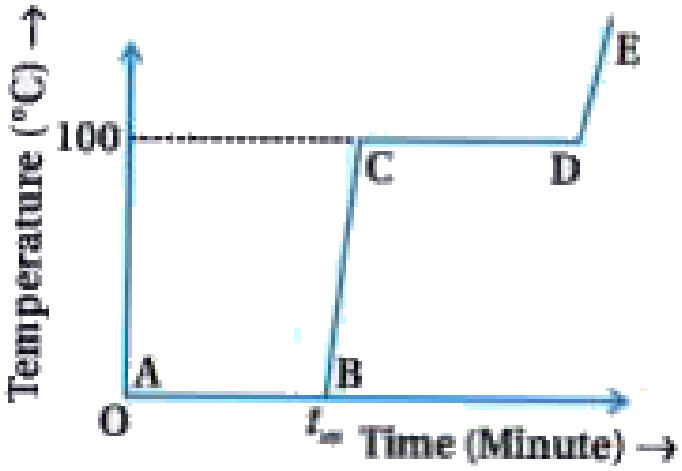
D. Bigger pizzas are heated before smaller ones.

Answer: B::C

Watch Video Solution

10. Refer to the plot of temperature versus time figure showing the changes in the state of ice on heating

(not to scale). Which of the following is correct ?



A. The region AB represents ice and water in thermal equilibrium.

B. At B water starts boiling.

C. At C all the water gets converted into steam

D. C to D represents water and steam in equilibrium at boiling point.

Answer: A::D

Watch Video Solution

11. A glass full of hot milk is poured on the table. It begins to cool gradually. Which of the following is correct

A. The rate of cooling is constant till milk attains the temperature of the surrounding.

B. The temperature of milk falls off exponentially with time.

C. While cooling, there is a flow of heat from milk to the surrounding as well as from surrounding to the milk but the net flow of heat is from milk to the surrounding and that is why it cools.

D. All three phenomenon, conduction convection and radiation are responsible for the loss of heat from milk to the surroundings.

Answer: B::C::D

 Watch Video Solution

Section D Ncert Exemplar Solution Multiple Choice Questions Mcqs More Than One Options

1. Mark the correct options :

A. A sustem X is thermal equilibrium with Y but not with Z. System Y and Z may be in thermal equilibrium with each other.

B. A system X is in thermal equilibrium with Y but not with Z. Systems Y and Z are not in thermal equilibrium with each other.

C. A system X is neither in thermal equilibrium with Y nor with Z. The systems Y and Z must be in

thermal equilibrium with each other.

D. A system X is neither in thermal equilibrium with Y nor with Z. The systems Y and Z may be in thermal equilibrium with each other.

Answer: B::D

Watch Video Solution

Section D Ncert Exemplar Solution Very Short Answer Type Questions

1. Is the bulb of a thermometer made of diathermic or adiabatic wall ?

Watch Video Solution

2. A Student records the initial length l, change in temperature ΔT and change in length Δl of a rod as follows :

S.No.	l(m)	ΔT(°C)	Δl(m)
(1)	2	10	4×10^{-4}
(2)	1	10	4×10^{-4}
(3)	2	20	2×10^{-4}
(4)	3	10	6×10^{-4}

If the first observation is correct what can you say about observations 2, 3 and 4.

Watch Video Solution

3. Why does a metal bar appear hotter than a wooden bar at the same temperature ? Equivalently it also appears cooler than wooden bar if they are both colder than room temperature.

Watch Video Solution

4. Calculate the temperature which has same numeral value on celsius and Fahrenheit scale.

Watch Video Solution

5. These days people use steel utensils with copper bottom. This is supposed to be good for uniform heating of food. Explain this effect using the fact that copper is the batter conductor.

Watch Video Solution

Section D Ncert Exemplar Solution Short Answer Type Questions

1. Find out the increases in moment of inertia I of a uniform rod (coefficient of linear expansion α) about its perpendicular bisector when its temperature is slightly increased by ΔT.

Watch Video Solution

2. During summers in India, one of the common practice to keep cool is to make ice balls of crushed ice, dip it in flavoured sugar syrup and sip it. For this a stick is inserted into crushed ice and is squeezed in the palm to make it into the ball. Equivalently in winter, in those areas where it snows, people make snow balls and throw around. Explain the formation of ball out of crushed ice or snow in the light of P - T diagram of water.

