PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

THERMAL PROPERTIES OF MATTER

Example

1. The thermal capacity of 8 liters of a liquid A is equal to the thermal capacity of 10 liters of

liquid B.If the densities of the liquids A and B are 0.5 g/cm^3 and 0.6 g/cm^3 respectively ,find the ration of their specific heats.

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2. The temperature of equal masses of three liquids A,B and C are 12°C,19°C and 28°C respectively.The temperature ,when A and B are mixed is 16°C and when B and C are mixed ,it is 23°C .What will be temperature when A and C are mixed.

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3. A brass sheet has a circular hole of diameter 3 cm at 30°C .What will be the change in diameter of the hole when it is heated to 120°C ?Given $\alpha_brass = 2 \cdot 10^{-5^\circ} C^{-1}$.

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4. The co-efficient of line expansion brass is $2 \cdot 10^{-5^\circ} C^{-1}$, By how much the temperature

of a brass rod be increased so as increase its length by 4%.

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5. A rod brass and a rod of iron differ by 14 cm in length at all temperature .What are their length at 0°C?($\alpha$for iron =$11 \cdot 10^{-6}$/°C and α for brass=$18 \cdot \frac{10^{-6}}{^\circ} C$)

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6. The length of a copper rod at 20°C is found to be 150cm when measured with a steel scale which gives correct reading at this temperature.What length of the same copper rod be found when measured with the same rod at 60°C?

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7. The co-efficient of volumn expansion of a liquid is $49 \cdot 10 - 5C^{-1}$,By what percentage

does its density change on raising the temperature by 50°C?

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8. A glass container of volumn $200cm^3$ is full of mercury at 20°C .the temperature is raised to 100°C.Find how much mercury will be going out of the container.Given that cubical expansion of glass $\gamma_g = 12 \cdot \frac{10^{-5}}{^\circ}C$,cubical expansion Hg$\gamma_g = 18 \cdot \frac{10^{-4}}{^\circ}C.$

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9. An electric heater takes 15 min to raise a certain quantity of water from 0°C to its boiling point.If it takes another 80 min to turn all water into steam ,find the latent heat of vaporsation of water.

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10. How much heat is required to convert 5 kg of ice at -10°C into steam at 100°C?

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11. When 0.2 kg of ice at 0°C is mixed with 0.40 kg water at 50°C,the resulting temperature is 7°C,Find latent heat of fusion of ice,(Give `s-w=4186 Jkg^-1 K^-1)

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12. Assume the thermal conductivity of copper is 4 times that of brass.Two rods of copper and brass having the same length and cross

section are joined end to end.The free and end of copper is at $0^{o}C$ and the free end of brass is at $100^{o}C$.Calculate the temperature of the junctionof thw two rods at equilibirum.

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13. A black body at $27^{o}C$ surrounds another at $-73^{o}C$.Calculate the net heat transferred per square metre of the body at higher temperature.

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Exercise

1. Define co-efficient of linear expansion.Dose it depend on unit of length?

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2. How does the density of a body change with temperature ?

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3. Why is some space left in between two rails?

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4. Why does a thick glass trembler crack on pouring hot water into it?

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5. Why are telegraph wires left loose between two poles?

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6. Why do lakes freeze first at the surface ?

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7. What is the principle of calorimetry?

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8. What are the units of heat in CGS and SI system.How are they related?

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9. What is meant by thermal capacity?

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10. Define water equivalent of a body .What is its unit?

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11. What is the relation between thermal capacity and specific heat?

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12. Define specific heat of substance.Does it depend on pressure?

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13. What is molar specific heat?How its related to specific heat?

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14. What is fusion?

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15. Define a melting point.Does it depend on pressure?

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16. What is the effect of increase of pressure on melting point of ice?

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17. Define a boiling point.Does it depand on pressure?

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18. What do you mean by emissive power of a body?

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19. What is a black body?

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20. What is the emissivity of a perfectly black body?What is meant by absorving power?

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21. What is meant by absorptive power?

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22. What is the relation between the emissivity and absorbing power of a black body?

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23. State stefan's law of radiation?

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24. Show that the co-efficient of area expansion of a rectangular sheet is twice its linear expansivity.

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25. What are the co-efficient of expansion of solid? How are they related?

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26. What is anomalous expansion of water? How is it useful in preserving acquatic life?

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27. Find a relation to show the effect of temperature on the density .

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28. What is the principle of calorimetry?

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29. Explain why at high altitude,water boils below 100?

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30. Explain what is meant by latent heat.

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31. Latent heat of vaporisation of water is 540 cal/gm.Explain the meaning of the statement.