Watch Video Solution

3. 100 g of water is supercooled to $-10^{\circ}C$. At this point, due to some disturbance mechanised or otherwise some of it suddenly freezes to ice What will be the temperature of the resultant mixture and how much mass would freeze ?

$$\left[s_w = 1 \text{ cal g}^{-1} \ ^{\circ}C^{-1} \text{ and } L^{W}_{\text{fussion}} = 80 \text{ cal g}^{-1}\right]$$

Watch Video Solution

4. One day in the morning, Ramesh filled up $\frac{1}{3}$ bucket of hot water from geyser, to take bath. Remaining $\frac{2}{3}$ was to be filled by cold water (at room temperature) to bring mixture to a comfortable temperature. Suddenly Ramesh had to attend to something which

would take take some times, say 5-10 minutes before he could take bath. Now he had two options : (1) fill the remaining bucket completely by cold water and then attend to the cork, (2) first attend to the work and fill the remaining bucket just before taking bath. Which option do you think would have kept water warmer ? Explain.

Watch Video Solution

Section D Ncert Exemplar Solution Long Answer Type Questions

1. We would like to prepare a scale whose length does not change with temperature. It is proposed to prepare a unit scale of this type whose length remains, say 10 cm. We can use a bimetallic strip made of brass and iron each of different length whose length (both components) would change in such a way that difference between their lengths remain constant. If $\alpha_{\text{iron}} = 1.2 \times 10^{-5}/K$ and $\alpha_{\text{brass}} = 1.8 \times 10^{-5}/K$ what should we take as length of each strip ?

Watch Video Solution

2. We would like to make a vessel whose volume does not change with temperature (take a hint from the problem above). We can use brass and iron $\left(\beta_{\text{vbrass}} = 6 \times 10^{-5}/K \text{ and } \beta_{\text{viron}} = 3.55 \times 10^{-5}/K\right)$ to create a volume of 100 cc. How do you think you can achieve this.

Watch Video Solution

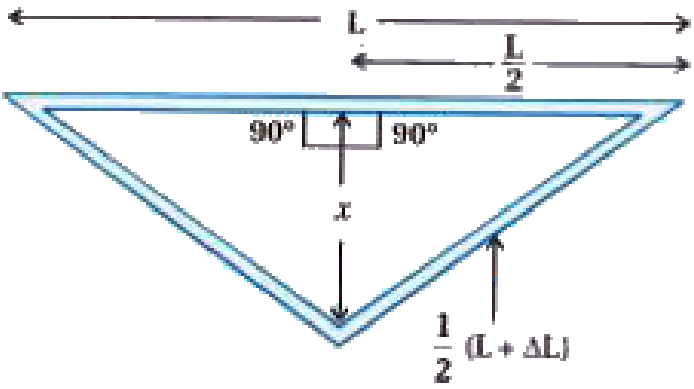
3. Calculate the stress developed inside a tooth cavity filled with copper when hot tea at temperature of $57^{\circ}C$ is drunk. You can take body (tooth) temperature

to be $37^{\circ}C$ and $\alpha = 1.7 \times 10^{-5}/^{\circ}C$, bulk modulus for copper $= 140 \times 10^{9} N/m^{2}$.

Watch Video Solution

4. A rail track made of steel having length 10 m is clamped on a railway line at its two ends as shown in figure. On a summer day due to rise in temperature by $20^{\circ}C$, it is deformed as shown in figure. Find x (displacement of the centre) if

$\alpha_{\text{steel}} = 1.2 \times 10^{-5} \quad {}^{\circ}C^{-1}$



Watch Video Solution

5. A thin rod having length L_0 at $0^{\circ}C$ and coefficient of linear expansion α has its two ends maintained at temperature θ_1 and θ_2 respectively. Find its new length.

Watch Video Solution

6. According to Stefan's law of radiation, a black body radiates energy σT^4 from its unit surface area every second where T is the surface temperature of the black body and $\sigma = 5.67 \times 10^{-8} W/m^2 K^4$ is known as Stefan's constant. A nuclear weapon may be thought of as a ball of radius 0.5 m. When detonated, it reaches temperature of 10^6 K and can be treated as a black body.

Estimate the power it radiates.

Watch Video Solution

7. According to Stefan's law of radiation, a black body radiates energy σT^4 from its unit surface area every second where T is the surface temperature of the black body and $\sigma = 5.67 \times 10^{-8} W/m^2 K^4$ is known as Stefan's constant. A nuclear weapon may be thought of as a ball of radius 0.5 m. When detonated, it reaches temperature of 10^6 K and can be treated as a black body.

If surrounding has water at $30^\circ C$, how much water can $10\,\%$ of the energy produced evaporate in 1 s ?

$\left[S_w = 4186.0 \ \text{J/kg K and} \ L_v = 22.6 \times 10^5 \ \text{J/kg}\right].$

Watch Video Solution

8. According to Stefan's law of radiation, a black body radiates energy σT^4 from its unit surface area every second where T is the surface temperature of the black body and $\sigma = 5.67 \times 10^{-8} W/m^2 K^4$ is known as Stefan's constant. A nuclear weapon may be thought of as a ball of radius 0.5 m. When detonated, it reaches temperature of 10^6 K and can be treated as a black body.

If all this energy U is in the form of radiation, corresponding momentum is $p = \frac{U}{c}$. How much momentum per unit time does it impart on unit area at a distance of 1 km ?

Watch Video Solution

Section E Multiple Choice Questions Mcqs

1. Temperature of a steel block changes from $80^{\circ}C$ to $75^{\circ}C$ in time t_1, from $75^{\circ}C$ to $70^{\circ}C$ in time t_2 and from $70^{\circ}C$ to $65^{\circ}C$ in time t_3 then .....

A. $t_1 = t_2 = t_3$

B. $t_1 < t_2 = t_3$

C. $t_1 < t_2 < t_3$

D. $t_1 > t_2 > t_3$

Answer: C

Watch Video Solution

2. A black body has maximum wavelength λ_m at 2000 K. Its corresponding wavelength at 3000 K will be . . . .

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

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

C. $\frac{4}{9}\lambda_m$

D. $\frac{9}{4}\lambda_m$

Answer: A

Watch Video Solution

3. A cylindrical rod having temperature T_1 and T_2 at its end. The rate of flow of heat is $Q_1 \frac{\text{Cal}}{s}$ If all linear dimensions are doubled keeping temperature constant, then the rate of flow of heat Q_2 in $\frac{\text{Cal}}{s}$ will be .....

A. $\frac{Q_1}{4}$

B. $\frac{Q_1}{2}$

C. $2Q_1$

D. $4Q_1$

Answer: C

Watch Video Solution

4. Two rods A and B are of equal lengths. Their ends are kept at the same temperature difference and their area of cross - sections are A_1 and A_2 and thermal conductivities k_1 and k_2. The rate of heat transmission in two rods will be equal, if . . . .

A. $k_1 A_2 = k_2 A_1$

B. $k_1 A_1 = k_2 A_2$

C. $k_1 = k_2$

D. $k_1 A_1^2 = k_2 A_2^2$

Answer: B

Watch Video Solution

5. Consider a compound slab consisting of two different materials having equal thicknesses and thermal conductivities K and 2K respectively. The equivalent thermal conductivity of the slab is . . . .

A. $\frac{4}{3}K$

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

C. $\sqrt{3}K$

D. 3 K

Answer: A

Watch Video Solution

6. A black body emits radiations of maximum intensity at wavelength of 5000Å When the temperature of the body is $1227^\circ C$. If the temperature of the body is increased by $1000^\circ C$, the maximum intensity of emitted radiation would be observed at .....

A. 3000Å

B. 4000Å

C. 5000Å

D. 6000Å

Answer: A

Watch Video Solution

7. Rate of emitted radiation energy from perfect black body at 500 K is proportional to . . . .. .

A. $(500)^4$

B. $(500)^3$

C. $(500)^2$

D. 500

Answer: A

Watch Video Solution

8. What will be the power incident normally on unit area of spherical surface which is at distance R from the outermost surface of Sun of radius r at $t^{\circ}C$?