32. Woolen clothes are warmer than cotton cloths why?

33. Describe the construction of a blck body.

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34. What is the emissivity of a perfectly black body?What is meant by absorving power?

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35. Define co-efficient of linear,superficial and volume expansions.

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36. What is the principle of calorimetry?

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37. Define unit heat.What is specific heat of solid? How does it defer from thermal capacity?

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38. Two soilds of same mass but the specific heat of one being greater then that of the other are heated equally.Explain in which body the rise of temperature will be more.

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39. Define melting point of a substance.State the effect of pressure on it.

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40. Explain the different modes of transmission of heat.

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41. What is meant by the thermal radiation?

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42. What is meant by the co -efficient of thermal conductivity of a material?state its unit and dimension.

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43. State Newton's law of cooling.Deduce it from strfan's law of radiation.

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44. The difference between the length of a certain brass rod and that of a steel rod is claimed to be constant at all temperatures.Is it possible?

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45. Does the co-efficient of linear expansion depend on the scale of temperature and unit of length?

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46. Explain when small pieces of ice pressed together, form a single block.

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47. Explain why steam at 100°C usually produces more severe burn than water at the same temperature.

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48. Explain why does drinking water kept in an earthern pot cool down ?

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49. Why do we feel cooler under the fan?

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50. Explain why at high altitude,water boils below 100?

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51. Explain why food does not cook speedily at high altitudes.

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52. Why does food get cooked more quickly in a pressure cooker?

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53. Why white cloths are preferred in summer ?

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54. Why is the bottom of a tea kettel blackended while its upper part is so polished?

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55. Explain why a piece of iron appears to be cooler than a piece of wood in winter.

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56. Explain why two layer of cloths of equal thickness provide warmer covering than a single layer of double thickness.

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57. Cloudy nights are warmer than clear nights-why?

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58. At what common temperature would a block of wood and a block of metal feel equally cold or equally hot when touched with?

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59. Explain why a piece of paper warpped tightly on a wooden rod is found to gets charred qucikly.

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60. Two thermometers are constructed in the same way except that one has a spherical bulb and the other an elongated cylindrical bulb.which one will respond quickly to temperature changes?

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61. A metallic solid sphere and a hollow sphere of same material and external radius are heated to the same temperature and allowed

to cool in the same environment .Which of the two has aa greater cooling rate?

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62. A sphere ,a cubeand a thin circular plate,all made of the same meteriel and having the same mass are initially heated to a temperature of 200°C .Which of them will cool fastest and which one slowest when left in air at room temperature?

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63. Heat is generated continuosly in an electric heater ,but its temperature becomes constant after some time.Why?

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64. A zinc rod is measured by means of a brass scale (Which is correct at 0°C) and is found to be 1.0001 metre long at 10°C .What is actual length of the rod at 0°C ?(αforZn=$29 \cdot \frac{10^{-6}}{\circ} C$,$\alpha$for brass=$19 \cdot \frac{10^{-6}}{\circ} C$).

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65. A hot ball of iron weighing 200 g is dropped into 500 g water at 10°C .The resulting temperature is 22.8°C .Calculate the temperature of the ball

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66. The densities of two substance are $2:3$ and their specific heats are 0.12 and 0.09

respectively.compare their capacities per unit volume.

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67. Calculate the minimum amount of water at $15^{\circ}C$ needed to cool 200g of mercury at $80^{\circ}C$ to a temperature of $24^{\circ}C$ (specific heat of mercury=0.033).

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68. A piece of metal weighing 50 g is heated to a temperature of 1000°C and quickly dropped into a clorimeter containing 200 g of water at 25°C .The water equivalent of the calorimeter is 10g and specific heat of the metal is 0.1.Calculate the rise in temperature of water.

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69. How much steam at 100°C will just melt 3200g of ice at -10°C ?

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70. Find the result of mixing 100 g of ice at -12°C with 50g of water at 92°C .

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71. Calculate the amount nof heat required to change 5.0 kg of a ice to -20°C into steam at 100°C .

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72. Find the time in which a layer of ice 3 cm thick on the surface of a pond will increase in thickness by 1 mm when the temperature of the surrounding is -20°C .the thermal conductivity of ice is 2.1 W/m K, latent heatof ice 3.36 10^5J/kg and density is 900 $k\frac{g}{m^{-3}}$.

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73. The opposite face of a cubic block of iron of cross-section 8 sq.cm are kept in touch with

steam and melting ice.Determine the quantity of ice melted at the end of 5 minutes (K=0.2 CGS units).