$\sigma =$ Stefan - Boltzmann's constant

A. $\frac{r^2\sigma\left(t+273^4\right)}{4\pi R^2}$

B. $\frac{16\pi^2 r^2\sigma t^4}{R^2}$

C. $\frac{r^2\sigma(t+273)^4}{R^2}$

D. $\frac{4\pi r^2\sigma t^4}{R^2}$

Answer: C

Watch Video Solution

9. In new temperature scale W, freezing point of water is $39^\circ W$ and boiling point is $239^\circ W$. What would be the temperature on new temperature scale for $39^\circ C$ temperature ?

A. $200^\circ W$

B. $139^\circ W$

C. $78^\circ W$

D. $117^\circ W$

Answer: D

Watch Video Solution

10. Constant temperature of ends are T_1 and T_2 (where $T_1 > T_2$) for a conducting rod of 'L' length and cross-sectional area A. What would be the rate of heat transfer in thermal steady state ?

A. $\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{L}$

B. $\frac{dQ}{dt} = KAL(T_1 - T_2)$

C. $\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{2}$

D. $\frac{dQ}{dt} = \frac{KL(T_1 - T_2)}{A}$

Answer: C

Watch Video Solution

11. With rate of $7\ \text{cal}\ \text{cm}^{-2}s^{-1}$, radiations are emitted from the black body at $227^\circ C$, the rate of emitted radiations at $727^\circ C$ will be .....

A. 50

B. 60

C. 80

D. 112

Answer: D

Watch Video Solution

12. Radius of a star acting like perfect black body is R, then at what temperature the rate of radiation will be Q ?

(Where $\sigma =$ Stefun - Boltzman constant)

A. $\frac{Q}{4\pi R^2\sigma}$

B. $\left(\frac{Q}{4\pi R^2\sigma}\right)^{-\frac{1}{2}}$

C. $\left(\frac{4\pi R^2 Q}{\sigma}\right)^{\frac{1}{4}}$

D. $\left(\frac{Q}{4\pi R^2\sigma}\right)^{\frac{1}{4}}$

Answer: D

Watch Video Solution

13. A stone of 0.36 m^2 cross -sectional area and 0.1 m thickness has its lower surface in contact with water at $100^\circ C$ and upper surface in contact with ice at $0^\circ C$. If 4.8 kg ice melting in 1 hour, then what is the thermal conductivity of stone ? Latent heat of fusion of ice is $3.36 \times 10^5 \ \text{J/kg}$.

A. $1.24 \ \text{J/ms} \ ^\circ C$

B. $1.29 \ \text{J/ms} \ ^\circ C$

C. $2.05 \ \text{J/ms} \ ^\circ C$

D. $1.02 \ \text{J/ms} \ ^\circ C$

Answer: A

Watch Video Solution

14. How much energy will be emitted from a furnace at 3000K temperature active as a perfect black body per unit area in 1 hour ?

$\left(\sigma = 5.7 \times 10^{-8} \ \ \mathrm{Wm}^{-2} K^{-4}\right)$

A. $1.1 \times 10^{12} J$

B. $1.7 \times 10^{10} J$

C. $4.6 \times 10^{6} J$

D. $2.8 \times 10^{8} J$

Answer: B

Watch Video Solution

15. Two spheres of the same material have radii 1 m and 4 m and temperature 4000 K and 2000 K respectively. Ratio of the energy radiated per second by the first sphere to that by the second is . . . . . .

A. $1:1$

B. $16:1$

C. $4:1$

D. $1:9$

Answer: A

Watch Video Solution

16. The radiation emitted by a star A is 10,000 times that of the Sun. If the surface temperature of the Sun and the star are 6000 K and 2000 K respectively, the ratio of the radius of star A and the Sun is . . . .

A. $300:1$

B. $600:1$

C. $900:1$

D. $1200:1$

Answer: C

Watch Video Solution

17. If the temperature of the Sun were to increase from T to 2T and its radius from R to 2R. The ratio of radiant energy received on earth to what it was previously will be . . . .

A. 4

B. 16

C. 32

D. 64

Answer: D

Watch Video Solution

18. Maximum wavelength of radiation from black body at 1640 K temp. is 1.75 μm. If moon is considered as perfect black body and maximum wavelength radiation from it is 14.35 μm, then what should be the temperature of moon ?

A. 100K

B. 150 K

C. 200 K

D. 250 K

Answer: C

 Watch Video Solution

19. A compound slab is made up two slabs. If thermal conductivity of their material are k_1 and k_2 respectively of their cross-sectional areas are the same, the equivalent thermal conductivity of the slab is . . . . . (consider series connection)

A. $\frac{2k_1k_2}{k_1+k_2}$

B. $\sqrt{k_1k_2}$

C. $\frac{k_1k_2}{k_1+k_2}$

D. k_1+k_2

Answer: A

Watch Video Solution

20. Suppose the Sun expands so that its radius becomes 100 times its presents radius and its surface temperature becomes half to its present value. The total energy emitted by it then will increase by a factor of . . . .

A. 104

B. 625

C. 256

D. 16

Answer: B

Watch Video Solution

21. Three bodies of black, gray and white colour are able to sustain upto $2800^{\circ} C$ temperature. If these are kept in a frame then temperature of each becomes $2000^{\circ} C$, then which body will be unlighted maximum ?

A. white body

B. black body

C. all three bodies

D. gray body

Answer: B

Watch Video Solution

22. Absorbing and emitting powers of a body are 10 and 8 respectively. Then (Ideal Black Body) IBB emissivity will be . . . . .

A. 0.2

B. 0.4

C. 0.6

D. 0.8

Answer: D

Watch Video Solution

23. By heating a iron part with flame, first it becomes red, then reddish yellow and at last white. Which can give correct explanation from following ?

A. Wien's displacement law

B. Kirchoff's law

C. Newton's cooling law

D. Stefan-Boltzzmann law

Answer: A

Watch Video Solution

24. By heating a iron part with flame, first it becomes red, then reddish yellow and at last white. Which can give correct explanation from following ?

A. Newton's law of cooling

B. Stefan's law

C. Wien's displacement law

D. Kirchoff's law

Answer: C

Watch Video Solution

25. Certain quantity of water cools from $70^\circ C$ to $60^\circ C$ in the first 5 minutes and to $54^\circ C$ in the next 5 minutes and to $54^\circ C$ in the next 5 minutes. The temperature of the surroundings is

A. $45^\circ C$

B. $20^\circ C$

C. $42^\circ C$

D. $10^\circ c$

Answer: A

Watch Video Solution

26. The two ends of a metal rod are maintained at temperatures $100^{\circ}C$ and $110^{\circ}C$. The rate of heat flow in the rod is found to be $4.0\ \ \mathrm{Js}^{-1}$. If the ends are maintained at temperatures $200^{\circ}C$ and $210^{\circ}C$, the rate of heat flow will be :

A. $16.8\ \ \mathrm{Js}^{-1}$

B. $8.0\ \ \mathrm{Js}^{-1}$

C. $4.0\ \ \mathrm{Js}^{-1}$

D. $44.0\ \ \mathrm{Js}^{-1}$

Answer: C

Watch Video Solution

27. On observing light from three different stars P, Q and R, it was found that intensity of violet color is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red colour is maximum in the spectrum of Q. If T_P, T_Q and T_R are the respective absolute temperatures of P,Q and R, then it can be concluded from the above observation that :