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74. Calculate the rate of loss heat through a glass window of area 1000sq.cm. and thickness 4mm when the temperature inside is $37^{\circ}C$ and outside is $5^{\circ}C$ (K for glass =0.0022)

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75. A body which has surface area of 5.0 cm^2 and a temperature of 727 radiates 300j of energy per minute.What is its emissivity?($\sigma = 5.67 \cdot 10^{-8} \frac{W}{m^{-2}} K^{-4}$)

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76. The temperature of abody is increased from 27°C to 127°C. By what fraction would the radiation emitted by it increase?

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77. A body cools from 80°C to 50°C in 5 minutes.If the temperature of the surrounding is 20°C ,Calculate the time it takes to cool from 60°C to 30°C .

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78. Two vessels of different materials are similar in size in every respect. The same quantity of ice filled in them gets melted in 20

min. and 40 min respectively. The ratio of their thermal conductivity is

A. $5:6$

B. $6:5$

C. $2:1$

D. $1:3$

Answer: A

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79. The temperature of a black body increases from 7°C to 287°C .The rate of energy radiation increases by

A. $\left(\frac{287}{4}\right)^4$

B. 16

C. 4

D. 2

Answer: C

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80. A black body has maximum $\omega. L. \lambda m$ at 2000K.Its corresponding ω.L. at 3000 K is

A. $\frac{3}{2}\lambda m$

B. $\frac{2}{3}\lambda m$

C. 16/81lambdam`

D. 81/16lambdam`

Answer: C

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81. Two spheres made of same meterial have radii in the ratio $1:2$ both are the same temperature Ratio of heat radiation energy emitted per sec by them is

A. $1:2$

B. $1:4$

C. $1:8$

D. $1:16$

Answer: B

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82. A body cools from $60^{\circ}C$ to $50^{\circ}C$ in 10 min.if room temperature is $25^{\circ}C$,the temperature of the body at the end of next 10 min will be

A. $38.53^{\circ}C$

B. $40^{\circ}C$

C. $45^{\circ}C$

D. $42.86^{\circ}C$

Answer: B

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83. A body cools from 50°C to 40°C in 5 min .Its temperature comes down to 33.3°C in next 5 min .the temperature of surrounding is

A. 15°C

B. 20°C

C. 25°C

D. 10°C

Answer: B

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84. There is a small hole at the centre of meta disc.On heating the size of the hole

A. decreases

B. increases

C. remains same

D. depends on β of the metal

Answer: B

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85. If a bimetallic strip made of iron and copper is heated ,then

A. it gets twisted

B. it does not bend

C. it bends

D. with copper strip on the convex side

Answer: A

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86. Which of the following is a correct relation for soilds?

A. $\alpha = = \frac{2}{3}\beta$

B. $\gamma = \frac{3}{2}\beta$

C. $\gamma = \frac{3}{2}\alpha$

D. $\gamma = \frac{2}{3}\beta$

Answer: B

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87. Sometimes ,a cycle with well inflated tyres left in sun,has its tube burst open.It is because

A. the volume of air inside the tube increases

B. the pressure of air inside the tube increases

C. the tube melts

D. both volume and pressure of air increases

Answer: B

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88. Two spheres of same size are made of same metal but one is hollow and the other is solid.They are heated to same temperature,then

A. both spheres will expand equally

B. hollow sphere will expand more than the solid one

C. solid sphere will expand more than the solid one

D. none of these

Answer: A

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89. Which of the following has the highest specific heat capacity?

A. Water

B. mercury

C. hydrogen

D. steel

Answer: C

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90. Water is used in hot water bottels,because

A. it is a good conductor

B. it is easily available

C. it has low specific heat

D. it has a high specific heat

Answer: D

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91. For a gram-molecule of an ideal gas (PV)/T is

A. 4.2 calories

B. 8.3 calories

C. 4.2*10^3 ergs

D. 2 calories

Answer: D

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92. Water equivalent of a substance is equal to

A. the mass of the substance

B. product of mass and specific heat

C. specific heat of the substance

D. none of these

Answer: B

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93. The unit of thermal capacity is

A. joule/kelvin

B. joule/kg

C. joule/kg/kelvin

D. none of these

Answer: A

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94. Specific heat of body depends upon

A. mass of the body

B. rise of temperature

C. amount of heat suppiled

D. none of these

Answer: D

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95. The specific heat of water is

A. one

B. zero

C. infinity

D. unknown

Answer: A

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96. The water equivalent of a block of solid mass 200 g and of specific heat 0.4 cal $g^{-1}(^{\circ}C)^{-}$ is

A. 800 cal$(^{\circ}C)^{-1}$

B. 80 g

C. 500 cal

D. 500g

Answer: B

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97. With rise of pressure,the boiling point of a liquid

A. decreases

B. increases

C. does not change

D. nothing can be predicted

Answer: B

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98. With increase in pressure ,the melting point of substance which contract on melting is

A. lowered

B. raised

C. unaffected

D. nothing can be predicted

Answer: A

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99. A closed bottle containig water 30°C is carried to the moon in sa spaceship.If it is placed on the surface of the moon,What will happen to the water as soon as the lid is opened?