A. $T_P > T_R > T_Q$

B. $T_P < T_R < T_Q$

C. $T_P < T_Q < T_R$

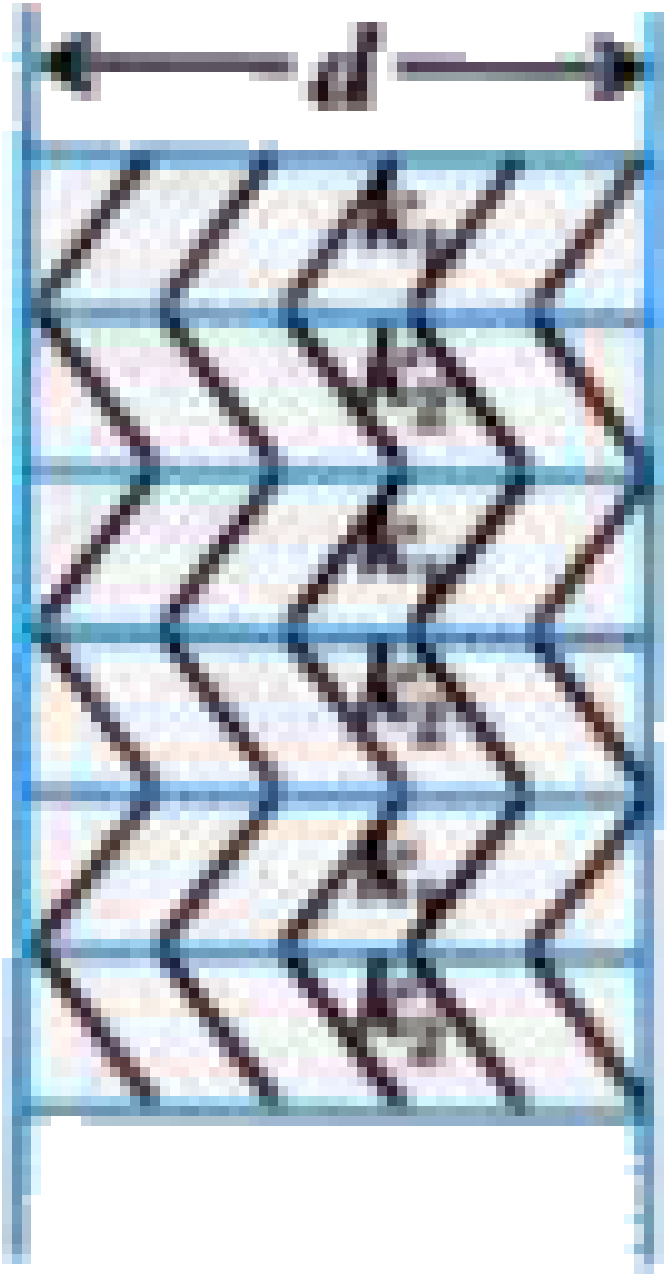
D. $T_P > T_Q > T_R$

Answer: A

Watch Video Solution

28. A wall consists of alternating blocks of length 'd' and coefficient of thermal conductivity k_1 and k_2 respectively as shown in figure. The cross sectional area of the blocks are the same. The equivalent coefficient of thermal conductivity of the wall between

left and right is . . . . .



A. $\frac{k_1 + k_2}{2}$

B. $\frac{2k_1k_2}{k_1 + k_2}$

C. $\frac{k_1 + k_2}{3}$

D. $\frac{3k_1k_2}{k_1 + k_2}$

Answer: A

Watch Video Solution

29. The power radiated by a black body is P and it radiates maximum energy at wavelength, λ_0. If the temperature of the black body is now changed so that

it radiates maximum energy at wavelength $\frac{3}{4}\lambda_0$, the power radiated by it becomes nP. The value of n is

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

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

C. $\frac{256}{81}$

D. $\frac{81}{256}$

Answer: C

Watch Video Solution

30. An unknown metal of mass 192 g heated to a temperature of $100 \quad ^\circ C$ was immersed into a brass

calorimeter of mass 128 g containing 240 g of water at a temperature of $8.4 \quad ^{\circ}C$. Calculate the specific heat of the unknown metal if water temperature stabilizes at $21.5 \quad ^{\circ}C$.

(Specific heat of brass is $394 JKg^{-1}K^{-1}$)

A. $458 \text{ J Kg}^{-1}K^{-1}$

B. $916 \text{ J Kg}^{-1}K^{-1}$

C. $654 \text{ J Kg}^{-1}K^{-1}$

D. $1232 \text{ J Kg} \quad K^{-1}$

Answer: B

Watch Video Solution

Section F Question From Module Sample Questions For Preparation Of Competitive Exams

1. In . . . .. process, gravitation is necessary for transfer of heat energy.

A. conduction

B. convection

C. to transfer liquid into vessel

D. radiation

Answer: B

Watch Video Solution

2. Which of the following is not correct of radiation ?

A. Wavelength is changed while transferring from one to another medium

B. Frequency is changed while transferring from one to another medium.

C. Speed is changed white transferring from one to another medium.

D. It performs linear motion in given medium.

Answer: B

 Watch Video Solution

3. Temperature of two identical balls are $200^\circ C$ and $400^\circ C$. Both are kept in surroundings of $27^\circ C$. The ratio of their rate of radiation energy is . .. . . .