A. Water will boil

B. Water will freeze

C. nothing will happen to it

D. it will decompose into h_2O_2

Answer: A

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100. The ventilation of building is necessary for

A. entry of outside oxygen

B. removing co_2 exhaled by us

C. entry of outside moisture

D. entry of outside heat and light

Answer: B

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101. The melting point of an alloy is usually

A. lower than those of the constituents

B. higher than those of the constitients

C. in between thoes of the constituentes

D. equal to that of the heaviest constituent

Answer: A

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102. What is the effect of increase of pressure on melting point of ice?

A. increased

B. decreased

C. remaining same

D. increased by 1^{o} for every unit rise of pressure

Answer: B

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103. Boiling point of water

A. increases with increase of pressure

B. decreases with increase of pressure

C. not affected by pressure

D. none of these

Answer: A

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104. A marble floor appears cold than a cemented floor, because marble has

A. low conductivity

B. high conductivity

C. high radiating capacity

D. high specific heat

Answer: B

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105. Air is heated by

A. conduction

B. convection

C. eradiation

D. none of these

Answer: B

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106. A perfect black body

A. absorbs all the radiations

B. reflects all radiations

C. absorbs and reflects all radiations

D. absorbs all radiations but reflects none.

Answer: A

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107. The essence of kirchoff's law is that

A. a good absorber must be a bad radiator

B. a good absorber must be a good radiator

C. a good absorber must be a good conductor

D. a good absorber must be a bad conducter

Answer: B

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108. The total radiation emitted by a perfectly black body is proportional to

A. the absolute temperature

B. the square of absolute temperature

C. the cube of absoulte temperature

D. the fourth power of absoulte temperature

Answer: D

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109. Conversion of heat into electrical energy can be achieved by Accroding to newton's law of cooling (provided the difference of temperature is small), the rate of loss of heat is proportional to

A. transistor

B. voltmeter

C. thermocouple

D. photo-electric cell

Answer: C

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110. Accroding to newton's law of cooling (provided the difference of temperture is small),the rate of loss of heat is proportional to

A. the excess temperature

B. the square of excess temperature

C. the cube of excess temperature

D. the fourth power of excess temperature

Answer: A

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111. An ideal material for making cooking vessels must have

A. Small conductivity and learge heat capacity

B. large heat capacity and large conductivity

C. small heat capacity and large conductivity

D. small heat capacity and small conductivity

Answer: C

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112. A hot body will radiate heat most rapidly ,if its surface is

A. White and polished

B. white and rough

C. black and polished

D. black and rough

Answer: D

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113. If the temperature of sun is doubled,the rate of energy received on earth wil be increased by a factor roughly

A. 2

B. 3

C. 8

D. 16

Answer: D

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114. which of the following cylindrical rods will conduct most heat,when their ends are maintained at the same steady temperature?

A. length 100cm,radius 1 cm

B. length 100 cm,radius 2 cm

C. legnth 200 cm,radius 2 cm

D. length 200 cm ,radius 1 cm

Answer: B

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115. Two spheres of same material have radii 1 m and 4m and temperature 4000K and 2000K

respectively. The energy radiated per second by the first sphere is

A. greater than that by the second

B. less than that by the second

C. equal in both cases

D. the information is incomplete to draw any conclusion

Answer: C

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116. A black body at a high temperature T radiates energy at the rate of E. When the temperature falls to T/2,the radiated energy will be

A. E/4

B. E/2

C. 2E

D. E/16

Answer: D

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117. A spherical black body with radius 12 cm radiates 450 W power at 500K,If the radius were halved and the temperature doubled,the power radiated in watt would be

A. 225

B. 450

C. 900

D. 1800

Answer: D

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118. A sphere ,a cubeand a thin circular plate,all made of the same meteriel and having the same mass are initially heated to a temperature of 3000°C .Which of these will cool fastest

A. sphere

B. cube

C. plate

D. All will take same time

Answer: C

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119. A polished metal plate with a rough black spot on it is heated to about 1400K and quickly taken to a dark room.Which of the following statements is ture?

A. The spot will appear brighter than the plate.

B. The spot will appear darke than the plate

C. The spot and the plate will appear equally bright

D. The sopt and the plate will not be visiblein the dark room

Answer: A

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