A. $\frac{1}{16}$

B. $\frac{1}{4}$

C. $\frac{1}{2}$

D. $\frac{(473)^4 - (300)^4}{(673)^4 - (300)^4}$

Answer: D

Watch Video Solution

4. Three large discs have same area. They are kept at equidistant in parallel. They can be considered as perfect black bodies and their thermal conductivity is very large. If temperature of first and third discs are $2TC$ and $3TC$ respectively then temperature of second disc in thermal steady state is . . . . .

A. $\left(\frac{65}{2}\right)^{\frac{1}{4}}T$

B. $\left(\frac{97}{4}\right)^{\frac{1}{4}}T$

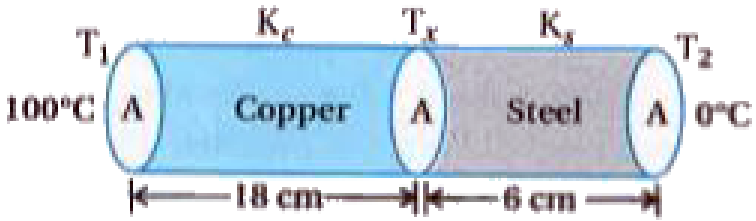
C. $\left(\frac{97}{2}\right)^{\frac{1}{4}}T$

D. $(97)^{\frac{1}{4}}T$

Answer: C

Watch Video Solution

5. Thermal conductivity of coppe is 9 times that of steel. As shown in figure the temperature difference between ends of copper and steel is $100^\circ C$. Find the temperature of their contact surface.



A. $75^\circ C$

B. $67^\circ C$

C. $33^\circ C$

D. $25^\circ C$

Answer: A

Watch Video Solution

6. Two black bodies at temperature $327^\circ C$ and $427^\circ C$ are arranged in a box of $27^\circ C$ variable temperature of free space, the ratio of their rate of radiant energy is . . . . . .

A. $\frac{6}{7}$

B. $\frac{36}{49}$

C. $\frac{464}{243}$

D. $\frac{243}{464}$

Answer: D

Watch Video Solution

7. 1.56×10^5 heat energy is transferred through wall 2 m^2 and 12 cm thickness in every hour. Temperature difference between two walls is $20^\circ C$, the mall conductivity of material of wall is ..... $\mathrm{Wm}^{-1}K^{-1}$

A. 0.11

B. 0.13

C. 0.15

D. 1.2

Answer: B

Watch Video Solution

8. What will be the increment in heat energy radiated when the temperature of hot body is raised by 5% ?

A. 12%

B. 22%

C. 32%

D. 42%

Answer: B

Watch Video Solution

Watch Video Solution

9. Decrease in temperature is noticed by sprinkling water in closed room. Because,

A. temperature of water is less than room

B. specific heat of water is high

C. latent heat of vapourization of water is high.

D. water is heat insulator

Answer: C

Watch Video Solution

10. Maximum wavelength of radiations from Sun and Moon are 25Å and 0.5×10^{-6}m respectively ratio of their temperature is . . . . . .

A. $1:1000$

B. $1:2000$

C. $200:1$

D. $400:1$

Answer: C

Watch Video Solution

11. Two substances A and B have relation $T_A = 4T_B$ for their absolute zero temperature. The difference in their wavelength is $3.0\mu m$ when maximum radiation energy emit from them. Wavelength of B for maximum radiation energy is $\ldots\ldots..\mu m$.

A. 2

B. 2.5

C. 4.0

D. 4.5

Answer: C

Watch Video Solution

12. . . . . . gives relation between temperature and colour of star.

A. Wein's displacement law

B. Planck's law

C. Fraunhoffer's diffraction law

D. Hubble's law

Answer: A

Watch Video Solution

13. In which process the rate of transfer of heat from one place to another place is large ?

A. Conduction

B. convection

C. radiation

D. equal in all 3

Answer: C

Watch Video Solution

14. Temperature of body A of 0.5 to mass is $60^\circ C$ Temperature of body B of 0.3 kg mass is $90^\circ C$. If both are joined by conducting rod, then heat .....

Specific heat of A is 0.85 J/gm K

Specific heat of B is 0.9 J/gm K

A. will flow from A to B

B. first flow from A to B. Then it will flow from B to A.

C. will flow from B to A

D. will bot flow

Answer: B

Watch Video Solution

15. Temperature of substances A and B are $727^\circ C$ and $327^\circ C$ respectively, then ratio of rate of their radiant energy $H_A : H_B = \ldots\ldots$

A. $727 : 327$

B. $5 : 3$

C. $25 : 9$

D. $625 : 81$

Answer: D

Watch Video Solution

16. A cubical wooden box is hanged in a room by keeping the 15 kg ice in it. Inner length of box is 50 cm and thickness is 7.5 mm. Time taken by whole ice at $0^{\circ}C$ to mellt will be . . .. For wood, $K = 6 \times 10^{-4}\ \text{cal}\,\text{s}^{-1}\ \text{cm}^{-1}\ {}^{\circ}C^{-1}$. Outer temperature is $25^{\circ}C$, located heat of fusion of ice is 80 cal/g :

A. 2000 s

B. 2500 s

C. 3500 s

D. 4000 s

Answer: D

Watch Video Solution

17. Consider a compound slab consisting of two different materials having equal thicknesses and thermal conductivities K and 2K respectively. The equivalent thermal conductivity of the slab is . . . . . .

A. $\sqrt{2K}$

B. 3K

C. $\frac{4}{3}K$

D. $\frac{2}{3}K$

Answer: C

Watch Video Solution

Watch Video Solution

18. A hot liquid in beaker at $80^\circ C$ cools down to $70^\circ C$ in 2 minutes in an atmosphere of $30^\circ C$ temperature, then time taken to cool it down from $60^\circ C$ to $50^\circ C$ is .....

A. 240

B. 360

C. 480

D. 216

Answer: D

Watch Video Solution

Question Paper Section A Answer Following In One Sentence Word Limit Of Answer Is 10 Each Question Carries 1 Mark

1. Give SI unit of heat current.

Watch Video Solution

2. Give dimensional formula of thermal conductivity.

Watch Video Solution

3. On which factor the properties of radiations of perfect black body depend ?

Watch Video Solution

4. In reference with natural convection, give Langmuir-Lorentz law of cooling.

Watch Video Solution

5. What are heat rays ?

Watch Video Solution

6. Give name of physical quantity which has same unit as of heat current.

Watch Video Solution

Question Paper Section B Answer The Following Question In Short Word Limit Of Answer Is 10 Each Carry 2 Mark

1. Write difference of conduction, convection and radiation.

Watch Video Solution

2. Define and explain spectral emissive power.

Watch Video Solution

Question Paper Section C Do As Directed Word Limit Of Answer Is 10 Each Carry 3 Mark

1. A hole is drilled in a copper sheet. The diameter of the hole is 4.24 cm at $27.0^{\circ}C$. What is the change in the diameter of the hole when the sheet is heated to $227^{\circ}C$? Coefficient of linear expansion of copper $= 1.70 \times 10^{-5}K^{-1}$.

Watch Video Solution

2. A brass rod of length 50 cm and diameter 3.0 mm is joined to a steel rod of the same length and diameter. What is the change in length of the combined rod at $250^{\circ}C$, if the original lengths are at $40.0^{\circ}C$? there a 'thermal stress' developed at the junction ? The ends of the rod are free to expand (Coefficient of linear expansion of brass $= 2.0 \times 10^{-5} K^{-1}$, steel $= 1.2 \times 10^{-5} K^{-1}$).

Watch Video Solution

Question Paper Section D Answer Following In Brief Each Carry 4 Marks

1. In an experiment on the specific heat of a metal, a 0.20 kg block of the metal at $150^{\circ}C$ is dropped in a copper calorimeter (of water equivalent 0.025 kg) containing $150\ \mathrm{cm}^3$ of water at $27^{\circ}C$. The final temperature is $40^{\circ}C$. Compute the specific heat of the metal. If heat losses to the surroundings are not negligible, is your answer greater or smaller than the actual value for specific heat of the metal ?

Watch Video Solution